Oregon Standard Specifications for Construction

2021

OREGON DEPARTMENT OF TRANSPORTATION
4040 FAIRVIEW INDUSTRIAL DRIVE SE
SALEM, OREGON 97302-1142

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PART 00100 - GENERAL CONDITIONS

Section 00110 - Organization, Conventions, Abbreviations, and Definitions

Organization

00110.00 Organization of Specifications - The Specifications are comprised of the following:

- The "2021 Oregon Standard Specifications for Construction", which contain Part 00100 "General Conditions", which deal with the solicitation process and contractual relationships and Parts 00200 through 03000 which contain the detailed "Technical Specifications" involved in prosecution of the Work, organized by subject matter; and
- The Special Provisions.

In addition, throughout the Specifications:

- Each Part is divided into Sections and Subsections.
- Reference to a Section includes all applicable requirements of the Section.
- When referring to a Subsection, only the number of the Subsection is used; the word "Subsection" is implied.
- Where Section and Subsection numbers are not consecutive, the interval has been reserved for use in the Special Provisions or future expansion of the Standard Specifications.

Conventions

00110.05 Conventions Used throughout the Specifications Include:

(a) Grammar - The "2021 Oregon Standard Specifications for Construction", Part 00100 "General Conditions", is written in the indicative mood, in which the subject is expressed. Parts 00200 through 03000, the detailed "Technical Specifications", are generally written in the imperative mood, in which the subject is implied. Therefore, throughout Parts 00200 through 03000, and on the Plans:

- The subject, "the Contractor", is implied.
- "Shall" refers to action required of the Contractor, and is implied.
- "Will" refers to decisions or actions of the Agency and/or the Engineer.
- The following words, or words of equivalent meaning, refer to the actions of the Agency and/or the Engineer, unless otherwise stated: "allowed", "directed", "established", "permitted", "ordered", "designated", "prescribed", "required", "determined".
- The words "approved", "acceptable", "authorized", "satisfactory", "suitable", "considered", and "rejected", "denied", "disapproved", or words of equivalent meaning, mean by or to the Agency and/or the Engineer, subject in each case to Section 00150 of the General Conditions.
- The words "as shown", "shown", "as indicated", or "indicated" mean "as indicated on the Plans".
- Certain Subsections labeled "Payment" contain statements to the effect that the accepted quantities "will be paid for at the Contract unit price, per unit of measurement, for the following items" (followed by a list of items). In such cases, the Agency will pay for only those Pay Items listed in the Schedule of Items.

(b) Capitalization of Terms - Capitalized terms, other than titles, abbreviations, and grammatical usage, indicate that they have been given a defined meaning in the Standard Specifications. Refer to Section 00110.20 "Definitions". Defined terms will always be capitalized in Part 00100; in Parts 00200 through 03000, defined terms will generally not be capitalized, with the notable exception of "the Contractor", "the Agency", and "the Engineer".

(c) Punctuation - In this publication the "outside method" of punctuation is employed for placement of the comma and the period with respect to quotation marks. Only punctuation that is part of the quoted matter is placed within quotation marks.

(d) References to Laws, Acts, Regulations, Rules, Ordinances, Statutes, Orders, and Permits - References are made in the text of the Specifications to "laws", "acts", "rules", "statutes", "regulations", "ordinances", etc. (collectively referred to for purposes of this Subsection as "Law"), and to "orders" and "permits" (issued by a governmental authority, whether local, state, or federal, and collectively referred to for purposes of this Subsection as "Permits"). Reference is also made to "applicable laws and regulations". The following conventions apply in interpreting these terms, as used in the Specifications.

- **Statutes and Rules** - Oregon Revised Statutes (ORS) and Oregon Administrative Rules (OAR) referenced in the Specifications are accessible on line, including through the Oregon Legislative Counsel Committee website (see 00110.05(e)) and through the Oregon Secretary of State Archives Division website (see 00110.05(e)).

- **Law** - In each case, unless otherwise expressly stated therein, the Law is to be understood to be the current version in effect. This also applies where a specific Law is referenced or cited, regardless of whether the text of the Law has been included in the Specifications or not, and regardless of whether the text of the Law has been summarized or paraphrased. In each case, the current version of the Law is applicable under any contract. The reader is therefore cautioned to check the actual text of the Law to confirm that the text included in the Specifications has not been modified or superseded.

- **Permits** - Orders and permits issued by a government agency may be modified during the course of performing the work under a contract. Therefore, wherever the term "order" or "permit" is used in the Specifications, it is intended to refer to the then-current version. That version may be embodied in a modified, superseding order or permit, or it may consist of all terms and conditions of prior orders or permits that have not been superseded, as well as the additional terms added by amendment or supplement. In certain cases, the orders and/or permits are identified by name in the Specifications; in other cases the terms are used in the generic sense. The reader is cautioned to check the text(s) of each order and permit identified either by name or by generic reference.

- **Applicable Laws and Regulations** - Where phrases such as “applicable law”, "applicable laws and regulations", “applicable legal requirements” or similar phrases appear, they are to be understood as including all applicable laws, acts, regulations, administrative rules, ordinances, statutes, and orders and permits issued by a governmental or regulatory authority. The words “law” or “laws” may or may not be capitalized in such phrases.

(e) Reference to Websites - For Specifications that reference this Subsection, the Agency will identify the website addresses in the Special Provisions.

Abbreviations

00110.10 Abbreviations - Following are meanings of abbreviations used in the Standard Specifications, in the Special Provisions, on the Plans, and in other Contract Documents. Other

abbreviations and meanings of abbreviations may be used in the individual Sections of the Standard Specifications to which they apply, in the Special Provisions, and in OAR 731-005 and OAR 731-007.

AAR	-	Association of American Railroads
AASHTO	-	American Association of State Highway and Transportation Officials
ABC	-	Associated Builders and Contractors, Inc.
AC	-	Asphalt Concrete
ACI	-	American Concrete Institute
ACP	-	Asphalt Concrete Pavement
ACWS	-	Asphalt Concrete Wearing Surface
ADA	-	Americans with Disabilities Act
AGC	-	Associated General Contractors of America
AIA	-	American Institute of Architects
AISC	-	American Institute of Steel Construction
AISI	-	American Iron and Steel Institute
AITC	-	American Institute of Timber Construction
ANSI	-	American National Standards Institute
APA	-	Engineered Wood Association
APWA	-	American Public Works Association
AREMA	-	American Railway Engineering and Maintenance of Right-of-Way Association
ASCE	-	American Society of Civil Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
ATPB	-	Asphalt Treated Permeable Base
ASTV	-	Actual Strength Test Value
AWG	-	American Wire Gauge
AWPA	-	American Wood Protection Association
AWS	-	American Welding Society
AWWA	-	American Water Works Association
CAgT	-	Certified Aggregate Technician
CAT-I	-	Certified Asphalt Technician I
CAT-II	-	Certified Asphalt Technician II
CBM	-	Certified Ballast Manufacturers
CCO	-	Contract Change Order
CCT	-	Concrete Control Technician
CDT	-	Certified Density Technician
CEBT	-	Certified Embankment and Base Technician
CFR	-	Code of Federal Regulations
CMDT	-	Certified Mixture Design Technician
CPF	-	Composite Pay Factor
CRSI	-	Concrete Reinforcing Steel Institute
CS	-	Commercial Standard, Commodity Standards Division, U.S. Department of Commerce
CSTT	-	Concrete Strength Testing Technician
D1.1	-	Structural Welding Code - Steel, American Welding Society, current edition
D1.5	-	Bridge Welding Code, American Welding Society, current edition
DBE	-	Disadvantaged Business Enterprise
DEQ	-	Department of Environmental Quality, State of Oregon
DOGAMI	-	Department of Geology and Mineral Industries, State of Oregon
DSL	-	Department of State Lands, State of Oregon
EAC	-	Emulsified Asphalt Concrete

EPA	-	U.S. Environmental Protection Agency
ESCP	-	Erosion and Sediment Control Plan
FHWA	-	Federal Highway Administration, U.S. Department of Transportation
FSS	-	Federal Specifications and Standards, General Services Administration
GSA	-	General Services Administration
ICEA	-	Insulated Cable Engineers Association (formerly IPCEA)
IES	-	Illuminating Engineering Society
IMSA	-	International Municipal Signal Association
ISO	-	International Standards Organization
ISSA	-	International Slurry Surfacing Association
ITE	-	Institute of Transportation Engineers
JMF	-	Job Mix Formula
MFTP	-	Manual of Field Test Procedures (ODOT)
MIL	-	Military Specifications
MSC	-	Minor Structure Concrete
MUTCD	-	Manual on Uniform Traffic Control Devices for Streets and Highways, FHWA, U.S. Department of Transportation
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturer's Association
NESC	-	National Electrical Safety Code
NIST	-	National Institute of Standards and Technology
NPDES	-	National Pollutant Discharge Elimination System
NPS	-	Nominal Pipe Size (dimensionless)
OAR	-	Oregon Administrative Rules
ODA	-	Oregon Department of Agriculture
ODOT	-	Oregon Department of Transportation
ORS	-	Oregon Revised Statutes
OR-OSHA	-	Oregon Occupational Safety and Health Division of the Department of Consumer and Business Services
OSHA	-	Occupational Safety and Health Administration, U.S. Department of Labor
PCA	-	Portland Cement Association
PCC	-	Portland Cement Concrete
PCI	-	Precast/Prestressed Concrete Institute
PCP	-	Pollution Control Plan
PF	-	Pay Factor of a constituent
PLS	-	Professional Land Surveyor
PMBB	-	Plant Mixed Bituminous Base
PTI	-	Post-Tensioning Institute
PUC	-	Public Utility Commission, State of Oregon
QA	-	Quality Assurance
QC	-	Quality Control
QCT	-	Quality Control Technician
QL	-	Quality Level
QPL	-	Qualified Products List
RAP	-	Reclaimed Asphalt Pavement
REA	-	Rural Electrification Administration, U.S. Department of Agriculture
RMA	-	Radio Manufacturers Association or Rubber Manufacturers Association
SAE	-	Society of Automotive Engineers
SI	-	International System of Units (Système Internationale)
SRCM	-	Soil and Rock Classification Manual (ODOT)
SSPC	-	Society for Protective Coatings

T	-	Tolerances, AASHTO Test Method
TM	-	Test Method (ODOT)
TV	-	Target Value
UBC	-	Uniform Building Code (as adopted by the State of Oregon)
UL	-	Underwriters Laboratory, Inc.
UPC	-	Uniform Plumbing Code (as adopted by the State of Oregon)
USC	-	United States Code
WAQTC	-	Western Alliance for Quality Transportation Construction
WCLIB	-	West Coast Lumber Inspection Bureau
WWPA	-	Western Wood Products Association

Definitions

00110.20 Definitions - Following are definitions of words and phrases used in the Standard Specifications, in the Special Provisions, on the Plans, and in other Contract Documents. Other definitions may be in the individual Sections of the Standard Specifications to which they apply, in the Special Provisions, and in OAR 731-005 and OAR 731-007.

3D Engineered Model - The Agency-prepared electronic file(s) that identify northing, easting, and elevation to represent the Work to be performed. The 3D Engineered Model may include the surface model(s) or other designed Work elements and is an electronic representation of the line, grade, and Cross Section applicable to the Project.

3D Construction Model - Supplemental unstamped 3D model, not furnished by the Agency, that the Contractor is required to submit to the Engineer.

Act of God or Nature - A natural phenomenon of such catastrophic proportions or intensity as would reasonably prevent performance.

Actual Strength Test Value (ASTV) - The ASTV at 28 Days is the average compressive strength of the three cylinders tested. All specimens that show definite evidence, other than low strength, of improper sampling, molding, handling, curing, or testing shall be discarded. The average strength of the remaining cylinders shall then be considered the test result.

Addendum - A written or graphic modification, issued before the opening of Bids, which revises, adds to, or deletes information in the Solicitation Documents or previously issued Addenda.

Additional Work - Increased quantities of any Pay Item, within the scope of the Contract, for which a unit price has been established.

Advertisement - The public announcement (Notice to Contractors) inviting Bids for Work to be performed or Materials to be furnished.

Agency - The city, county, or State agency or special district or political subdivision, as applicable, which has entered into a Contract with the Contractor.

Agency-Controlled Lands - Lands owned by the Agency, or controlled by the Agency under lease or agreement, or under the jurisdiction and control of the Agency for the purposes of the Contract.

Aggregate - Rock of specified quality and gradation.

Attorney-in-Fact - An Entity appointed by another to act in its place, either for some particular purpose, or for the transaction of business in general.

Award - Written notification to the Bidder that the Bidder has been awarded a Contract.

Base - A Course of specified material of specified thickness placed below the Pavement.

Bid - A competitive offer, binding on the Bidder and submitted in response to an invitation to bid.

Bid Bond - The Surety bond for Bid guaranty

Bid Booklet - The version that can be accessed and printed from the ODOT Electronic Bidding Information Distribution System (eBids) website (see 00110.05(e)), which contains the information identified in 00120.10, or the computer-generated electronic version that is available from the BidExpress® website (see 00110.05(e)).

Bid Closing - The date and time after which Bids, Bid modifications, and Bid withdrawals will no longer be accepted.

Bid Documents - See under Solicitation Document.

Bid Opening - The date and time Bids are opened.

Bid Schedule - The list of Pay Items, their units of measurement, and estimated quantities. (When a Contract is awarded, the Bid Schedule becomes the Schedule of Items.)

Bid Section - The portion of the Bid Booklet containing all pages after the Bidder's checklist and before the appendix.

Bidder - An Entity that submits a Bid in response to an invitation to bid.

Bike Lane - A lane in the Traveled Way, designated by striping and Pavement markings for the preferential or exclusive use of bicyclists.

Borrow - Material lying outside of planned or required Roadbed excavation used to complete Project earthwork.

Boulders - Particles of Rock that will not pass a 12-inch square opening.

Bridge - A single or multiple span Structure, including supports, that carries motorized and non-motorized vehicles, pedestrians, or utilities on a Roadway, walk, or track over a watercourse, Highway, Railroad, or other feature.

Buttress - A Rock fill placed at the toe of a landslide or potential landslide in order to resist slide movement.

Calendar Day - Any Day shown on the calendar, beginning and ending at midnight.

Camber - A slight arch in a surface or Structure to compensate for loading.

Change Order - A written order issued by the Engineer to the Contractor modifying Work required by the Contract, or adding Work within the scope of the Contract, and, if applicable, establishing the basis of payment for the modified Work, or otherwise modifying the Contract.

Changed Work - Work included in a Pay Item and within the scope of the Contract that is different from that reflected in the Contract Documents. (See 00140.30.)

Class of Project - A designation based on a Project's funding source, (i.e., State or Federal-aid).

Class of Work - A designation referring to the type of Work in which Bidders must be prequalified. Classes of Work are limited to those listed in ODOT's Contractor's Prequalification Application.

Clay - Soil passing a No. 200 sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents.

Clear Zone - The total roadside border area, starting at the edge of the Traveled Way, available for safe use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width is dependent upon the traffic volumes and speeds and on the roadside geometry.

Close Conformance - Where working tolerances are given on the Plans or in the Specifications, Close Conformance means compliance with those tolerances. Where working tolerances are not given, Close Conformance means compliance, in the Engineer's judgment, with reasonable and customary manufacturing and construction tolerances.

Coarse Aggregate - Crushed Rock or crushed Gravel retained on a 1/4-inch sieve, with allowable undersize.

Cobbles - Particles of Rock, rounded or not, that will pass a 12-inch square opening and be retained on a 3-inch sieve.

Commercial Grade Concrete - Concrete furnished according to Contractor proportioning, placed in minor Structures and finished as specified.

Contract - The written agreement between the Agency and the Contractor, including, without limitation, all Contract Documents, describing the Work to be completed and defining the rights and obligations of the Agency and the Contractor.

Contract Administration Engineer - The Agency representative presiding over Agency-level claims review under 00199.40.

Contract Amount - Sum of the Pay Item amounts computed by multiplying the Pay Item quantities by the unit prices in the Schedule of Items.

Contract Documents - Solicitation Documents, Specifications, Plans, Contract booklet (titled *Contract and Bonds for Highway Construction*), Change Orders, Force Account Work orders, pay documents issued by the Agency, Materials certifications, Project Work schedules, final estimate, written orders and authorizations issued by the Agency, Material source development and reclamation plans, and permits, orders and authorizations obtained by the Contractor or Agency applicable to the Project, as well as all documents incorporated by reference therein.

Contract Time - The amount of time allowed to complete the Work under the Contract.

Contractor - The Entity awarded the Contract according to the solicitation.

Course - A specified Surfacing Material placed in one or more Lifts to a specified thickness.

Coverage - One Pass by a piece of Equipment over an entire designated area.

Cross Section - The exact image formed by a plane cutting through an object, usually at right angles to a central axis, to determine area.

Day - A Calendar Day including weekdays, weekends, and holidays, unless otherwise specified.

Durable Rock - Rock that has a slake durability index of at least 90% based on a two-cycle slake durability test, according to ASTM D4644. In the absence of test results, the Engineer may evaluate the durability visually.

Emulsified Asphalt - Emulsified asphalt cement.

Emulsified Asphalt Concrete - A mixture of Emulsified Asphalt and graded Aggregate.

Engineer - The Chief Engineer of the Agency acting either directly or through authorized representatives. If the Agency has not designated a Chief Engineer, this term denotes the person responsible for administering its public works program.

Entity - A natural person capable of being legally bound, sole proprietorship, limited liability company, corporation, partnership, limited liability partnership, limited partnership, for-profit or nonprofit unincorporated association, business trust, two or more persons having a joint or common economic interest, or any other person with legal capacity to contract, or a government or governmental subdivision.

Equipment - All machinery, tools, manufactured products, and fabricated items needed to complete the Contract or specified for incorporation into the Work.

Establishment Period - The time specified to assure satisfactory establishment and growth of planted Materials.

Existing Surfacing - Pavements, slabs, curbs, gutters, walks, driveways, and similar constructions of bricks, blocks, portland cement concrete, bituminous treated materials, and granular Surfacing materials on existing Highways.

Extra Work - Work not included in the Contract, but deemed by the Engineer to be necessary to complete the Project.

Final Acceptance - Written confirmation by the Agency that the Project has been completed according to the Contract, with the exception of latent defects and Warranty obligations, if any, and has been accepted.

Final Inspection - The inspection conducted by the Engineer to determine that the Project has been completed according to the Contract.

Fine Aggregate - Crushed Rock, crushed Gravel, or Sand that passes a 1/4-inch sieve, with allowable oversize.

First Notification - Written acknowledgment by the Engineer of the date on which workers employed by the Contractor or a Subcontractor have begun performance of the Contract, including Aggregate source development or erection of a plant, but not including installation of covered temporary signs according to Section 00222.

Force Account Work - Items of Extra Work ordered by the Engineer that are to be paid according to Section 00197.

Granular Material - Graded and selected free-draining material composed of particles of Rock, Sand, and Gravel.

Gravel - Particles of Rock, rounded or not, that will pass a 3-inch sieve and be retained on a No. 4 sieve.

Highway - Every road, street, thoroughfare and place, including Bridges, viaducts and other Structures within the boundaries of the State, open, used or intended for use by vehicular traffic.

Incidental - A term identifying those acts, services, transactions, property, Equipment, labor, Materials, or other items for which the Agency will make no separate or additional payment.

Inspector - The representative of the Engineer authorized to inspect and report on Contract performance.

Leveling - Placing a variable-thickness Course of Materials to restore horizontal and vertical uniformity to existing Pavements, normally continuous throughout the Project.

Lift - The compacted thickness of material placed by Equipment in a single Pass.

Mandatory Source - A material source provided by the Agency from which the Contractor is required to obtain Materials. (See 00160.00(b) and 00160.40.)

Materials - Any natural or manmade substance specified for use in the construction of the Project or for incorporation into the Work.

Median - The portion of a divided Highway separating traffic traveling in opposite directions.

Multiple Course Construction - Two or more Courses, exclusive of Patching or Leveling, placed over the entire Roadway width.

Multi-Use Path - That portion of the Highway Right-of-Way or a separate Right-of-Way, physically separated from motor vehicle traffic and designated for use by pedestrians, bicyclists and other non-motorized users.

Neat Line - Theoretical lines specified or indicated on the Plans for measurement of quantities.

Nondurable Rock - Rock that has a slake durability index of less than 90% based on a two-cycle slake durability test, as tested by ASTM D4644, or Rock that is observed to readily degrade by air, water, and mechanical influence.

Notice to Contractors - The public announcement inviting Bids for Work to be performed or Materials to be provided.

Notice to Proceed - Written notice authorizing the Contractor to begin performance of the Work.

On-Site Work - Any Work taking place on the Project Site, including designated staging areas adjacent to the Project Site, except for installation of covered temporary signs according to Section 00222.

Organic Soil - A Soil with sufficient organic content to influence the Soil properties.

Panel - The width of specified Material being placed by Equipment in a single Pass.

Pass - One movement of a piece of Equipment over a particular location.

Patching - Placing a variable-thickness Course of Materials to correct sags, dips, and/or bumps to the existing grade and Cross Section, normally intermittent throughout the Project.

Pavement - Asphalt concrete or portland cement concrete placed for the use of motor vehicles, bicycles, or pedestrians on Roadways, Shoulders, Multi-Use Paths and parking areas.

Pay Item (Contract Item) - A specific unit of Work for which a price is provided in the Contract.

Payment Bond - The approved security furnished by the Contractor's Surety as a guaranty of the Contractor's performance of its obligation to pay promptly in full all sums due for Materials, Equipment, and labor furnished to complete the Work.

Peat - A Soil composed primarily of vegetative matter in various stages of decomposition, usually with an organic odor, dark brown to black color, and a spongy consistency.

Performance Bond - The approved security furnished by the Contractor's Surety as a guaranty of the Contractor's performance of the Contract.

Plans - Standard and Supplemental Drawings, and approved unstamped and reviewed stamped Working Drawings. (See 00150.10 and 00150.35.)

Project - The sum of all Work to be performed under the Contract.

Project Manager - The Engineer's representative who directly supervises the engineering and administration of a Contract.

Project Site - The geographical dimensions of the real property on which the Work is to be performed, including designated contiguous staging areas.

Prospective Source - A Material source provided by the Agency, from which the Contractor has the option of obtaining Materials. (See 00160.00(a) and 00160.40.)

Publicly-Owned Equipment - Equipment acquired by a state, county, municipality or political subdivision primarily for use in its own operations.

Public Traffic - Vehicular or pedestrian movement, not associated with the Contract Work, on a public way.

Railroad - Publicly or privately owned rail carriers, including passenger, freight, and commuter rail carriers, their tenants, and licensees. Also, Utilities that jointly own or use such facilities.

Right-of-Way - Land, property, or property interest, usually in a strip, acquired for or devoted to transportation or other public works purposes.

Roadbed - Completed excavations and embankments for the Subgrade, including ditches, side slopes, and slope rounding, if any.

Roadside - The area between the outside edges of the Shoulders and the Right-of-Way boundaries. Unpaved Median areas between inside Shoulders of divided Highways and infield areas of interchanges are included.

Roadway - That portion of a Highway improved, designed, or ordinarily used for vehicular travel, exclusive of the berm or Shoulder. If a Highway includes two or more separate Roadways, the term "Roadway" refers to any such Roadway separately, but not to all such Roadways collectively. (See Traveled Way.)

Rock - Natural deposit of solid material composed of one or more minerals occurring in large masses or fragments.

Sand - Particles of Rock that will pass a No. 4 sieve and be retained on a No. 200 sieve.

Schedule of Items - The list of Pay Items, their units of measurement, estimated quantities, and prices.

Schedule of Values - The breakdown of the values of the component elements comprising a lump sum Pay Item.

Second Notification - Written acknowledgment by the Engineer of the end of Contract Time according to 00180.50(g).

Shoulder - The part of a Roadbed contiguous to the Traveled Way or Roadway, whether paved or unpaved, for accommodating stopped vehicles, for emergency use and for lateral support of Base and surface Courses.

Silt - Soil passing a No. 200 sieve that is nonplastic or exhibits very low plasticity.

Single Course Construction - A wearing Course only, not including patching or Leveling Courses or partial width Base Course.

Slope - Vertical distance to horizontal distance, unless otherwise specified.

Soil - Accumulations of particles produced by the disintegration of Rock, which sometimes contains organic matter. Particles may vary in size from Clay to Boulders.

Solicitation Document - Documents which define the procurement of a public improvement Project, including, but not limited to, the Bid Booklet, Agency-provided Plans, Standard Specifications, Special Provisions, Addenda, and which includes all documents incorporated by reference. May also be called Bid Documents.

Special Provisions - The special directions, provisions, and requirements specific to a Project that supplement or modify the Standard Specifications. Permits and orders governing the Project that are issued directly to the Agency by a governmental or regulatory authority are considered to be part of the Special Provisions, to the extent and under the conditions stipulated in the Special Provisions. This includes any amended or supplemental permits or orders issued during the course of performing the Work under a Contract.

Special Services - Work services that the Contractor and Engineer agree cannot be satisfactorily performed by the Contractor's and Subcontractors' forces, (e.g., fabrication and machining work that is most effectively performed away from the Project Site, or rental of operated Equipment as defined in 00180.20(c)).

Specifications - The Standard Specifications and Special Provisions, together with all provisions of other documents incorporated therein by reference.

Standard Drawings - The Agency-prepared detailed drawings for Work or methods of construction that normally do not change from project to project.

Standard Specifications - "Oregon Standard Specifications for Construction", current edition, published by the Oregon Department of Transportation.

State - The State of Oregon.

Structures - Bridges, retaining walls, endwalls, cribbing, buildings, culverts, manholes, catch basins, drop inlets, sewers, service pipes, underdrains, foundation drains, and other similar features which may be encountered in the Work.

Subbase - A Course of specified material of specified thickness between the Subgrade and a Base.

Subcontractor - An Entity having a direct contract with the Contractor or another Subcontractor, at any tier, to perform a portion of the Work.

Subgrade - The top surface of completed earthwork on which Subbase, Base, Surfacing, Pavement, or a Course of other Material is to be placed.

Substructure - Those parts of a Structure which support the Superstructure, including bents, piers, abutments, and integrally built wing walls, up to the surfaces on which bearing devices rest. Substructure also includes portions above bearing surfaces when those portions are built integrally with a Substructure unit (e.g., backwalls of abutments). When Substructure and Superstructure elements are built integrally, the division between Substructure and Superstructure is considered to be at the bottom soffit of the longitudinal or transverse beam, whichever is lower. Culverts and rigid frames are considered to be entirely Substructure.

Superstructure - Those parts of a Structure above the Substructure, including bearing devices.

Supplemental Drawings - The Agency-prepared detailed drawings for Work or methods of construction that are Project specific, and are denoted by title in the Project title block.

Supplier - The Entity that furnishes goods to be incorporated into the Work.

Surety - The Entity that issues the bond.

Surfacing - The Course or Courses of Material on the Traveled Way, auxiliary lanes, Shoulder, or parking areas for pedestrian, bicycle or vehicle use.

Third Notification - Written acknowledgment by the Engineer, subject to Final Acceptance, that as of the date of the notification the Contractor has completed the Project according to the Contract, including, without limitation, completion of all minor corrective work, Equipment and plant removal, site clean-up, and submittal of all certifications, bills, forms and documents required under the Contract.

Ton - One short ton of 2,000 pounds (Ton, ton, Tn, or T).

Topsoil - Soil ready for use in a planting bed.

Traffic Lane - That part of the Traveled Way marked for moving a single line of vehicles.

Traveled Way - That part of the Highway for moving vehicles, exclusive of berms and Shoulders.

Typical Section - That Cross Section established by the Plans or the 3D Engineered Model which represents in general the lines to which the Contractor shall work in the performance of the Contract.

Unsuitable Material - Frozen material, or material that contains organic matter, muck, humus, Peat, sticks, debris, chemicals, toxic matter, or other deleterious materials not normally suitable for use in earthwork.

Utility - A line, facility, or system for producing, transmitting, or distributing communications, power, electricity, heat, gas, oil, water, steam, waste, stormwater not connected with highway drainage, or

any other similar commodity which directly or indirectly serves the public. The term may also mean the utility company, district, or cooperative owning and operating such facilities, including any wholly-owned or controlled subsidiary.

Warranty Bond - The approved security furnished by the Contractor's, Subcontractor's, or Supplier's Surety as a guaranty of the Contractor's performance of its warranty obligations.

Wetlands - Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, vegetation typically adapted for life in saturated Soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Work - The furnishing of all Materials, Equipment, labor, and Incidentals necessary to successfully complete any individual Pay Item or the entire Contract, and the discharge of duties and obligations imposed by the Contract.

Working Drawings - Supplemental Plans, not furnished by the Agency, that the Contractor is required to submit to the Engineer. (See 00150.35.)

Section 00120 - Bidding Requirements and Procedures

00120.00 Prequalification of Bidders - The Oregon Department of Transportation (ODOT) will prequalify Bidders according to ODOT's Oregon Administrative Rules and prequalification procedures. A Bidder must file for prequalification and pay a fee. Bidders shall make application for prequalification, and for required renewals, on standard forms available from the ODOT Procurement Office - Construction Contracts Unit website (see 00110.05(e)). Bidders shall return the completed application and fee to the ODOT Procurement Office - Construction Contracts Unit by one of the following methods:

- If hand delivered, the application shall be date stamped with the provided date stamping device and the application and fee shall be placed in the ODOT Procurement Office Bid Box located in the lobby of:

  Oregon Department of Transportation
  3930 Fairview Industrial Drive SE
  Salem, OR 97302.

- If delivered by mail or parcel delivery service, the application and fee shall be sent to:

  ODOT Procurement Office - Construction Contracts Unit, MS# 2-2
  3930 Fairview Industrial Drive SE
  Salem, OR 97302-1166.

Contracts will only be awarded to Bidders who, at the time of Bid Opening, are prequalified in the Class or Classes of Work specified in the Special Provisions, except that a Bidder whose prequalification has been revoked or revised as provided in ORS 279C.430(4) may also be eligible for Award under that statute if the Project was advertised prior to the revocation or revision. The Agency will consider a Bid from a Bidder whose complete application for prequalification has been received by the ODOT Procurement Office - Construction Contracts Unit at least 10 Calendar Days before the opening of Bids. Bidders shall submit Bids in the same company name used on the prequalification application; provided however, if Bidder's legal name has changed since the submittal of its application for prequalification, it shall submit its Bid under its current legal name with the former name referenced by "formerly known as".

The Agency will regularly evaluate the performance of Contractors on its projects for purposes of responding to reference checks, future prequalification and determinations of responsibility.

00120.01 General Bidding Requirements - Bidders may submit Bids by paper or through the internet (electronic). If both paper Bids and electronic Bids are submitted for the same invitation to bid, the paper Bids will prevail.

The standard prequalification forms furnished by the ODOT Procurement Office shall be used by the Bidder to file authorized signatures with the Agency. Signatures shall be of personnel authorized to submit Bids, modify Bids, or withdraw Bids. In addition, for electronic Bids, the authorized personnel shall have a digital signature and unique ID. The digital signature and unique ID shall be obtained from BidExpress® and approved by the Agency. For ODOT Bids, only digital signatures obtained from BidExpress® will be accepted. Bidders submitting Bids as a joint venture must also establish a digital signature and unique ID.

As and when applicable, the Contractor shall maintain the certifications required by ORS 279A.107.

00120.05 Request for Plans, Special Provisions, and Bid Booklets:

(a) Informational Plans and Special Provisions - Informational Project Plans and Special Provisions are available, free of charge, on the ODOT Electronic Bidding Information Distribution System (eBIDS) website (see 00110.05(e)) identified in the Notice to Contractors available on the ODOT Procurement Office - Construction Contracts Unit website (see 00110.05(e)).

(b) Bidding Plans, Special Provisions, and Bid Booklets - Bidders may submit either paper Bids or electronic Bids.

(1) Paper Bids - Bidders choosing to submit paper Bids shall access and print Plans, Special Provisions, and Bid Booklets from the ODOT eBIDS website. Bidders obtaining Plans, Special Provisions, and Bid Booklets must register on ODOT's list of "Holders of Bidding Plans". Bids will be considered responsive only if Bidders are registered as "Holders of Bidding Plans".

(2) Electronic Bids - Bidders choosing to submit electronic Bids shall use the computer-generated electronic Bid Booklet from the BidExpress® website (see 00110.05(e)). In addition, Bidders shall access and print Plans and Special Provisions from the ODOT eBIDS website. Bidders obtaining Plans and Special Provisions must register on ODOT's list of "Holders of Bidding Plans". Bids submitted through BidExpress® will be considered responsive only if Bidders are registered as "Holders of Bidding Plans".

In the event that access to Project information on the eBIDS website is not available, an alternate method to access the information will be posted on the ODOT Procurement Office – Construction Contracts Unit website (see 00110.05(e)). If the information is not available on the eBIDS website, there may be a delay before the information is available using the alternate method.

00120.10 Bid Booklet - The Bid Booklet may include, but is not limited to:

- Bidder's checklist
- Bid Section
- Appendix, which includes required time-sensitive forms, DBE information, sample forms, and other informational pages

The Bid Section includes all pages after the Bidder's checklist and before the appendix. The Bid Section may include, but is not limited to:

- Description and location of the proposed Project
- Time, date, and location for opening Bids
- Project completion time
- Class of Project (i.e., Federal-aid or State)
- Class of Work
- Identification of applicable Special Provisions
- Bid statement
- Certificate of non-collusion
- Certificate of noninvolvement in any debarment or suspension (for Federal-aid Projects)
- Certificate regarding lobbying activities (for Federal-aid Projects)
- Certificate of residency (for State Projects)
- Certificate of compliance with Oregon tax laws

- Certificate of nondiscrimination regarding ORS 279A.110 and certificate regarding policy and practice against sexual harassment, sexual assault and discrimination against employees who are members of a protected class as required by ORS 279A.112 (House Bill 3060, 2017)
- Bid Schedule
- Identification of Bidder(s) and Sureties
- Limiting statements (See 00120.50.)
- Bid signature page
- Bid Bond form
- First-tier Subcontractor disclosure form

Depending on the Class of Project, other certificates or statements may be included within the Bid Section. Plans, Specifications, and other documents referred to in the Bid Section will be considered part of the Bid.

00120.15 Examination of Work Site and Solicitation Documents; Consideration of Conditions to be Encountered - Before submitting a Bid, Bidders shall carefully examine the site of the proposed Work, the Bid Booklet, Plans, and Specifications. Bidders shall also contact Utility owners to verify all Utilities' anticipated involvement on the Project Site. Bidders are also encouraged to review any subsurface investigation material referenced in 00120.25 that may be available. Submission of a Bid will constitute confirmation that the Bidder has examined the Project Site and Solicitation Documents, finds the Plans and Specifications to be sufficiently detailed and accurate to enable Bidder to properly perform the Work, and understands the conditions to be encountered in performing the Work and all requirements of the Contract.

The Bidder is responsible for loss or unanticipated costs suffered by the Bidder because of the Bidder's failure to fully examine the site and become fully informed about all conditions of the Work, or failure to request clarification of Plans and Specifications Bidder believes to be erroneous or incomplete.

Any clarification of Plans and Specifications needed by the Bidder shall be requested in writing through the Engineer. Requests shall be made in sufficient time for the Agency's reply to reach all Bidders before Bid Closing. Oral explanations or interpretations given before receiving Bids for a Project will not be binding. To be binding, interpretation of the Plans and Specifications by the Agency must be made by written Addendum furnished to all Holders of Bidding Plans according to 00120.30. Notification of erroneous or incomplete Plans or Specifications shall also be submitted to the Engineer. Such notification shall also be made in sufficient time for the Agency to make any necessary modifications and issue Addenda to Bidders prior to Bid Closing.

00120.16 Material, Equipment, and Method Substitutions - When the Contract specifies certain Materials, Equipment, products, and/or methods, the Bidder shall include those Materials, Equipment, products, and/or methods in the Bid unless the Engineer has issued an Addendum granting approval to substitute. Unless the Engineer has approved substitutions of Materials, Equipment, products, and/or methods prior to opening of Bids, the Bidder shall furnish the items specified in the Contract. Substitution after Award is specified in 00180.31(b), 00180.31(c), and 00180.31(d). The procedure for requesting approval is as follows:

(a) Written Request - Unless specified as the subject of an exemption per ORS 279C.345, if a Bidder proposes to use Materials, Equipment, products, and/or methods other than those specified, the Bidder shall send a written request to the Engineer, at least 7 Calendar Days prior to Bid Opening, including complete descriptive and technical information on the proposed Materials, Equipment, products, and/or methods.

(b) Functional Similarity - Materials, products, and Equipment proposed for substitution shall be similar in design, and equal or better in quality and function to those specified.

(c) Manufacturer's Information - If manufacturers' brochures or information is needed, the Bidder shall submit three copies of each with all pertinent information clearly marked.

(d) Differences - The Bidder shall specifically note all differences between the specified Materials, Equipment, products, and/or methods and the proposed substitutes.

(e) Cost - Where a substitute will result in alteration of the design or space requirements, or any other modifications to the Plans, the Bidder shall include in the substitution request all items of cost for the revised design and construction.

(f) Notification of Holders of Bidding Plans - If the Engineer approves any proposed substitution, such approval, and any modifications necessitated to the design and construction by the substitution, will be acknowledged by Addenda.

00120.17 Use of Agency-Owned Land for Staging or Storage Areas - The Contractor may use Agency-owned property for staging or storage areas, subject to the following limitations:

(a) Within Normal Right-of-Way Limits - If approved by the Engineer, the Contractor may use available property within the normal Right-of-Way limits for the purpose of constructing improvements under the Contract. Where the Agency owns, or has rights to, other adjacent properties in the Project area, "normal Right-of-Way" is limited to a line drawn across that property connecting the normal Right-of-Way limits on either side of the property.

(b) Outside Normal Right-of-Way Limits - The Contractor may not use Agency-owned property outside of normal Right-of-Way limits for the Project without the approval of the Engineer.

If a Bidder obtains approval before submitting a Bid, use of the property will be at no cost to the Contractor, or at a cost stated by the Engineer upon granting approval, as confirmed by Addendum.

If approval is not obtained before submitting a Bid, and the Contractor proposes to use Agency-owned property outside the normal Right-of-Way limits, then use of the property may be approved by the Engineer, but the Contractor will be assessed fair market value, as determined by the Engineer, for use of the property.

(c) Restrictions on Use - Contractors shall comply with all applicable laws, ordinances, and regulations pertaining to use of Agency-owned property, and shall:

- Not cause unreasonable impacts on traffic and other facility users.
- Clean up all hazardous materials deposited by, or resulting from, Contractor operations.
- Be responsible for all costs associated with use of the property.

00120.20 Interpretation of Quantities in Bid Schedule - Quantities appearing in the Bid Schedule are approximate and are provided only for comparison of Bids. The Agency does not warrant that the actual individual items, amount of Work, or quantities will correspond to those shown in the Bid Schedule. Payment to the Contractor will be made only for actual quantities of Work performed and accepted or Materials furnished and accepted, as required by the Contract. Quantities of Work to be performed and Materials to be furnished may each be increased, decreased, or omitted as provided in 00120.30 and 00140.30.

00120.25 Subsurface Investigations - If the Agency or its consultant has conducted subsurface or geologic investigations of the proposed Project Site, the results of the investigations may be included

in written reports. If reports have been prepared, copies will be available at the Engineer's office. If the Agency has retained subsurface samples, they will also be available for inspection. Bidders and the Contractor may make arrangements for viewing the samples through the Engineer's office.
The availability of subsurface information from the Agency is solely for the convenience of the Bidder and shall not relieve the Bidder or the Contractor of any risk, duty to make examinations and investigations as required by 00120.15, or other responsibility under the Contract Documents. It is mutually agreed to by all parties that:

- The written report(s) are reference documents and not part of the Contract Documents.
- The subsurface investigations made by the Agency are for the purpose of obtaining data for planning and design of the Project.
- The data for individual test boring logs apply only to that particular boring and is not intended to be conclusive as to the character of any material between or around test borings.
- If Bidders use this information in preparing a Bid, it is used at their own risk, and Bidders are responsible for all conclusions, deductions, and inferences drawn from this information.

00120.30 Changes to Plans, Specifications, or Quantities before Opening of Bids - The Agency reserves the right to issue Addenda making changes or corrections to the Plans, Specifications, or quantities. The Agency will provide Addenda only by publishing them on the ODOT eBIDS website (see 00110.05(e)).

Addenda may be downloaded from the ODOT eBIDS website. Bidders shall be responsible for checking the website for Addenda. Bidders should check the website weekly until the week of Bid Closing and daily the week of Bid Closing.

Bidders, not the Agency, shall be responsible for failure of Bidders to check and download Addenda. Bids shall incorporate all Addenda. Bids may be rejected if opened and found by the Agency to not be based on all Addenda published on the ODOT eBIDS website before Bid Closing.

In the event that access to Addenda on the eBIDS website is not available, an alternate method to access the Addenda will be posted on the ODOT Procurement Office - Construction Contracts Unit website (see 00110.05(e)). If the Addenda is not available on the eBIDS website, there may be a delay before the Addenda is available using the alternate method.

00120.40 Preparation of Bids - Bids not in compliance with the requirements of this Subsection will be considered non-responsive.

(a) General:

(1) Paper Bids - For Bids submitted by paper, Bidders shall not alter, in any manner, the (paper) documents within the Bid Section that are accessed and printed from the ODOT eBIDS website (see 00110.05(e)). Bid Sections obtained from BidExpress® shall not be substituted for paper Bid Sections. Bidders shall complete the certifications and statements included in the Bid Section of the Bid Booklet according to the instructions. Signature of the Bidder's authorized representative thereon constitutes the Bidder's confirmation of and agreement to all certifications and statements contained in the Bid Booklet. Entries on paper documents in the Bid Section shall be in ink or typed. Signatures and initials shall be in ink, except for changes and withdrawls submitted by email transmission as provided by 00120.60 (in which case signatures on the scanned document shall be considered originals).

The Bidder shall properly complete and bind all the paper documents in the Bid Section, as specified in 00120.10, together with all other required documents that are part of the Bid Booklet, between the front and back covers of the Bid Booklet, except that the Bid Bond is not required if another permissible type of Bid guaranty is provided. (See 00120.40(e).)

(2) Electronic Bids - For Bids submitted electronically, Bidders shall prepare Bids using the latest version of AASHTOWare Project Bids™ software and submit using the BidExpress® website (see 00110.05(e)). Bidders shall complete the certifications and statements included in the Bid Section of the electronic Bid Booklet according to the instructions. The authorized digital signature of the Bidder constitutes the Bidder's confirmation of and agreement to all certifications and statements contained in the electronic Bid Booklet. Bidders choosing to submit Bids through the internet shall be responsible for any additional fees associated with submitting Bids using AASHTOWare Project Bids™ software and the BidExpress® website.

(b) Bidding Considerations - Bidders may refer to the following Subsections for requirements that may affect bidding considerations:

Subsection	Requirements
00120.80	Reciprocal Preference for Oregon Resident Bidders
00130.80	Project Site Restrictions
00150.55	Cooperation with Other Contractors
00150.75	Protection and Maintenance of Work during Construction
00160.20(a)	Buy America
00160.20(b)	Buy Oregon
00170.07	Record Requirements
00180.20	Subcontracting Limitations
00180.21	Subcontracting
00195.00(a)	Cost of Insurance and Bonds
00195.50(a)(1)	Progress Estimates
00199.30	Claims Procedure

(c) Bid Schedule Entries:

(1) Paper Bid Schedule Entries - Using figures, Bidders shall fill in all blank spaces in the paper Bid Schedule. For each item in the paper Bid Schedule, Bidders shall enter the unit price and the product of the unit price multiplied by the quantity given. The unit price shall be greater than zero, shall contain no more than two decimal places to the right of the decimal point, and shall be expressed in U.S. dollars and cents (for example, $150.25 or $0.37). Bidders shall also enter the total amount of the Bid obtained by adding amounts for all items in the paper Bid Schedule. Corrections or changes of item entries shall be in ink, with incorrect entry lined out and correct entry entered and initialed.

(2) Electronic Bid Schedule Entries - For Bids submitted electronically, Bidders shall enter the unit price for each of the separate Bid Items listed. The unit price shall be greater than zero, shall contain no more than two decimal places to the right of the decimal point, and shall be expressed in U.S. dollars and cents (for example, $150.25 or $0.37).

(d) Bidder's Address and Signature Pages - Bidders shall include in the Bid the address to which all communications concerning the Bid and Contract should be sent. The Bid must be signed, or digitally signed, as appropriate, by a duly authorized representative of the Bidder. In addition, the electronic Bid requires the unique ID obtained from BidExpress® and approved by the Agency.

(e) Bid Guaranty - All Bids shall be accompanied by a Bid guaranty in the amount of 10% of the total amount of the Bid. Acceptable Surety companies are limited to those authorized to do business in the State of Oregon. Forfeiture of Bid guaranties is covered by 00130.60, and return of guaranties is covered by 00130.70.

(1) Bid Guaranty with Paper Bids - For Bids submitted by paper, the Bid guaranty shall be either a Surety bond, irrevocable letter of credit issued by an insured institution as defined in

ORS 706.008, or security in the form of a cashier's check or certified check made payable to the Agency. (See ORS 279C.365(4).)

If a Surety bond is submitted, Bidders shall use the Agency's standard Bid Bond form included with the paper Bid Booklet. Bidders shall submit the bond with original signatures and the Surety's seal affixed. The Bid guaranty shall be submitted by mail, delivery service, or hand delivered to the offices and addresses, and at the times given in the paper Bid Booklet.

(2) Bid Guaranty with Electronic Bids - For Bids submitted electronically, the Bidder may choose to submit an electronic Bid Bond or a paper Bid guaranty prior to the time of Bid Closing, as follows:

- The electronic Bid Bond which is part of the digitally signed electronic Bid Booklet. This electronic Bid Bond shall include the approved Bond ID number issued by the Surety and shall be submitted by the Bidder prior to the time of Bid submission given in the Bid Booklet; or
- A Bid Bond form which is part of the electronic Bid Booklet may be printed and then filled out. The printed Bid Bond form, with original signatures and the Surety's seal affixed, shall be submitted by mail, delivery service, or hand delivered to the offices and addresses, and at the times given in the Bid Booklet. Alternately, if the Bidder chooses to submit a Bid guaranty in the form of an irrevocable letter of credit issued by an insured institution as defined in ORS 706.008, or a cashier's check or certified check made payable to the Agency (see ORS 279C.365(4)), it shall be submitted by mail, delivery service, or hand delivered to the offices and addresses, and at the times given in the Bid Booklet.

(f) Disclosure of First-Tier Subcontractors - Without regard to the amount of a Bidder's Bid, if the Agency's cost range for a public improvement Project in the "Notice to Contractors", or in other advertisement or Solicitation Documents, exceeds $100,000, the Bidder shall, within 2 working hours of the time Bids are due to be submitted, submit to the Agency, on a form provided by the Agency, a disclosure identifying any first-tier Subcontractors that will furnish labor or labor and Materials, and whose contract value is equal to or greater than:

- 5% of the total Project Bid, but at least $15,000; or
- $350,000, regardless of the percentage of the total Project Bid.

For each Subcontractor listed, Bidders shall state:

- The name of the Subcontractor;
- The dollar amount of the subcontract; and
- The category of Work that the Subcontractor would be performing.

If no subcontracts subject to the above disclosure requirements are anticipated, a Bidder shall so indicate by entering "NONE" or by filling in the appropriate check box. For each Subcontractor listed, Bidders shall provide all requested information. Failure to submit a form or submission of a form that does not include the information required by ORS 279C.370 for each Subcontractor listed, specifically the name of each Subcontractor, the dollar amount of each subcontract and the category of Work that each Subcontractor will perform, will result in the rejection of the Bid. The Agency is not required to determine the accuracy or the completeness of the Subcontractor disclosure. See ORS 279C.370 and OAR 731-007-0260.

The Subcontractor Disclosure Form may be submitted for a paper Bid (see 00120.05(b)(1)) by:

- Filling out the Subcontractor Disclosure Form printed from the Bid Booklet on the ODOT eBIDS website (see 00110.05(e)) and submitting it together with the Bid at the time and place designated for receipt of Bids;
- Printing it from the Bid Booklet on the ODOT eBIDS website, filling it out and submitting it separately to the ODOT Procurement Office at the address or email transmission to the email address given in the paper Bid Booklet; or
- Using the form provided on the Agency's website identified in the Bid Booklet on the ODOT eBIDS website and pressing the submit button on the form.

The Subcontractor Disclosure Form may be submitted for an electronic Bid (see 00120.05(b)(2)) by:

- Filling out the Subcontractor Disclosure Form included as a file in the electronic Bid Booklet and submitting it together with the Bid, using the BidExpress® website (see 00110.05(e)), at the time designated for receipt of Bids;
- Printing it from the Bid Booklet on the ODOT eBIDS website, filling it out and submitting it separately to the ODOT Procurement Office at the address or email transmission to the email address given in the paper Bid Booklet; or
- Using the form provided on the Agency's website identified in the Bid Booklet on the ODOT eBIDS website and pressing the submit button on the form.

Subcontractor Disclosure Forms submitted by any method will be considered late if not received by the ODOT Procurement Office within 2 working hours of the time designated for receiving Bids.

The Agency is not responsible for partial, failed, illegible or partially legible email transmissions or submittals, and such forms may be rejected as incomplete.

In the event that multiple Subcontractor Disclosure Forms are submitted, the last version received prior to the deadline will be considered to be the intended version.

(g) Disclosure of Conflict of Interest - Bidders shall review the Agency's Conflict of Interest Guidelines, and if any disclosures are required (with the exception of any required disclosures for Subcontractors, which are addressed under 00180.21), Bidders shall complete the Conflict of Interest Disclosure Form(s) and submit, before the time Bids are due to be submitted, by paper according to 00120.45(a) for both paper Bids and electronic Bids. The ODOT Conflict of Interest Guidelines and Conflict of Interest Disclosure Form are available on the ODOT Procurement Office website (see 00110.05(e)).

If disclosures are not required under the Agency's Conflict of Interest Guidelines, no disclosures need be submitted.

00120.45 Submittal of Bids:

(a) Paper Bids - Paper Bids may be submitted by mail, parcel delivery service, or hand delivery to the offices and addresses, and at the times, given in the Bid Booklet. Bidders shall submit paper Bids in a sealed envelope provided by the Agency, or a reasonably similar envelope marked with the word "Bid", the name of the Project, and the words "To Be Opened Only by Authorized Personnel" on the outside. If submitting Bids by mail or by parcel delivery service, the Bidder shall place the sealed envelope containing the paper Bid inside a separate sealed envelope or package.

Paper Bids submitted after the time set for receiving paper Bids will not be opened or considered. The Agency assumes no responsibility for the receipt and return of late paper Bids.

(b) Electronic Bids - Electronic Bids shall be submitted using the latest version of AASHTOWare Project Bids™ software and shall be submitted using the BidExpress® website (see 00110.05(e)). Closing time for acceptance of Bids is 9:00:00 a.m. local time on the day of Bid Opening. ODOT and BidExpress® will not accept any Bids submitted after that time.

00120.50 Submitting Bids for More than One Contract - A Bidder who desires to submit either paper Bids or electronic Bids for more than one Contract at a single opening of multiple Bids may submit one of the "Limiting Statements" in the Bid as follows:

- If the volume of Work to be awarded is to be limited by the number of Contracts, fill in Limiting Statement No. 1 in the paper Bid Booklet, or check the appropriate box in the electronic Bid Booklet.
- If the volume of Work to be awarded is to be limited by the total of the Contract Amounts, fill in Limiting Statement No. 2 in the paper Bid Booklet, or check the appropriate box in the electronic Bid Booklet.

If a Bidder makes a limiting statement on any Bid, the statement will apply to all Bids submitted by the Bidder at that opening. Should limiting statements be made on more than one Bid, and the statements differ, the lower limiting number or amount shall govern.

Bidders shall make no qualifications of the Bids that attempt to reserve the right to choose, from among two or more Contracts, the Contract or Contracts that the Bidder will accept. Selection of Contracts will be made by the Agency.

00120.60 Revision or Withdrawal of Bids:

(a) Paper Bids - Information entered into the paper Bid Booklet by the Bidder may be changed after the paper Bid has been delivered to the ODOT Procurement Office, provided that:

- Changes are prepared according to the instructions identified in the Bid Booklet; and
- Changes are received at the same offices, addresses, and times identified in the paper Bid Booklet for submitting Bids; and
- The changes are submitted in writing or by scanning and submitting via email transmission to the email address given in the paper Bid Booklet, signed by an individual authorized to sign the Bid.

A Bidder may withdraw its paper Bid after it has been delivered to the ODOT Procurement Office, provided that:

- The written withdrawal request is submitted on the Bidder's letterhead, either by hand delivery or by scanning and submitting via email to the email address given in the paper Bid Booklet; and
- The request is signed by an individual who is authorized to sign the Bid, and proof of authorization to sign the Bid accompanies the withdrawal request; and
- The request is received at the same offices, addresses, and times identified in the paper Bid Booklet for submitting Bids.

(b) Electronic Bids - FAX and email submittals and submittals in writing to revise electronic Bids will not be permitted. However, the Bidder may submit multiple electronic Bids for the same Project to revise the electronic Bid. All electronic Bid submittals must meet all requirements and deadlines for submitting electronic Bids. The last electronic Bid submitted shall supersede all previous submittals.

Any request for withdrawal of a Bid submitted electronically may be completed through BidExpress® prior to the time set for closing Bids. The Bidder may also withdraw its electronic Bid by written withdrawal request according to the following:

- The written withdrawal request is submitted on the Bidder's letterhead, either by hand delivery or by submitting a scanned version via email to the email address given in the Bid Booklet; and
- The request is signed by an individual who is authorized to sign the Bid, and proof of authorization to sign the Bid accompanies the withdrawal request; and
- If the request is being submitted by hand delivery, the Bidder shall date stamp the written withdrawal request with the provided date stamping device and shall place it in the ODOT Procurement Office Bid Box located in the lobby of:

  Oregon Department of Transportation
  3930 Fairview Industrial Drive SE
  Salem, OR 97302

- The written withdrawal request is received before 9:00:00 a.m. local time on the day of Bid Opening.

00120.65 Opening and Comparing Bids - Bids will be opened and the total price for each Bid will be read publicly at the time and place specified in the Notice to Contractors and the Bid Booklet. Bidders and other interested parties are invited to be present.

Bids for each Project will be compared on the basis of the total amount of each Bid. The total amount of the Bid will be the total sum computed from quantities listed in the Bid Schedule and unit prices entered by the Bidder.

In case of conflict between the unit price and the corresponding extended amount, the unit price shall govern, and the Agency may make arithmetic corrections on extension amounts.

00120.70 Rejection of Non-responsive Bids - A Bid will be considered irregular and will be rejected if the irregularity is deemed by the Agency to render the Bid non-responsive. Examples of irregularities include, without limitation:

- The Bid Section documents provided are not properly used or contain unauthorized alterations.
- The Bid is incomplete or incorrectly completed.
- The Bid contains improper additions, deletions, alternate Bids, or conditions.
- The Bid or Bid modifications are not signed by a person authorized to submit Bids or modify Bids, as required by 00120.01.
- The Bid is submitted on documents not obtained directly from the ODOT eBIDS website or from BidExpress® (see 00110.05(e)), or is submitted by a Bidder who is not registered on ODOT's "Holders of Bidding Plans" list, as required by 00120.05.
- A member of a joint venture and the joint venture submit Bids for the same Project. Both Bids may be rejected.
- The Bid has entries not typed or in ink, or has signatures or initials not in ink (save for changes received by email as provided by 00120.60).
- Each change or correction is not individually initialed.
- White-out tape or white-out liquid is used to correct item entries.
- The price per unit cannot be determined.
- The Bid guaranty is insufficient or improper.

- The original Bid Bond form is not used or is altered.
- The Oregon Construction Contractors Board registration number and expiration date are not shown on the Bid if required in the Solicitation Document. This requirement applies to State-funded Projects, with the exception of Aggregate production and landscape Projects. (Not required on Federal-aid Projects.)
- A disclosure of first-tier Subcontractors, if required under 00120.40(f), is not received within 2 working hours of the time Bids are due to be submitted, or the disclosure form is not complete.
- The Bidder has not complied with the DBE requirements of the solicitation.
- The Bid does not acknowledge all issued Addenda.
- The Bid contains entries that are not greater than zero.
- The Bid contains entries with more than two decimals to the right of the decimal point.
- The Bid entries are not expressed in U.S. dollars and cents.
- An electronic Bid is not received due to failure to comply with all requirements of BidExpress®.
- The Bidder has not submitted required Conflict of Interest Disclosure Form(s), if any. (See 00120.40(g).)
- The Bidder has liquidated and delinquent debt owed to the State or any department or agency of the State.

00120.80 Reciprocal Preference for Oregon Resident Bidders - This Subsection applies only to Contracts for Projects financed without federal funds.

Bidders shall complete the certificate of residency provided by the Agency in the Bid Booklet. Failure to properly complete the form will be cause to reject the Bid.

As used in the certificate of residency and this Subsection, "Resident Bidder" means a Bidder who has:

- Paid unemployment taxes or income taxes in the State of Oregon during any of the 12 calendar months immediately preceding submission of the Bid;
- A business address in the State of Oregon; and
- Certified in the Bid that the Bidder qualifies as a Resident Bidder.

"Nonresident Bidder" means a Bidder who is not a Resident Bidder as defined above.

In determining the lowest Bid, the Agency will, for the purpose of awarding the Contract, add a percentage increase to the Bid of a Nonresident Bidder equal to the percentage, if any, of the preference given to that Bidder in the state in which the Bidder resides (ORS 279A.120). The percentage preference applied in each state will be published on or before January 1 of each year by the Oregon Department of Administrative Services. The Agency may rely on these percentages without incurring liability to any Bidder (ORS 279A.120).

This increase will only be applied to determine the lowest Bid, and will not cause an increase in payment to the Contractor after Award of the Contract.

00120.90 Disqualification of Bidders - The Bid(s) of a disqualified Bidder will be rejected. Any of the following reasons is sufficient to disqualify a Bidder:

- More than one Bid is submitted for the same Work by an Entity under the same or different name(s).

- Evidence of collusion among Bidders. Participants in collusion will be found not responsible, and may be subject to criminal prosecution.
- Any of the grounds for disqualification cited in ORS 279C.440.

A Bidder will be disqualified if the Bidder has:

- Not been prequalified as required by 00120.00;
- Been declared ineligible by the Commissioner of the Bureau of Labor and Industries under ORS 279C.860;
- Not been registered (licensed) by the Oregon Construction Contractors Board (CCB) or has not been licensed by the State Landscape Contractors Board before submitting a Bid (ORS 279C.365(1)(k), ORS 701.021, ORS 701.026, and ORS 671.530). The Bidder's registration number and expiration date shall be shown in the Bid form, if requested. Failure to furnish the registration number, if requested, will render the Bid non-responsive and subject to rejection. (Not required on Federal-aid projects.); or
- Been determined by the CCB under ORS 701.227 not to be qualified to hold or participate in a public contract for a public improvement.

00120.91 Rejection of Bid on Grounds of Nonresponsibility of Bidder - The Bid of a Bidder who is found to be nonresponsible according to the criteria listed in 00130.10 or ORS 279C.375(3) will be rejected.

00120.95 Opportunity for Cooperative Arrangement - The Agency will offer the Contractor and its Subcontractors an opportunity to enter into a partnering agreement structured to take advantage of the strengths of each organization. The objective of the partnering agreement is the effective and efficient completion of the Work, on time and to a standard of quality that will be a source of pride to both the Agency and the Contractor. Participation in the program is voluntary and is not a condition for Award. An offer to participate should not be included in Bid or Proposal materials. An election for a partnering agreement will be included with the Contract Documents to be executed by the successful Bidder.

It is intended that the partnering agreement will result in informal agreements that will allow the Contract requirements to be achieved effectively and efficiently by both the Contractor and the Agency.

The Agency will make all arrangements for the orientation workshop and will bear the costs of the workshop including meals, facilitator, and workshop materials. The Agency and the Contractor will bear the salary, transportation, lodging, and other costs of their own personnel. The orientation workshop may include key Agency personnel, other stakeholders, key Contractor personnel and key Subcontractor personnel. Generally, workshops are limited to about 20 participants. Participants will not be available for other duties during this period.

Section 00130 - Award and Execution of Contract

00130.00 Consideration of Bids - After opening and reading Bids, the Agency will check them for correct extensions of unit prices and totals. (See 00120.65.) The total of extensions, corrected where necessary, will be used by the Agency for Award purposes.

The Agency reserves the right to waive minor informalities and irregularities, seek clarification of any Bid or response that, in its sole discretion, it deems necessary or advisable, and to reject any or all Bids for irregularities under 00120.70 or for good cause after finding that it is in the public interest to do so (ORS 279C.395). An example of good cause for rejection in the public interest is the Agency's determination that any of the unit Bid prices are significantly unbalanced to the Agency's potential detriment. The Agency may correct obvious clerical errors, when the correct information can be determined from the face of the documents, if it finds that the best interest of the Agency and the public will be served thereby.

Bids will be considered and a Contract awarded, if at all, within 30 Calendar Days from the date of Bid Opening, unless an extension beyond that time is agreed to by both parties and acknowledged in writing by the Bidder.

00130.10 Award of Contract - After the Bids are opened and a determination is made that a Contract is to be awarded, the Contract will be awarded to the lowest responsible Bidder. For the purposes of this Section, "lowest responsible Bidder" means the responsible Bidder who submitted the lowest responsive Bid, who is not on the list created by the Construction Contractors Board according to ORS Chapter 701, and who has:

- Substantially complied with all prescribed public bidding procedures and requirements.
- Available the appropriate financial, Materials, Equipment, facility and personnel resources and expertise, or ability to obtain the resources and expertise, necessary to indicate the capability of the prospective Bidder to meet all contractual responsibilities.
- A satisfactory record of performance. In evaluating a Bidder's record of performance, the Agency may consider, among other things, whether the Bidder completed previous contracts of a similar nature with a satisfactory record of performance. For purposes of evaluating a Bidder's performance on previous contracts of a similar nature, a satisfactory record of performance means that to the extent that the costs associated with and time available to perform a previous contract remained within the Bidder's control, the Bidder stayed within the time and budget allotted for the procurement and otherwise performed the contract in a satisfactory manner. Satisfactory performance of the Contract also includes compliance with the requirements for records in 00170.07 for Contracts with the Agency.
- A satisfactory record of integrity. In evaluating a Bidder's record of integrity, the Agency may consider, among other things, whether the Bidder has previous criminal convictions for offenses related to obtaining or attempting to obtain a contract or subcontract or in connection with the Bidder's performance of a contract or subcontract.
- Qualified legally to contract with the Agency.
- Supplied all necessary information in connection with the inquiry concerning responsibility. If a prospective Bidder fails to promptly supply information requested by the Agency concerning responsibility, the Agency will base the determination of responsibility upon any available information, or may find the prospective Bidder not to be responsible.
- Not been disqualified by the public contracting agency under ORS 279C.440.
- An unexpired certificate issued by the Oregon Department of Administrative Services (under ORS 279A.167) upon completion of the curriculum and assessment that the Bidder understands the prohibitions set forth in ORS 652.220 and in other laws or rules that prohibit discrimination in compensation or wage payment. The certificate is only required if the Bidder employs 50 or

more full-time workers and submitted a Bid for a procurement with an estimated contract price that exceeds $500,000.

If the Bidder is found not to have a satisfactory record of performance or integrity, the Agency will document the record and the reasons for the unsatisfactory finding.

In determining whether the Bidder is responsible, the Agency may also consider whether the Bidder has liquidated and delinquent debt owed to the State of Oregon or any department or agency of the State.

The Agency will provide Notice of Intent to Award on the ODOT Procurement Office - Construction Contracts Unit Notice of Intent website (see 00110.05(e)).

The Award will not be final until the later of the following:

- Three working days after the Notice of Intent to Award has been posted as specified in the advertised solicitation or Addendum thereto; or
- The Agency has provided a written response to each timely protest, denying the protest and affirming the Award.

If the Agency accepts a Bid and awards a Contract, the Agency will send the successful Bidder written notice of acceptance and Award.

Notice of Award and Contract booklets ready for execution will be sent within 30 Calendar Days of the opening of Bids or within the number of Calendar Days specified in the Special Provisions or a written mutual agreement.

00130.15 Right to Protest Award - Adversely affected or aggrieved Bidders, limited to the three apparent lowest Bidders and any other Bidder directly in line for Contract Award, may submit to the ODOT Procurement Office - Construction Contracts Unit a written protest of the Agency's intent to Award within 3 working days following posting of the Notice of Intent to Award on the ODOT Procurement Office - Construction Contracts Unit Notice of Intent website (see 00110.05(e)). The protest shall specify the grounds upon which it is based.

The Agency will not consider late protests.

00130.20 Cancellation of Award - Without liability to the Agency, the Agency may for good cause cancel Award at any time before the Contract is executed by all parties to the Contract, as provided by ORS 279C.395 for rejection of Bids, upon finding it is in the public interest to do so.

00130.30 Contract Booklet - The Contract booklet may include, but is not limited to:

- Special Provisions
- Addenda
- Schedule of Items
- Contract
- Performance Bond
- Payment Bond
- Certification of workers' compensation coverage

00130.40 Contract Submittals - Before the Agency will execute the Contract, the successful Bidder shall furnish the following:

(a) Performance and Payment Bonds - When Awarded the Contract, the successful Bidder shall furnish a Performance Bond and a Payment Bond of a Surety authorized to do business in the State of Oregon.

The successful Bidder shall submit the standard bond forms, which are bound in the Contract booklet. Faxed or photocopied bond forms will not be accepted. The amount of each bond shall be equal to the Contract Amount. The Performance Bond and the Payment Bond must be signed by the Surety's authorized Attorney-in-Fact, and the Surety's seal must be affixed to each bond. A power of attorney for the Attorney-in-Fact shall be attached to the bonds in the Contract booklet, which must include bond numbers, and the Surety's original seal must be affixed to the power of attorney. Bonds shall not be canceled without the Agency's consent, nor will the Agency normally release them, prior to Contract completion.

When a coating system warranty is required by 00594.75, the Contractor shall also furnish a supplemental warranty performance bond as and when described in 00594.75.

(b) Certificates of Insurance - The successful Bidder shall furnish the Agency certificates of insurance applicable to the Project, according to 00170.70. The insurance coverages shall remain in force throughout the performance of the Contract and shall not be allowed to lapse without prior written approval of the Agency. Bidders may refer to 00170.70 for minimum coverage limits and other requirements.

For specified Contracts, certified copies, and in some instances the original, of insurance policies may be required by the Special Provisions.

(c) Workers' Compensation - To certify compliance with the workers' compensation insurance coverage required by 00170.61(a) and 00170.70(d), the successful Bidder shall complete and sign the "Certification of Workers' Compensation Coverage" form bound in the Contract booklet.

(d) Registration Requirements:

(1) ORS 701.021, ORS 701.026, and ORS 671.530 require that Bidders be registered with the Oregon Construction Contractors Board or licensed by the State Landscape Contractors Board prior to submission of a Bid on a Project not involving federal funds. Registration with the Construction Contractors Board or licensing by the State Landscape Contractors Board is not a prerequisite to bidding on Federal-aid Projects; however, the Agency will not execute a Contract until the Contractor is so registered or licensed.

(2) Bidders must be registered with the Corporation Division, Oregon Secretary of State, if bidding as a corporation, limited liability company, joint venture, or limited liability partnership, or if operating under an assumed business name and the legal name of each person carrying on the business is not included in the business name.

(3) A Contractor registered under ORS Chapter 701 may bid on a landscaping project or perform a construction project that includes landscape contracting as a portion of the project if the landscape contracting is subcontracted to a licensed landscaping business as defined in ORS 671.520.

(4) A landscaping business may bid on a Project or perform a Contract that includes the phase of landscape contracting for which it is not licensed if it employs a landscape contractor, or subcontracts with another licensed landscaping business, licensed for that phase.

(e) Tax Identification Number - The successful Bidder shall furnish the Agency the Bidder's Federal Tax Identification Number.

00130.50 Execution of Contract and Bonds:

(a) By the Bidder - The successful Bidder shall deliver the required number of Contract booklets with the properly executed Contract, Performance Bond, Payment Bond, certification of workers' compensation coverage, and the required certificates of insurance, to the ODOT Procurement Office - Construction Contracts Unit within 15 Calendar Days after the date on which the Contract booklets are sent or otherwise conveyed to the Bidder under 00130.10. The Bidder shall return the originals of all documents received from the Agency and named in this Subsection, with original signatures. Certificates of insurance shall also be originals. Certificates of insurance for coverages that are permitted by the Agency under 00170.70(a) to be obtained by appropriate Subcontractors shall be delivered by the Contractor to the Agency together with the Contractor's request under 00180.21 for approval of the subcontract with that Subcontractor. No copies of these documents will be accepted by the Agency.

Proper execution requires that:

- If the Contractor is a partnership, limited liability partnership, joint venture, or limited liability company, an authorized representative of each Entity comprising it shall sign the Contract, Performance Bond, and Payment Bond, and an authorization to sign shall be attached.
- If the Contractor is a corporation, the President and the Secretary of that corporation shall sign the Contract, Performance Bond, and Payment Bond. However, if other corporate officers are authorized to execute contracts and bonds, the successful Bidder shall furnish with those documents a certified, true and correct copy of the corporate bylaws or minutes stating that authority. If only one officer is signing, then the bylaws or minutes must include the authority to sign without the signature of others. The successful Bidder shall also include the title(s) or corporate office(s) held by the signer(s).

(b) By the Agency - Within 7 Calendar Days after the Agency has received and verified the properly executed documents specified in 00130.50(a), and received legal sufficiency approval from the Attorney General (if required), the Agency will execute the Contract. The Agency will then send a fully-executed original Contract booklet to the successful Bidder, who then officially becomes the Contractor.

00130.60 Failure to Execute Contract and Bonds - Failure of the successful Bidder to execute the Contract and provide the required certificates, certifications, and bonds may be cause for cancellation of the Award, and may be cause for forfeiture of the Bid guaranty under ORS 279C.385.

Award may then be made to the next lowest responsible Bidder, the Project may be re-advertised, or the Work may be performed otherwise as the Agency decides.

The forfeited Bid guaranty will become the Agency's property, not as a penalty but as liquidation of damages resulting from the Bidder's failure to execute the Contract and provide the certificates, certifications, and bonds as required by these Specifications.

00130.70 Release of Bid Guaranties - Bid guaranties will be released and checks returned 7 Calendar Days after Bids are opened, except for those of the three apparent lowest Bidders on each Project. The guaranties of the three apparent lowest Bidders will be released and checks returned to unsuccessful Bidders within 7 Days of the Agency's execution of the Contract.

00130.80 Project Site Restriction - Until the Agency sends the Contractor written Notice to Proceed with the Work, and the Contractor has filed the public works bonds required in 00170.20, the Contractor shall not go onto the Project Site on which the Work is to be done, nor move Materials, Equipment, or workers onto that Project Site.

The Contractor will not automatically be entitled to extra compensation because the commencement of Work is delayed by failure of the Agency to send the Contract for execution. However, if more than 30 Calendar Days elapse between the date the Bid is opened and the date the Agency sends the Contract to be executed, the Agency will consider granting an adjustment of time for completion of the Work to offset any actual delay to Contract completion resulting directly from delay in commencement.

00130.90 Notice to Proceed - Notice to Proceed will be issued within 5 Calendar Days after the Contract is executed by the Agency.

Should the Agency fail to issue the Notice to Proceed within 5 Calendar Days of Contract execution, the Contractor may apply for an adjustment of Contract Time according to 00180.80(c).

The Engineer will issue a First Notification recording the date the performance of the Contract has begun.

Section 00140 - Scope of Work

00140.00 Purpose of Contract - The purpose of the Contract is to set forth the rights and obligations of the parties and the terms and conditions governing completion of the Work. The Contractor's obligations shall include without limitation the following:

- The Contractor shall furnish all Materials, Equipment, labor, transportation, and Incidentals required to complete the Work according to Plans, Specifications, and terms of the Contract.
- The Contractor shall perform the Work according to the lines, grades, Cross Section data, Typical Sections, dimensions, and other details shown on the Plans or in the 3D Engineered Model, as modified by written order, or as directed by the Engineer.
- The Contractor shall perform all Work determined by the Engineer to be necessary to complete the Project.
- The Contractor shall contact the Engineer for any necessary clarification or interpretation of the Contract.

00140.10 Typical Sections - The Typical Sections are intended to apply in general. At other locations where the Typical Section is not appropriate, the Contractor shall perform construction to the identified alignment as directed by the Engineer.

00140.20 Thickness - The thickness of Courses of Materials shown on the Plans, given in the Specifications, or established by the Engineer is considered to be the compacted thickness. Minor variations are acceptable when within tolerances specified in the Specifications or Plans, or when approved by the Engineer.

00140.30 Agency-Required Changes in the Work - Changes to the Plans, quantities, or details of construction are inherent in the nature of construction and may be necessary or desirable during the course of Project construction.

Without impairing the Contract, the Agency reserves the right to require changes it deems necessary or desirable within the scope, which in the Specifications means general scope, of the Project. These changes may modify, without limitation:

- Specifications and design
- Grade and alignment
- Cross Sections and thicknesses of Courses of Materials
- 3D Engineered Model
- Method or manner of performance of Work
- Project Limits

or may result in:

- Increases and decreases in quantities
- Additional Work
- Elimination of any Contract item of Work
- Acceleration or delay in performance of Work

Upon receipt of a Change Order, the Contractor shall perform the Work as modified by the Change Order. If the Change Order increases the Contract Amount, the Contractor shall notify its Surety of the increase and shall provide the Agency with a copy of any resulting modification to bond documents. The Contractor's performance of Work according to Change Orders shall neither

invalidate the Contract nor release the Surety. Payment for changes in the Work will be made according to 00195.20. Contract Time adjustments, if any, will be made according to 00180.80.

00140.40 Differing Site Conditions - The following constitute differing Project Site conditions provided such conditions are discovered at the Project Site after commencement of the Work:

- **Type 1** - Subsurface or latent physical conditions that differ materially from those indicated in the Contract Documents; or
- **Type 2** - Unknown physical conditions of unusual nature that differ materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract.

The party discovering such a condition shall promptly notify the other party, in writing, of the specific differing conditions before they are disturbed and before the affected Work is performed. The Contractor shall not continue Work in the affected area until the Engineer has inspected such condition according to 00195.30 to determine whether an adjustment to Contract Amount or Contract Time is required.

Payment adjustments due to differing Project Site conditions, if any, will be made according to 00195.30. Contract Time adjustments, if any, will be made according to 00180.80.

00140.50 Environmental Pollution Changes - ORS 279C.525 will apply to any increases in the scope of the Work required as a result of environmental or natural resources laws enacted or amended after the submission of Bids for the Contract. The Contractor shall comply with the applicable notice and other requirements of ORS 279C.525. The applicable rights and remedies of that statute will also apply.

In addition to ORS 279C.525, the Agency has compiled a list at 00170.01 of those federal, State, and local agencies, of which the Agency has knowledge, that have enacted ordinances, rules, or regulations dealing with the prevention of environmental pollution and the preservation of natural resources that may affect the performance of Agency contracts.

00140.60 Extra Work - If directed by the Engineer's written order, the Contractor shall perform work not included in the Contract. The Contractor shall perform this work according to:

- Standard Specifications
- Other Plans and Specifications issued by the Engineer

Payment for Extra Work will be made according to Section 00196. Contract Time adjustments, if any, will be made according to 00180.80.

00140.65 Disputed Work - The Contractor may dispute any part of a Change Order, written order, or an oral order from the Engineer by the procedures specified in Section 00199.

00140.70 Cost Reduction Proposals - The Contractor may submit written proposals to the Engineer that modify Plans, Specifications, or other Contract Documents for the sole purpose of reducing the total cost of construction. Unless otherwise agreed to in writing by the Agency, a proposal that is solely or primarily a proposal to reduce estimated quantities or delete Work, as determined by the Engineer, is not eligible for consideration as a cost reduction proposal and will instead be addressed under 00140.30, whether proposed or suggested by the Agency or the Contractor.

(a) Proposal Requirements - The Agency will not adopt a cost reduction proposal that impairs essential functions or characteristics of the Project, including, but not limited to, service life,

economy of operation, ease of maintenance, designed appearance, or design and safety standards.

To conserve time and funds, the Contractor may first submit a written request for a feasibility review by the Engineer. The request should contain a description of the proposal together with a rough estimate of anticipated dollar and time savings. The Engineer will, within a reasonable time, advise the Contractor in writing whether or not the proposal would be considered by the Agency, should the Contractor elect to submit a detailed cost reduction proposal.

A detailed cost reduction proposal shall include without limitation the following information:

- A description of existing Contract requirements for performing the Work and the proposed change;
- The Contract items of Work affected by the proposed change, including any quantity variation caused by the proposed change;
- Pay Items affected by the proposed change including any quantity variations;
- A detailed cost estimate for performing the Work under the existing Contract and under the proposed change. Cost estimates shall be made according to Section 00197. Costs of re-design, which are incurred after the Agency has accepted the proposal, shall be included in the cost of proposed work; and
- A date by which the Engineer must accept the proposal in order to accept the proposed change without impacting the Contract Time or cost reduction amount.

(b) Continuing to Perform Work - The Contractor shall continue to perform the Work according to Contract requirements until the Engineer issues a Change Order incorporating the cost reduction proposal. If the Engineer fails to issue a Change Order by the date specified in the proposal, the proposal shall be deemed rejected.

(c) Consideration of Proposal - The Engineer is not obligated to consider any cost reduction proposal. The Agency will not be liable to the Contractor for failure to accept or act upon any cost reduction proposal submitted.

The Engineer will determine in its sole discretion whether to accept a cost reduction proposal as well as the estimated net savings in construction costs from the adoption of all or any part of the proposal. In determining the estimated net savings, the Engineer may disregard the Schedule of Items. The Engineer will establish prices that represent a fair measure of the value of Work to be performed or to be deleted as a result of the cost reduction proposal.

(d) Sharing Investigation Costs - As a condition for considering a Contractor's cost reduction proposal, the Agency reserves the right to require the Contractor to share in the Agency's costs of investigating the proposal. If the Agency exercises this right, the Contractor shall provide written acceptance of the condition to the Engineer. Such acceptance will authorize the Agency to deduct its share of investigation costs from payments due or that may become due to the Contractor under the Contract.

(e) Acceptance of Proposal Requirements - If the Contractor's cost reduction proposal is accepted in whole or in part, acceptance will be made by a Change Order that will include without limitation the following:

- Statement that the Change Order is made according to 00140.70;
- Revised Contract Documents that reflect all modifications necessary to implement the approved cost reduction measures;
- Any conditions to which the Agency's approval is subject;

- Estimated net savings in construction costs attributable to the approved cost reduction measures; and
- A payment provision according to which the Contractor will be paid 50% of the estimated net savings amount as full and adequate consideration for performance of the Work of the Change Order.

The Contractor's cost of preparing the cost reduction proposal and the Agency's costs of investigating the proposal, including any portion paid by the Contractor, will be excluded from determination of the estimated net savings in construction costs. Costs of re-design, which are incurred after the Agency has accepted the proposal, will be included in the cost of the Work attributable to cost reduction measures.

If the Agency accepts the cost reduction proposal, the Change Order that authorizes the cost reduction measures will also address any Contract Time adjustment.

(f) Right to General Use - Once submitted, the cost reduction proposal becomes the property of the Agency. The Agency reserves the right to adopt the cost reduction proposal for general use without additional compensation to the Contractor when it determines that a proposal is suitable for application to other contracts.

00140.80 Use of Publicly Owned Equipment - The Contractor is prohibited from using publicly-owned Equipment except in the case of emergency. In an emergency, the Contractor may rent publicly-owned Equipment provided that:

- The Engineer provides written approval that states that such rental is in the public interest; and
- Rental does not increase the Project cost.

00140.90 Final Trimming and Cleanup - Before Final Inspection as described in 00150.90, the Contractor shall neatly trim and finish the Project and remove all remaining unincorporated Materials and debris. Final trimming and cleanup shall include without limitation the following:

- The Contractor shall retrim and reshape earthwork, and shall repair deteriorated portions of the Project Site.
- Where the Work has impacted existing facilities or devices, the Contractor shall restore or replace those facilities to their pre-existing condition.
- The Contractor shall clean all drainage facilities and sanitary sewers of excess Materials or debris resulting from the Work.
- The Contractor shall clean up and leave in a neat, orderly condition, Rights-of-Way, Materials sites, and other property occupied in connection with performance of the Work.
- The Contractor shall remove temporary buildings, construction plants, forms, falsework and scaffolding, surplus and discarded Materials, and rubbish.
- The Contractor shall dispose of Materials and debris, including, without limitation, forms, falsework, scaffolding, and rubbish resulting from clearing, grubbing, trimming, clean-up, removal, and other Work. These Materials and debris become the property of the Contractor. The Contractor shall dispose of these Materials and debris immediately.

Unless the Contract specifically provides for payment for this item, the Agency will make no separate or additional payment for final trimming and cleanup.

Section 00150 - Control of Work

00150.00 Authority of the Engineer - The Engineer has full authority over the Work and its suspension. (See Section 00180.) The Contractor shall perform all Work to the complete satisfaction of the Engineer. The Engineer's determination shall be final on all matters, including, but not limited to, the following:

- Quality and acceptability of Materials and workmanship
- Measurement of unit price Work
- Timely and proper prosecution of the Work
- Interpretation of Contract Documents
- Payments due under the Contract

The Engineer's decision is final and, except as provided in 00180.80 for adjustments of Contract Time and Section 00199 for claims for additional compensation, may be challenged only through litigation.

Work performed under the Contract will not be considered complete until it has passed Final Inspection by the Engineer and has been accepted in writing by the Agency.

Interim approvals issued by the Engineer, including, but not limited to, Third Notification, will not discharge the Contractor from responsibility for errors in prosecution of the Work, for improper fabrication, for failure to comply with Contract requirements, or for other deficiencies, the nature of which are within the Contractor's control.

00150.01 Project Manager's Authority and Duties - The Engineer may designate a Project Manager as its representative on the Project with authority to enforce the provisions of the Contract.

When the Engineer has designated a Project Manager, the Contractor should direct all requests for clarification or interpretation of the Contract, in writing, to the Project Manager. The Project Manager will respond within a reasonable time. Contract clarification or interpretation obtained from persons other than the Project Manager will not be binding on the Agency.

The Project Manager shall have the authority to appoint Inspectors and other personnel as required to assist in the administration of the Contract.

00150.02 Inspector's Authority and Duties - To the extent delegated under 00150.01, Inspectors are authorized to represent the Engineer and Project Manager to perform the following:

- Inspect Work performed and Materials furnished, including, without limitation, the preparation, fabrication, or manufacture of Materials to be used;
- Orally reject defective Materials and to confirm such rejection in writing;
- By oral order, temporarily suspend the Work for improper prosecution pending the Engineer's decision; and
- Exercise additional delegated authority.

Inspectors are not authorized to:

- Accept Work or Materials.
- Alter or waive provisions of the Contract.
- Give instructions or advice inconsistent with the Contract Documents.

00150.05 Cooperative Arrangements - The Contractor may enter into a voluntary partnering agreement with the Agency for the Work covered by this Contract. Some elements of this arrangement are described in 00120.95. The Contractor may exercise the election to enter into a partnering agreement by signing and returning the form provided with the Notice of Award. If the Contractor elects to enter into a partnering agreement, this form must be returned no later than the time that the Contractor returns the signed Contract to the Agency. This form does not need to be returned if the Contractor does not wish to enter into a partnering agreement. Entering into a partnering agreement does not constitute nor create a legal partnership, joint venture, other legal Entity, or legal relationship between the Contractor and the Agency.

No partnering agreement shall replace, modify, or suspend the terms of the Contract.

If the partnering agreement alternative is selected:

- Within 5 Calendar Days of receipt of the signed form by the Agency, the Contractor and the Engineer will identify the key personnel who will participate in the orientation workshop. Key personnel should include key Subcontractors and other stakeholders. The Agency will arrange the workshop time and location.
- It is intended that the partnering agreement will result in informal agreements that establish an environment of cooperation between the Contractor and the Agency.
- A working arrangement for the Contractor and the Agency will be developed and, if agreed at the workshop, committed to writing.
- Either the Contractor or the Agency may withdraw from the partnering agreement upon written notice to the other. However, no claim or dispute settled or change approved during the existence of the partnering agreement shall be revived.
- The sole remedy for nonperformance of the partnering agreement shall be the ability to withdraw from the partnering agreement as stated in the paragraph immediately above.

00150.10 Coordination of Contract Documents - The Contract Documents, including, but not limited to, Contract Change Orders, the Special Provisions, the Plans, and the Standard Specifications are intended to collectively describe all of the items of Work necessary to complete the Project.

(a) Order of Precedence - The Engineer will resolve any discrepancies between these documents in the following order of precedence:

- Contract Change Orders;
- Special Provisions;
- Stamped Agency-prepared drawings specifically applicable to the Project and bearing the Project title;
- Reviewed and accepted, stamped Working Drawings;
- 3D Engineered Models and supplemental Agency-prepared line, grade and Cross Section data applicable to the Project;
- Standard Drawings;
- Approved unstamped Working Drawings and 3D Construction Models;
- Standard Specifications; and
- All other Contract Documents not listed above.

Notes on a drawing shall take precedence over drawing details.

Dimensions shown on the drawings, or that can be computed, shall take precedence over scaled dimensions.

(b) Immaterial Discrepancies - The Contract Documents specify details for the construction and completion of the Work. If Contract Documents describe portions of the Work in sufficient detail but are silent in some minor respect, the Contractor may proceed utilizing the current best industry practices.

(c) Material Discrepancies - If the Contractor identifies a discrepancy, error, or omission in the Contract Documents that cannot be resolved by the approach specified in (b) above, the Contractor shall immediately request clarification from the Engineer.

00150.15 Construction Stakes, Lines, and Grades:

(a) General - The Contractor shall perform no Work until the Engineer establishes field controls. Work performed without field controls will be subject to removal at the Contractor's expense.

(b) Agency Responsibilities - The Engineer will:

- Lay out and set construction stakes and marks to establish the lines, grades, Slopes, Cross Sections, and curve super-elevations for roadwork;
- Provide one set of construction stakes for line and grade for each additional phase of the Work;
- Set bench marks and stakes for centerline of Bridges and bents;
- Calculate and provide finish deck grades; and
- Deduct from payments due the Contractor all costs incurred to replace stakes and marks negligently or intentionally damaged, removed, or destroyed by the Contractor.

(c) Contractor Responsibilities - The Contractor shall:

- Inform the Engineer of staking requirements at least 5 Calendar Days before the staking needs to begin;
- Coordinate construction to provide sufficient area for the Engineer to perform surveying work efficiently and safely;
- Accurately measure detailed dimensions, elevations, and Slopes from the Engineer's stakes and marks;
- Perform the Work in such a manner as to preserve stakes and marks; and
- Set any reference lines for automatic control from the control stakes provided by the Engineer.

00150.20 Inspection:

(a) Inspection by the Engineer - The Engineer may test Materials furnished and inspect Work performed by the Contractor to ensure Contract compliance.

If the Contractor performs Work without the Engineer's inspection or uses Materials that the Engineer has not approved, the Engineer may order affected portions of the Work removed at the Contractor's expense. The foregoing sentence shall not apply if the Engineer fails to inspect the Work within a specific period of time required in the Contract or, in the absence of a specific period of time, within a reasonable period of time after receiving the Contractor's timely written request for inspection or testing.

At the Engineer's direction, any time before the Work is accepted, the Contractor shall uncover portions of the completed Work for inspection. After inspection, the Contractor shall restore these portions of Work to the standard required by the Contract. If the Engineer rejects Work due to Materials or workmanship, or if the Contractor performed such Work without providing sufficient advance request for inspection to the Engineer, the Contractor shall bear all costs of uncovering and restoring the Work. If the Engineer accepts the uncovered Work, and the Contractor performed the Work only after providing the Engineer with sufficient advance notice, the costs of uncovering and restoring the Work will be paid for by the Agency according to 00195.20.

(b) Inspection Facilities - The Contractor shall furnish walkways, railings, ladders, shoring, tunnels, platforms, and other facilities necessary to permit the Engineer to have safe access to the Work to be inspected. The Contractor shall require producers and fabricators to provide safe inspection access as requested by the Engineer.

(c) Sampling - The Contractor shall furnish the Engineer with samples of Materials that the Engineer will test. All of the Contractor's costs related to this required sampling are Incidental.

(d) Inspection by Third Parties - Where third parties have the right to inspect the Work, the Contractor shall coordinate with the Engineer and shall provide safe inspection access.

(e) Contractor's Duty to Make Corrections - The Contractor shall perform all Work according to the Contract Documents. The Contractor shall correct Work that does not comply with the Contract Documents at its own expense. Inspection of the Work by the Engineer does not relieve the Contractor of responsibility for improper prosecution of the Work.

00150.25 Acceptability of Materials and Work - The Contractor shall furnish Materials and shall perform Work in Close Conformance to the Contract Documents. If the Engineer determines that the Materials furnished or the Work performed are not in Close Conformance with the Contract Documents, the Engineer may:

- Reject the Materials or Work and order the Contractor, at the Contractor's expense, to remove, replace, or otherwise correct any non-conformity; or
- Accept the Materials or Work as suitable for the intended purpose, adjust the amount paid for applicable Pay Items to account for diminished cost to the Contractor or diminished value to the Agency, document the adjustment, and provide written documentation to the Contractor regarding the basis of the adjustment.

The Engineer's decisions concerning acceptability of Materials or Work will be final.

00150.30 Delivery of Notices - Written notices to the Contractor by the Engineer or the Agency will be delivered:

- In person;
- By U.S. Postal Service first class mail or priority mail (which at the sender's option may include certified or registered mail return receipt requested), to the current office address as shown in the records of the Agency; or
- By overnight delivery service of a private industry courier, to the current office address as shown in the records of the Agency.

Notices shall be considered as having been received by the Contractor:

- At the time of actual receipt when delivered in person;
- At the time of actual receipt or 7 Calendar Days after the postmarked date when deposited for delivery by first class or priority mail, whichever is earlier; or

- At the time of actual receipt or 3 Calendar Days after deposit with a private industry courier for overnight delivery service, whichever is earlier.

Written notices to the Engineer or the Agency by the Contractor shall be delivered to the Agency address shown in the Special Provisions, unless a different address is agreed to by the Engineer, and shall be delivered:

- In person;
- By U.S. Postal Service first class mail or priority mail (which at the sender's option may include certified or registered mail return receipt requested); or
- By overnight delivery service of a private industry courier.

Notices will be considered as having been received by the Agency:

- At the time of actual receipt when delivered in person;
- At the time of actual receipt or 7 Calendar Days after the postmarked date, when deposited for delivery by first class or priority mail, whichever is earlier; or
- At the time of actual receipt or 3 Calendar Days after deposit with a private industry courier for overnight delivery service, whichever is earlier.

For purposes of this Subsection, the time zone is Pacific Standard Time (PST) to determine time of receipt of notices and other documents. For purposes of this Subsection, non-business days are Saturdays, Sundays and legal holidays as defined by ORS 187.010 and 187.020.

Following Notice to Proceed, all notices and other documents submitted to the Contractor by the Engineer, or to the Engineer by the Contractor, electronically under 00170.08:

- If recorded in Doc Express® as received before 5:00 p.m. PST on a business day it shall be considered as received on the business day on which it was actually received in Doc Express®.
- If recorded in Doc Express® as received on a non-business day, or after 5:00 p.m. PST on a business day, it shall be considered as received at 8:00 a.m. PST on the next business day.

Claims must be submitted on paper documents according to Section 00199.

00150.35 Plans, 3D Engineered Models, Working Drawings, and 3D Construction Models:

(a) Plans and 3D Engineered Models - The Agency-prepared Plans and 3D Engineered Models will show details of lines, grades, Cross Sections, and Typical Section of the Roadway, and locations and design details of Structures.

(b) Working Drawings and 3D Construction Models - The Contractor shall supplement the Agency-prepared Plans and 3D Engineered Models with stamped Working Drawings, unstamped Working Drawings, or 3D Construction Models that show all information necessary to complete the Work. The applicable Section or Subsection of the Standard Specifications will indicate the supplemental information required and whether the drawings are to be stamped or unstamped. Stamped Working Drawings, unstamped Working Drawings, and 3D Construction Models are defined as follows:

(1) Stamped Working Drawings - Working Drawings, calculations, and other data which are prepared by or under the direction of a Professional Engineer licensed in the State of Oregon, and which bear the engineer's signature, seal, and expiration date.

(2) Unstamped Working Drawings - Working Drawings, calculations, and other data that do not bear an engineering seal.

(3) 3D Construction Models - See 00110.20.

(c) Number, Size, and Format of Working Drawings and 3D Construction Models - The Contractor shall submit Working Drawings and 3D Construction Models according to one of the following methods:

(1) Paper Submittal - The Contractor shall submit to the Engineer seven copies of Working Drawings for steel Structures and six copies of Working Drawings for other Structures. The submitted copies shall be clear and readable. Drawing dimensions shall be 8 1/2 by 11 inches, 11 by 17 inches, or 22 by 36 inches in size. One copy of the submitted Working Drawings will be returned to the Contractor after processing. The Contractor shall submit such additional number of copies to the Engineer for processing that the Contractor would like to have returned.

The Contractor shall not submit 3D Construction Model data in paper format.

(2) Electronic Submittal - The Contractor shall submit electronic Working Drawings as required in 00170.08. The Contractor shall submit 3D Construction Model data in LandXML format or as directed by the Engineer.

(d) Processing Working Drawings and 3D Construction Models - The Engineer will process Working Drawings and 3D Construction Models as follows:

(1) Stamped Working Drawings - Stamped Working Drawings will be designated as "accepted", "accepted with comments", or "returned for correction" by the Engineer. If stamped Working Drawings are returned for correction by the Engineer, the Contractor shall address all comments and resubmit the stamped Working Drawings.

(2) Unstamped Working Drawings - Unstamped Working Drawings will be designated as "approved", "approved as noted", or "returned for correction" by the Engineer. If unstamped Working Drawings are returned for correction by the Engineer, the Contractor shall address all comments and resubmit the unstamped Working Drawings.

(3) 3D Construction Models - 3D Construction Models will be designated as "approved", "approved as noted", or "returned for correction" by the Engineer. If 3D Construction Models are returned for correction by the Engineer, the Contractor shall address all comments and resubmit the 3D Construction Models.

The Contractor shall not fabricate or construct any structural components until the stamped or unstamped Working Drawings are returned by the Engineer with a written designation of "accepted", "accepted with comments", "approved", or "approved as noted", as applicable for the Working Drawings.

The Contractor shall not begin construction activities that will utilize a 3D Construction Model until the Engineer has processed the model and designated it as "approved" or "approved as noted".

The Engineer's processing of the Working Drawings and 3D Construction Models does not amend any contractual obligations of the parties.

The Engineer will process and return Working Drawings and 3D Construction Models within 21 Calendar Days (65 Calendar Days if Railroad approval is required) after receipt by the Engineer. If the Engineer fails to return such drawings or models within this period of time, the Engineer will consider granting a Contract Time extension according to 00180.80. If the Contractor is required

to resubmit Working Drawings or 3D Construction Models to the Engineer, the Engineer will process and return the Working Drawings or 3D Construction Models within 21 Calendar Days (65 Calendar Days if Railroad approval is required) after receipt of the resubmitted Working Drawings or 3D Construction Models by the Engineer.

00150.37 Equipment Lists and Other Submittals - The Contractor shall submit Equipment lists, and other required submittals for approval by the Engineer. The Engineer will respond to requests for approval within 21 Calendar Days (65 Calendar Days if Railroad approval is required) after receipt by the Engineer unless otherwise specified in the Section of the Specifications requiring such approval.

00150.40 Cooperation and Superintendence by the Contractor - The Contractor is responsible for full management of all aspects of the Work, including superintendence of all Work by Subcontractors, Suppliers, and other providers. The Contractor shall appoint a single Superintendent and may also appoint alternate Superintendents as necessary to control the Work. The form of appointment of the alternate shall state, in writing, the alternate's name, duration of appointment in the absence of the Superintendent, and scope of authority. The Contractor shall:

- Provide for the cooperation and superintendence on the Project by:
  - Furnishing the Engineer all data necessary to determine the actual cost of all or any part of the Work, added Work, or Changed Work.
  - Allowing the Engineer reasonable access to the Contractor's books and records at all times. To the extent permitted by public records laws, the Engineer will make reasonable efforts to honor the Contractor's request for protection of confidential information.
  - Keeping one complete set of Contract Documents on the Project Site at all times, available for use by all the Contractor's own organization, and by the Engineer if necessary.
- Appoint a single Superintendent, and any alternate Superintendent, who shall meet the following qualifications:
  - Appointees shall be competent to manage all aspects of the Work.
  - Appointees shall be from the Contractor's own organization.
  - Appointees shall have performed similar duties on at least one previous project of the size, scope and complexity as the current Contract.
  - Appointees shall be experienced in the types of Work being performed.
  - Appointees shall be capable of reading and thoroughly understanding the Contract Documents.
- The appointed single Superintendent, or any alternate Superintendent, shall:
  - Be present for all On-Site Work, regardless of the amount to be performed by the Contractor, Subcontractors, Suppliers, or other providers, unless the Engineer provides prior approval of the Superintendent's or alternate Superintendent's absence.
  - Be equipped with a two-way radio or cell phone capable of communicating throughout the Project during all the hours of Work on the Project Site and be available for communication with the Engineer.
  - Have full authority and responsibility to promptly execute orders or directions of the Engineer.
  - Have full authority and responsibility to promptly supply the Materials, Equipment, labor, and Incidentals required for performance of the Work.
  - Coordinate and control all Work performed under the Contract, including, without limitation, the Work performed by Subcontractors, Suppliers, and owner/operators.
  - Diligently pursue progress of the Work according to the schedule requirements of Section 00180.

- Cooperate in good faith with the Engineer, Inspectors, and other contractors in performance of the Work.
- Provide all assistance reasonably required by the Engineer to obtain information regarding the nature, quantity, and quality of any part of the Work.
- Provide access, facilities and assistance to the Engineer in establishing such lines, grades and points as the Engineer requires.
- Carefully protect and preserve the Engineer's marks and stakes.

Any Superintendent or alternate Superintendent who repeatedly fails to follow the Engineer's written or oral orders, directions, instructions, or determinations, shall be subject to removal from the Project.

If the Contractor fails or neglects to provide a Superintendent, or an alternate Superintendent, and no prior approval has been granted, the Engineer has the authority to suspend the Work according to 00180.70. Any continued Work by the Contractor, Subcontractors, Suppliers, or other providers may be subject to rejection and removal. The Contractor's repeated failure or neglect to provide the superintendence required by these provisions constitutes a material breach of the Contract, and the Engineer may impose any remedies available under the Contract, including, but not limited to, Contract termination.

00150.50 Cooperation with Utilities:

(a) General - Unless otherwise specified in the Special Provisions or on the Plans, existing Utilities requiring adjustment may be adjusted by the Utility before, during, or after Project construction. "Adjustment of Utilities" shall mean the alteration, improvement, connection, disconnection, relocation, or removal of existing Utility lines, facilities, or systems in temporary or permanent manner.

(b) Agency Responsibilities - Before Bids are received, the Agency will make preliminary arrangements for planned Adjustment of Utilities. The Agency will list in the Special Provisions the estimated completion dates or times for adjustment work by the Utility owner, and will include a general statement describing any relocation. The Plans will not normally show the anticipated new location of Utilities that have been or will be adjusted.

(c) Contractor's Responsibilities - The Contractor shall:

- Follow applicable rules adopted by the Oregon Utility Notification Center;
- Contact Utility owners during Bid preparation and after the Contract is awarded to verify all Utilities' involvement on the Project Site;
- Coordinate Project construction with the Utilities' planned adjustments, take all precautions necessary to prevent disruption of Utility service, and perform its Work in the manner that results in the least inconvenience to the Utility owners;
- Include all Utility adjustment work, whether to be performed by the Contractor or the Utilities, on the Contractor's Project Work schedule submitted under 00180.41;
- Protect from damage or disturbance any Utility that remains within the area in which Work is being performed. Maintain and re-establish location marks according to OAR 952-001-0090(2)(a). Coordinate re-establishment of the location marks with the associated Utility;
- Not disturb an existing Utility if it requires an unanticipated adjustment, but shall protect the Utility from damage or disturbance and promptly notify the Engineer;
- Determine the exact location before excavating within the reasonable accuracy zone according to OAR 952-001-0090(2)(c);

- Backfill any exposed Utilities as recommended and approved by the Utility representative. Obtain Utility locate warning tape from the Utility and replace damaged or removed warning tape. Utility locate warning tape may not be present at all existing Utilities;
- Stake, place warning tape, and maintain no work limits around critical Utility facilities as shown or directed by the Engineer and the Utility;
- In addition to the notification required in OAR 952-001-0090(5), notify the Engineer and the Utility as soon as the Contractor discovers any previously unknown Utility conflicts or issues. Contrary to the OAR, stop excavating until directed by the Engineer and allow the Utility a minimum of two weeks to relocate or resolve the previously unknown Utility issues; and
- Report to the Engineer any Utility owner who fails to cooperate or fails to follow the planned Utility adjustment.

Subject to the Engineer's approval, the Contractor may adjust the Utilities by asking the Utility owners to move, remove, or alter their facilities in ways other than as shown on the Plans or in the Special Provisions. The Contractor shall conduct all negotiations, make all arrangements, and assume all costs that arise from such changes.

(d) Delays - If the Contractor complies with 00150.50(c), and if Utility adjustments are completed later than the date specified in the Special Provisions, thus causing Project completion to be delayed (provide notification under 00180.60), additional Contract Time will be considered under 00180.80, and additional compensation, if applicable, will be considered under 00195.40.

(e) Notification - Unless otherwise specified in the Special Provisions, the Project is located within the area served by the Oregon Utility Notification Center, which operates a Utilities notification system for notifying owners of Utilities about Work being performed in the vicinity of their facilities. The Contractor shall notify owners of Utilities prior to the performance of Work in the vicinity of their facilities. The Utilities notification system telephone number is 811 or 1-800-332-2344.

The Contractor shall comply with the rules of the Oregon Utility Notification Center, OAR 952-001-0010 through OAR 952-001-0090, and ORS 757.993. The Contractor may contact the Oregon Utility Notification Center at 503-232-1987 about these rules.

00150.55 Cooperation with Other Contractors - The Agency reserves the right to perform other work on or near the Project Site, including, without limitation, any Materials site, with forces other than those of the Contractor.

If such work takes place on or near the Project Site, the Contractor shall have the following obligations:

- The Contractor shall coordinate Work with other contractors or forces.
- The Contractor shall cooperate in good faith with all other contractors or forces.
- The Contractor shall perform the Work specified in the Contract in a way that will minimize interference and delay for all forces involved.
- The Contractor shall place and dispose of the Materials being used so as not to interfere with the operations of other forces.
- The Contractor shall join the Work with that of other forces in a manner acceptable to the Engineer or the Agency, and shall perform it in the accepted sequence with the work of the other force.

The Engineer will resolve any disagreements under this Subsection that may arise among the Contractor and other work forces, or between the Contractor and the Agency. The Engineer's decision in these matters is final, as provided in 00150.00.

When the schedules for Work of the Contractor and the work of other forces overlap, each contractor involved shall submit a current, realistic progress schedule to the Engineer. Before the Engineer accepts the schedule, each party shall have the opportunity to review all schedules. After this review and any necessary consultations, the Engineer will determine acceptable schedules.

The Contractor waives any right it may have to make claims against the Agency for any damages or claims that may arise because of inconvenience, delay, or loss due solely to the presence of other contractors working on or near the Project Site.

If the Contract gives notice of work to be performed by other forces that may affect the Contractor's Work under the Contract, the Contractor shall include any costs associated with coordination of the Work in the appropriate Pay Item or as a portion of a Pay Item.

In an emergency, the Contractor most immediately able to respond may repair a facility or Utility of another contractor in order to prevent further damage to the facility, Utility, or other Structure as a result of the emergency.

00150.60 Construction Equipment Restrictions:

(a) Load and Speed Restrictions for Construction Vehicles and Equipment - The Contractor shall comply with legal weight and speed restrictions when moving Materials or Equipment beyond the limits of the Project Site.

The Contractor shall control vehicle and Equipment loads and speeds within the Project Site according to the following restrictions, unless the Special Provisions provide otherwise:

- The Contractor shall restrict loads and speeds as necessary to avoid displacement or loss of Materials on Subgrades and Aggregate Bases.
- The Contractor shall restrict weights to legal loads, and shall travel at speeds of no more than 45 mph or the posted construction speed, whichever is less, on treated Bases, Pavement, or wearing Courses.
- The Contractor shall not cross Bridges or other Structures with Equipment or vehicles exceeding the legal load limit without prior written permission of the Engineer. The Contractor shall make any such request in writing, describing the loading details and the arrangement, movement, and position of the Equipment on the Structure. The Contractor shall comply with any restrictions or conditions included in the Engineer's written permission.

(b) Protection of Buried Items - The Contractor shall use temporary fill or other methods to avoid overload of pipes, box culverts, and other items that are covered, or to be covered, by fill or backfill.

(c) Responsibility for Damages - The Contractor shall assume responsibility for damages caused by excessive Equipment speed or loads while performing the Work, both inside and outside the Project Site. The Engineer's permission to cross Bridges and other Structures, according to 00150.60(a), will not relieve the Contractor from responsibility for load-caused damages.

00150.70 Detrimental Operations - The Contractor shall avoid operations whose methods, conditions, or timing may injure people or damage property or the Work. Damage may include, without limitation, staining surfaces with mud or asphalt or damaging Utilities and foundations. (See also 00150.60, 00150.75, and Section 00170.)

When any such damage occurs, the Engineer will determine if it is to be corrected by repair, replacement, or compensatory payment by the Contractor. If compensatory payment is required, the Engineer will determine the amount. Compensatory payment may be deducted from monies due or to become due to the Contractor under the Contract.

00150.75 Protection and Maintenance of Work During Construction - The Contractor shall protect and maintain the Work during construction and until Third Notification has been issued, unless otherwise provided in the Contract. For the purposes of this Subsection, "maintenance" shall include measures to prevent deterioration of Roadway and Structures at the Project Site, and to keep them in good condition at all times during the prosecution of the Work. The Contractor shall continuously allocate sufficient Equipment and workers to achieve such maintenance.

If the Contract requires the placement of a Course upon a previously constructed Course or Subgrade, the Contractor shall maintain the previous Course or Subgrade during all construction operations.

The Contractor shall include costs of protecting and maintaining the Work during construction in the unit prices bid for the various Pay Items. The Contractor will not be paid an additional amount for this Work, unless otherwise specified.

The Engineer will notify the Contractor of the Contractor's noncompliance with this Subsection. If the Contractor fails to remedy unsatisfactory protection or maintenance within 24 hours after receipt of such notice, the Engineer may proceed to remedy the deficiency, and deduct the entire cost from monies due or to become due the Contractor under the Contract.

00150.80 Removal of Unacceptable and Unauthorized Work - The Contractor shall correct or remove unacceptable Work and remove unauthorized work, as directed by the Engineer in writing. The Contractor shall replace such work with Work and Materials conforming to the requirements of the Contract.

For the purposes of this Subsection, "unauthorized work" shall include without limitation the following:

- Work that extends beyond lines shown on the Plans or otherwise established by the Engineer;
- Work that is contrary to the Engineer's instructions; and
- Work that is conducted without the Engineer's written authorization.

The Agency will not pay the Contractor for unacceptable Work, except as provided in 00150.25, or for unauthorized work. The Engineer may issue a written order for the correction or removal of such work at the Contractor's sole expense.

If, when ordered by the Engineer, the Contractor fails to correct or remove unacceptable Work or remove unauthorized work, the Engineer may have the correction, removal or removal and replacement, done by others and deduct the entire cost from monies due or to become due the Contractor under the Contract.

00150.90 Final Inspection:

(a) On-site Construction Work - The Engineer will inspect the Project at a time close to the completion of On-Site Work.

When all On-Site Work on the Project is completed, including, but not limited to, Change Order Work and Extra Work, the Engineer will issue Second Notification as specified in 00180.50(g).

Within 15 Calendar Days after the Engineer receives the Contractor's written notification that all punch list items, final trimming and cleanup according to 00140.90 have been completed, the Engineer will review the Project and notify the Contractor that all Work is complete, or will give the Contractor written instruction regarding incomplete or unsatisfactory Work.

(b) All Contract Work - The Engineer will issue the Third Notification when the Contractor has satisfactorily accomplished all of the following:

- The Contractor has completed all On-Site Work required under the Contract, including the punch list items from (a) above;
- The Contractor has removed all Equipment, other than that incorporated into the Work; and
- The Contractor has submitted all required certifications, bills, forms, warranties and other documents.

00150.91 Post-Construction Review - The Contractor or the Engineer may request a Post-Construction Review meeting, to be held at a time prior to issuance of Third Notification but not earlier than 45 Days following the date of Second Notification. The meeting may be held if agreed to by both parties. The party making the request will conduct the meeting, and will announce the time and place of the meeting at least 15 Days prior to the meeting date. The purpose of this meeting is to examine the Project for possible process improvements that may benefit future projects.

00150.95 Final Acceptance - After the Engineer completes Final Inspection of all Work and sends Third Notification to the Contractor, the Agency will acknowledge Final Acceptance. The Agency will notify the Contractor in writing of the date of Final Acceptance within 7 Calendar Days after Final Acceptance, or as soon thereafter as is practicable.

00150.96 Maintenance Warranties and Guarantees - Prior to Third Notification, the Contractor shall transfer to the Agency all unexpired manufacturers' warranties and guarantees for Materials and Equipment installed on the Project. Such warranties and guarantees shall recite that they are enforceable by the Agency.

00150.97 Responsibility for Materials and Workmanship:

(a) The Contractor shall perform the Work according to the terms, conditions, and requirements of the Contract.

(b) Whether before or after the Agency's acceptance of the Work, the Contractor shall be responsible for:

- Correcting or repairing any defects in, or damage to, the Work that results from the use of improper or defective materials or workmanship; or
- Replacing, in its entirety, the Work affected by the use of improper or defective materials or workmanship to the extent provided by law; and
- Correcting or repairing any Work, Materials, Structures, Existing Surfacings, Pavement, Utilities, or sites, including, without limitation, Wetlands, damaged or disturbed in that correction, repair, or replacement. (See 00170.80 to 00170.85.)

(c) Full or partial termination of the Contract under 00180.90 shall not relieve the Contractor of responsibility for completed or performed Work, or relieve the Contractor's Surety of the obligation for any just claims arising from the completed or performed Work.

Section 00160 - Source of Materials

00160.00 Definitions - The following definitions apply to Section 00160:

(a) Prospective Source - Agency-furnished Materials source, use of which by the Contractor is optional. The Agency makes no guarantee or representation, by implication or otherwise, of the land use status, quantity, quality, or acceptability of Materials available from it, except as may be stated in the Special Provisions.

(b) Mandatory Source - Agency-furnished Materials source, use of which by the Contractor is required.

(c) Blue Sheets - Prequalified products and submittals for qualification of electrical equipment and materials.

(d) Green Sheets - Conditionally prequalified products and submittals for conditional qualification of controller equipment.

(e) Red Sheets - Statewide list of certification exempt traffic management systems components pursuant to ORS 479.540 and OAR 918-261-0037.

00160.01 Notification of Source of Supply and Materials:

(a) All Materials - The Contractor shall notify the Engineer in writing of all proposed Materials sources of supply, including, without limitation, any steel or other fabricators within the following time frames:

- At least 15 Calendar Days before using or fabricating Materials, if the source is within the State; or
- At least 45 Calendar Days before using or fabricating Materials, if the source is outside the State

The Contractor shall identify if the material source is a DBE or non-DBE. For DBE Suppliers, the Contractor shall identify an estimated value of the materials to be supplied. For each committed DBE Supplier, the Contractor shall submit a copy of the materials purchase order or supply agreement. For non-committed DBE suppliers, when the estimated value is over $10,000, the Contractor shall submit a copy of the materials purchase order or supply agreement.

For this purpose, a committed DBE firm is one that was identified by the Contractor to meet an assigned DBE goal, including DBE firms substituting for DBE firms committed as a condition of Contract Award.

(b) Prospective Source Materials - When given an option to use Prospective Sources of Materials to be incorporated into the Work, the Contractor shall notify the Engineer in writing of the option selected within 15 Calendar Days from date of Notice to Proceed. Otherwise, such Materials sources may become unavailable.

(c) Approval Required - Before allowing production or delivery of Materials to begin from any source, the Contractor must obtain the Engineer's approval. Approval to use any source does not imply that Materials from that source will be accepted. If approved sources do not provide Materials that meet Specifications, the Materials will be rejected. The Contractor will then be responsible for locating other sources and obtaining the Engineer's approval.

(d) Terms Required - The Contractor shall comply with 00170.07.

00160.05 Qualified Products List (QPL) - The QPL is a listing of manufactured products available on the market (shelf items) that ODOT has evaluated and found suitable for a specified use in highway construction. The QPL is available from ODOT's Construction Section website (see 00110.05(e)).

The most current published PDF version of the QPL on ODOT's Construction Section website at the time of Advertisement is the version in effect for the Project. When the Contract specifies the use of the QPL, unless specified as the subject of an exemption per ORS 279C.345, the Agency may approve for use a conditionally qualified product, a product qualified for inclusion in a later edition of the QPL, or other equivalent product that meets the requirements of the QPL, following the Standard Guidelines for Product Review, if the Agency finds the product acceptable for use on the Project.

Use of listed products shall be restricted to the category of use for which they are listed. The Contractor shall install all products as recommended by the manufacturer. The Contractor shall replace qualified products not conforming to Specifications or not properly handled or installed at no additional cost to the Agency.

00160.07 Electrical Equipment and Materials - The Blue Sheets and Green Sheets are a listing of manufactured products available on the market (shelf items) that ODOT has evaluated and found suitable for use as electrical and controller equipment and materials for highway construction. The Blue Sheets and Green Sheets are available on the ODOT Traffic-Standards website (see 00110.05(e)). The most current version of the Blue Sheets and Green Sheets on the date of Advertisement is the version in effect for the Project.

When the Contract specifies the use of the Blue Sheets and Green Sheets, unless specified as the subject of an exemption per ORS 279C.345, the Agency may approve for use a product qualified for inclusion in a later edition of the Blue Sheets and Green Sheets or other equivalent product that meets the requirements of the Blue Sheets, following the Blue Sheet Qualification/Specification Information, or the Green Sheets, following the ODOT *Standard Specification for Microcomputer Signal Controller* and errata information, if the Agency finds the product acceptable for use on the Project.

Use of listed products shall be restricted to the category of use for which they are listed. The Contractor shall install all products as recommended by the manufacturer. The Contractor shall replace qualified products not conforming to the Specifications or not properly handled or installed at no additional cost to the Agency.

00160.10 Ordering, Producing, and Furnishing Materials - The Contractor shall not place orders for or produce full quantities of Materials anticipated to be required to complete the Work until the Work has advanced to a stage that allows the quantities to be determined with reasonable accuracy. Upon request, the Engineer will notify the Contractor in writing of the quantities required. Quantity estimates by the Engineer before this notification are only approximate.

(a) Contractor's Duties - In purchasing, producing, or delivering Materials, the Contractor shall take into account the following:

- Kind of work involved;
- Amount of work involved;
- Time required to obtain Materials; and
- Other relevant factors.

(b) Approval of Quantity of Materials Ordered - Materials quantities shown on the Plans, or indicated by quantities and Pay Items, are subject to change or elimination. Therefore, the Contractor is cautioned to order or produce Materials only after having received the approval of the Engineer. The Contractor is responsible for payment for excess Materials delivered to the Project

Site or storage sites without advance authorization from the Engineer. Unless otherwise specified in the Contract, the Agency will not be responsible for:

- Materials the Contractor may deliver or produce in excess of Contract requirements;
- Extra expense the Contractor may incur because Materials were not ordered or produced earlier; or
- The Contractor's expenses related to Materials ordered by the Contractor that are not subsequently approved for use.

Excess Materials ordered or produced by the Contractor without approval of the Engineer may be purchased by the Agency at the sole discretion of the Agency. (See 00195.80.)

00160.20 Preferences for Materials:

(a) Buy America - If federal highway funds are involved on the Project, the Contractor shall limit the quantity of foreign Materials incorporated into the Work as follows. Section 635.410 of Title 23, Code of Federal Regulations, and the Intermodal Surface Transportation Efficiency Act require that all iron or steel manufacturing processes, including, without limitation, the casting of ingots, for iron or steel Materials permanently incorporated into the Project shall occur in the United States, unless the cost of foreign-origin iron or steel Materials does not exceed one-tenth of one percent (0.1%) of the Contract Amount or $2,500, whichever is greater. The Contractor shall not incorporate foreign-origin iron or steel Materials in excess of this amount into the Project. All foreign-origin iron or steel Materials incorporated in the Project in excess of the amount indicated above shall be removed and replaced with domestic iron or steel Materials at the Contractor's expense. For purposes of this Specification, the cost of foreign-origin iron or steel Materials shall be the value of the iron or steel products as of the date they are delivered to the Project Site.

Manufacturing processes include without limitation the application of coatings to finished iron or steel products or components. Coatings include epoxy coating, galvanizing, painting, and any other coating that protects or enhances the value of the steel or iron product or component.

The Contractor shall provide the Engineer with a Certificate of Materials Origin, on a form furnished by the Engineer, before incorporating any iron or steel products into the Project. Unless a Certificate of Materials Origin has been provided to the Engineer, the Materials shall be considered of foreign origin.

The Contractor shall retain manufacturers' certificates verifying the origin of all domestic iron or steel Materials for 3 years after the date of final payment for the Project, and shall furnish copies to the Engineer upon request.

(b) Buy Oregon - According to ORS 279A.120, the Contractor shall give preference to goods or services produced in Oregon if price, fitness, availability, and quality are equal. This provision does not apply to contracts financed wholly or in part by federal funds.

(c) Recycled Materials - According to ORS 279A.010, ORS 279A.125, ORS 279A.145, ORS 279A.150, and ORS 279A.155, and subject to the approval of the Engineer, the Contractor shall use recycled products to the maximum extent economically feasible.

00160.21 Cargo Preference Act Requirements - If federal highway funds are involved on the Project, the Contractor shall comply with the Cargo Preference Act and implementing regulations (46 CFR Part 381) for use of United States flag ocean vessels transporting materials or equipment acquired specifically for the Project. Strict compliance is required, including, but not limited to, the clauses in 46 CFR 381.7(a) and (b), which are incorporated by reference. The Contractor shall also include this provision in all subcontracts.

00160.30 Agency-Furnished Materials - Unless otherwise specified in the Special Provisions, Materials listed as Agency-furnished will be available to the Contractor free of charge.

The Contractor shall be responsible for all Materials furnished by the Agency and shall pay all demurrage and storage charges. The Contractor shall replace at its expense Agency-furnished Materials lost or damaged due to any cause.

The locations at which Agency-furnished Materials are available will be specified in the Special Provisions. If the locations are not listed in the Special Provisions, the Agency-furnished Materials will be furnished to the Contractor at the Project Site. In either case, all costs of handling, hauling, unloading, and placing Agency-furnished Material shall be considered included in the price paid for the Pay Item involving such Material.

All Agency-furnished Materials not incorporated into the Work remain the property of the Agency. The Contractor shall deliver such Materials as directed by the Engineer.

00160.40 Agency-Furnished Sources - The Agency may list in the Special Provisions, or show on the Plans, Borrow pits or Aggregate sources from which the Contractor may, or shall, obtain Materials. These sources will be identified and referred to as Prospective or Mandatory Sources. A development plan will be included in Section 00235 of the Special Provisions when such sources are shown on the Plans.

(a) Working in a Different Area of the Materials Source - If the Contractor desires to work in a different area of the Materials source than that shown on the development plan, the Contractor must submit a written request stating the reasons for the requested change. If a new land use permit, development plan, or reclamation plan is needed, the Contractor must submit it and obtain approval from the Engineer before starting work in any area other than that shown on the Plans. Approval for work in a different area will not entitle the Contractor to any added compensation or adjustment of Contract Time.

The Agency will not be responsible for the availability of sources other than as stated in the Special Provisions. If the Contractor has given notice of intent to use, but does not use the source(s) on the Project, the Contractor shall reimburse the Agency for any costs the Agency incurs in making such source(s) available.

(b) Cost of Sources - Unless otherwise specified in the Special Provisions, any Prospective or Mandatory Source will be provided by the Agency for use without payment of royalty or other charge. (See 00160.50.)

(c) Exhaustion of Sources - If the Engineer determines that the quantities of specified Materials that can be produced from a Mandatory Source are insufficient for the Work, and it becomes necessary to move to another source, the Agency will pay for the reasonable cost of moving the plant to, and erecting it at, a new approved source from which specified Materials can be produced. Adjustment in hauling costs, other costs, and Contract Time will be determined as provided in 00140.30.

No allowance, reimbursement, compensation, or adjustment will be made for changes in the use of sources, or for moving from one source to another, except as provided above.

00160.50 Agency-Controlled Land; Limitations and Requirements:

(a) General - The Contractor shall have no property rights in, or right of occupancy on, Agency-Controlled Land. Nor shall the Contractor have the right to sell, use, remove, or otherwise

dispose of any material from Agency-Controlled Land, areas, or property, except as specified or by the written authorization of the Engineer.

Unless authorized in the Contract, the Contractor shall not disturb any material within Rights-of-Way without written authorization from the Engineer.

Unless otherwise specified in the Contract, the ownership of all materials originating on Agency-Controlled Lands will at all times vest in, and remain within the control of, the Agency.

(b) Waste, Excess, and By-Product Materials - All waste, excess, and by-product materials, collectively referred to in this Subsection as "By-Products", from the manufacture or production of Aggregate Materials from Agency-Controlled Lands shall remain Agency property. Unless otherwise ordered by the Engineer in writing, By-Products shall be placed as required by the development plan:

- In stockpiles at designated locations;
- At locations and in shapes that are readily accessible; and
- In such a manner as to avoid fouling areas containing useable materials, or interfering with future plant setups to use materials from the property.

The Agency will not compensate the Contractor for handling and stockpiling By-Products according to the development plan requirements. If by written order the Engineer directs the Contractor to stockpile or place designated By-Products at alternate sites, the By-Products designated shall be loaded, hauled, and placed as directed, and this work will be paid for according to 00195.20.

00160.60 Contractor-Furnished Materials and Sources:

(a) General - The Contractor shall furnish, at its own expense, all products and Materials required for the Project from sources of its own choosing, unless such sources have been specified in the Special Provisions or Plans as Prospective or Mandatory Sources.

(b) Acquisition of Sources - The Contractor shall acquire, at its own expense, the rights of access to, and the use of, all sources the Contractor chooses that are not Agency-controlled and made available by the Agency to the Contractor.

(c) Additional Requirements - Except for continuously-operated commercial sources, Work shall not begin, nor will any Materials be accepted by the Engineer, until the Contractor has:

(1) Given to the Engineer a copy of permits from, or proof that permits are not required from:

- The Department of Geology and Mineral Industries, as required under ORS 517.790;
- The Department of State Lands, as required under ORS 196.815 (when removing material from the bed or banks of any waters or from any Wetland); and
- Local governmental authorities having jurisdiction over land use at the source location.

(2) Furnished to the Engineer written approval of the property owner, if other than the Contractor, for the Contractor's proposed plans of operation in, and reclamation of, the source.

00160.70 Requirements for Plant Operations - Before operating mixing plants, Rock crushers, or other Equipment, the Contractor shall provide the Engineer copies of all applicable discharge permits for noise, air contaminants, and water pollutants from DEQ or applicable local jurisdictions, or a letter from DEQ or the local jurisdiction stating that no permits are required for the use of the Equipment and sites.

00160.80 Requirements for Sources of Borrow and Aggregate - The Contractor shall conduct operations according to all applicable federal, State, and local laws (including, without limitation, ORS Chapter 517 and OAR 632-030) when developing, using, and reclaiming all sources of Borrow material and Aggregate. The Contractor shall provide erosion control at Borrow sources that are not within the Project Site. The Contractor shall not operate in Wetlands except as allowed by permit. The Contractor shall comply with all requirements for pollution and sediment control, including, without limitation, the National Pollutant Discharge Elimination System where applicable.

Except for continuously-operated commercial sources, the Contractor shall also conform to the following:

(a) If a natural growth of trees or shrubs is present, preserve a border of such to conceal land scars.

(b) Excavate Borrow sources and Aggregate sources, except for those in streams and rivers, to provide:

- Reasonably uniform depths and widths;
- Natural drainage so no water stands or collects in excavated areas, when practicable;
- Slopes trimmed to blend with the adjacent terrain upon completion of operations;
- Slopes covered with native Soil, or acceptable plant rejects to support plant growth, if required by Specifications, Plans, or permits; and
- A vegetative cover that blends with the adjacent natural growth.

(c) Excavate in quarries so that:

- Faces will not be steeper than vertical (no overhang);
- Vertical faces conform to Oregon OSHA standards, Division 3, and as shown on an approved development plan;
- Floors or benches are excavated to a uniform Slope free of depressions and will drain and not interfere with the downland owner's property; and
- Upon completion, the quarry is left appearing neat and compatible with surrounding terrain.

(d) Obliterate haul roads specifically built for access to sources, and restore the areas disturbed by these roads as nearly as practicable to the conditions that existed before the roads were built, unless otherwise directed by the landowner or regulatory body.

Section 00165 - Quality of Materials

Description

00165.00 General - The Contractor shall incorporate into the Work only Materials conforming to the Specifications and approved by the Engineer. The Contractor shall incorporate into the Work only manufactured products made of new materials unless otherwise specified in the Contract. The Agency may require additional testing or retesting to determine whether the Materials or manufactured products meet Specifications.

Materials or manufactured products not meeting the Specifications at the time they are to be used are unacceptable and must be removed immediately from the Project Site, unless otherwise directed by the Engineer.

00165.01 Rejected Materials - The Engineer may reject any Materials that appear to be defective (see 00150.25) or that contain asbestos. The Contractor shall not incorporate any rejected Materials into the Work. Rejected Materials whose defects have been corrected may not be incorporated into the Work until the Engineer has approved their use. The Engineer may order the removal and replacement by the Contractor, at the Contractor's expense, of any defective Materials. (See also 00150.20.)

00165.02 Materials Conformance and Quality Compliance Documents - For purposes of this Section, "Materials Conformance Documents" means the Contractor's quality-control, the Agency's verification, and the independent assurance test results, and the identity of the testing facility, as specified in the ODOT *Manual of Field Test Procedures* (MFTP), unless otherwise specified in the Contract.

For purposes of this Section, "Quality Compliance Documents" means those documents specified in ODOT's *Nonfield-Tested Materials Acceptance Guide*, unless otherwise specified in the Contract.

00165.03 Testing by Agency - When testing Materials, the Agency will conduct the tests in its central laboratory, field laboratories, or other laboratories designated by the Engineer, even though certain AASHTO, ASTM, and other materials specifications may require testing at the place of manufacture. Results of the Agency's tests will be made available to the Contractor.

00165.04 Costs of Testing - When the Contract requires that the Agency perform the testing, the testing will be at the Agency's expense. The Agency will pay the cost of Contractor-requested source-review tests on unprocessed Aggregates from no more than two sources for each Project, and on no more than three unprocessed samples from each source. Additional source-review tests performed at the Contractor's request shall be at the Contractor's expense.

Unless otherwise provided in the Contract, all testing required to be performed by the Contractor will be at the Contractor's expense.

Provisions and Requirements

00165.10 Materials Acceptance Guides - Unless otherwise specified elsewhere in the Contract, Materials will be accepted according to the following guides:

(a) Field-Tested Materials - Field-tested Materials will be accepted according to the MFTP. The MFTP is published once per year and is available from the ODOT Construction Section; 800 Airport Road SE; Salem, OR 97301-4798; phone 503-986-3000. The MFTP is also available on the ODOT Construction Section website (see 00110.05(e)). The most current version of the MFTP on the date of Advertisement is the version in effect for the Project.

(b) Nonfield-Tested Materials - Nonfield-tested Materials will be accepted according to the ODOT *Nonfield Tested Materials Acceptance Guide* (NTMAG), unless otherwise specified in the Contract. The NTMAG is available on the ODOT Construction Section website (see 00110.05(e)). The most current version of the NTMAG on the date of Advertisement is the version in effect for the Project.

00165.20 Materials Specifications and Test Method References - References to materials specifications and test methods of ODOT, WAQTC, AASHTO, ASTM, other governmental agencies, or other recognized organizations mean those officially adopted and in current use by the agency or organization on the date of Advertisement.

If there are conflicting references, or if no reference is made to materials specifications, sampling and testing frequencies, or test method, the Engineer will resolve any discrepancies between these documents in the following orders of precedence:

Field-Tested Materials:

- Contract Change Orders;
- Special Provisions;
- ODOT *Laboratory Manual of Test Procedures*;
- MFTP; and
- Standard Specifications.

Nonfield-Tested Materials:

- Contract Change Orders;
- Special Provisions;
- ODOT *Laboratory Manual of Test Procedures*; and
- Standard Specifications.

Material test methods:

- ODOT;
- WAQTC;
- AASHTO;
- ASTM;
- Other recognized national organizations, such as ANSI, AWPA, IMSA, ISSA, and UL; and
- Industry standards in the location where the Work is being performed.

Sampling and testing frequencies:

- Contract Change Orders;
- Special Provisions;
- MFTP; and
- Standard Specifications.

If the Contractor identifies conflicting references or if no reference is made, the Contractor shall immediately request a clarification from the Engineer.

00165.30 Field-Tested Materials:

(a) Contractor's Duties - The Contractor shall:

- Furnish Materials of the quality specified in the Contract;
- Provide and administer a quality control program as described in the Quality Assurance Program portion of the MFTP. Upon request, the Contractor shall provide to the Engineer the names, telephone numbers, and copies of certifications for all personnel performing field testing; and
- Perform other testing as required by the Contract.

(b) Types of Tests - The types of tests and testing methods generally required by ODOT are described in the MFTP.

(c) Acceptance of Field-Tested Materials - The Contractor's test results for field-tested Materials will be verified by the Agency according to the Quality Assurance program outlined in the MFTP. If the Agency's QA test results verify the Contractor's results, the Materials will be analyzed for acceptance according to one of the following methods before the Engineer will accept them for incorporation into the Work:

- Statistically, according to 00165.40, to determine "Pay Factors" for produced Aggregate;
- Statistically, according to 00165.40, to determine "Composite Pay Factors" for mixtures; or
- Other methods determined by the Engineer.

If the Agency's verification test results do not verify the Contractor's test results, the Agency may require additional testing to determine whether the Materials meet Specifications. The Contractor shall perform additional testing or provide samples to the Agency for testing as directed. If the Materials do not meet Specifications, the Contractor shall reimburse the Agency for the cost of the additional testing, which may be deducted from monies due or to become due the Contractor under the Contract. Incorporated Materials that do not meet Specifications will be evaluated according to 00165.01 and 00150.25. If the Materials meet Specifications, the Agency will pay the cost for the additional testing.

00165.35 Nonfield-Tested Materials - The Contractor shall furnish Materials meeting Specifications, along with all Materials Conformance and Quality Compliance Documents.

(a) Test Results Certificate - The certificate shall:

- Be from the manufacturer, verifying that the Material furnished has been sampled and tested and the test results meet the Specifications.
- Include, or be accompanied by, a copy of the specified test results (ODOT, AASHTO, ASTM, UL or other).
- Identify the testing agency and the representative responsible for the test results.
- Permit positive determination that Material delivered to the Project is the same Material covered by the test results.
- Be delivered to the Engineer with the shipment of the material.

(b) Quality Compliance Certificate - The certificate shall be from the manufacturer and shall:

- Verify that the Material meets the Specifications, and identify by number the specified test methods used, (ODOT, AASHTO, ASTM, UL, or other)

- Permit positive determination that Material delivered to the Project is the same Material covered by the certificate,
- Be delivered to the Engineer with the shipment of the Material, or be an identification plate or mark, decal, sticker, label, or tag attached to the container or Material,

(c) Equipment List and Drawings - These consist of lists of proposed Equipment and Materials, such as:

- Shop drawings
- Material lists
- Equipment lists
- Catalog description sheets
- Manufacturer's brochures

Submit these lists to the Engineer for review of conformance with the Specifications.

(d) Certificate of Origin of Steel Materials - When specified, complete this document (ODOT Form 734-2126) as required by 00160.20 for Federal-aid projects.

Materials will be subject to acceptance testing if the Engineer so elects. The Engineer may reject damaged or non-specification materials regardless of the Materials Conformance Documents furnished.

00165.40 Statistical Analysis - When 00165.30(c) or 00165.50 applies, the Contractor shall divide the Materials into lots and sublots, randomly sample and test them as required, and analyze the results statistically to determine whether the Materials conform to the Specifications.

All acceptance test results of lots and sublots will be analyzed collectively using the Quality Level Analysis procedure set out in this Subsection. This procedure shall not be used for a lot with less than three sublots. Sampling of Material for a lot that contains two or fewer sublots shall be increased to obtain at least three sublots. The Engineer has discretion to either accept or reject lots originating with two or fewer sublots, even after sampling is increased.

(a) Lot - A lot is the quantity of Materials produced by a single process or JMF that is sampled, tested, and statistically evaluated, as specified in this Subsection.

(b) Sublot - A sublot is a portion of a lot, for which a sample test value may be normally obtained.

(c) Quality Level Analysis - Quality Level Analysis is a statistical procedure to determine, for each lot:

- The percentage of each constituent of the Materials meeting Specifications;
- The Pay Factor for each constituent; and
- The Composite Pay Factor, when specified.

(d) Pay Factor and Composite Pay Factor Computation - Procedures for determining the percent meeting Specifications, Pay Factors, and Composite Pay Factor for a lot of Materials are as follows:

(1) Compute lot arithmetic mean ($\overline{X}$) for each constituent:

$$\overline{X} = \frac{\Sigma X}{n}$$

Where ΣX = summation of sample test values
n = total number of samples

(2) Compute standard deviation (sd) for each constituent:

$$sd = \sqrt{\frac{\Sigma X^2 - n\overline{X}^2}{n-1}}$$

Where ΣX^2 = summation of the squares of each sample test value
$\overline{X}^2$ = square of the lot arithmetic mean

(3) Compute the upper quality index (Q_U) for each constituent:

$$Q_U = \frac{USL - \overline{X}}{sd}$$

Where USL (upper specification limit) is the target value plus allowable tolerance

(4) Compute the lower quality index (Q_L) for each constituent:

$$Q_L = \frac{\overline{X} - LSL}{sd}$$

Where LSL (lower specification limit) is the target value minus allowable tolerance

(5) From Table 00165-1, for each constituent, determine the percent within the upper specification limit (P_U) which corresponds to a given Q_U. If USL is 100% or is not specified, P_U will be 100.

(6) From Table 00165-1, for each constituent, determine the percent within the lower specification limit (P_L) which corresponds to a given Q_L. If LSL is 0 or not specified, P_L will be 100.

(7) Compute the quality level, or total percent within Specification limits (P_T), for each constituent:

$$P_T = (P_U + P_L) - 100$$

(8) Using the P_T from Step 7, determine the Pay Factor (PF) from Table 00165-2 for each constituent tested. A minimum PF of 1.00 will be used when all sublot test values are within the upper and lower Specification limits, regardless of the calculated PF.

(9) Compute the Weighted Pay Factor (WPF) for each constituent:

$$WPF = (PF) \times (f_i)$$

Where f_i = weighting factor listed in the Specifications for each constituent tested.

(10) Compute the Composite Pay Factor (CPF) for the lot and report the results to three decimal places.

$$CPF = \frac{\sum WPF}{\sum f_i}$$

Where $\sum WPF$ = sum of the weighted pay factors for each constituent

$\sum f_i$ = sum of the weighting factors listed in the Specifications

Table 00165-1

QUALITY LEVEL ANALYSIS BY THE STANDARD DEVIATION METHOD								
P_U or P_L PERCENT WITHIN LIMITS FOR POSITIVE VALUES OF Q_U or Q_L	UPPER QUALITY INDEX Q_U OR LOWER QUALITY INDEX Q_L							
	n = 3	n = 4	n = 5	n = 6	n = 7	n = 8	n = 9	n = 10 to n = 11
100	1.16	1.50	1.79	2.03	2.23	2.39	2.53	2.65
99	-	1.47	1.67	1.80	1.89	1.95	2.00	2.04
98	1.15	1.44	1.60	1.70	1.76	1.81	1.84	1.86
97	-	1.41	1.54	1.62	1.67	1.70	1.72	1.74
96	1.14	1.38	1.49	1.55	1.59	1.61	1.63	1.65
95	-	1.35	1.44	1.49	1.52	1.54	1.55	1.56
94	1.13	1.32	1.39	1.43	1.46	1.47	1.48	1.49
93	-	1.29	1.35	1.38	1.40	1.41	1.42	1.43
92	1.12	1.26	1.31	1.33	1.35	1.36	1.36	1.37
91	1.11	1.23	1.27	1.29	1.30	1.30	1.31	1.31
90	1.10	1.20	1.23	1.24	1.25	1.25	1.26	1.26
89	1.09	1.17	1.19	1.20	1.20	1.21	1.21	1.21
88	1.07	1.14	1.15	1.16	1.16	1.16	1.16	1.17
87	1.06	1.11	1.12	1.12	1.12	1.12	1.12	1.12
86	1.04	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.01	1.02	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96
82	0.97	0.96	0.95	0.94	0.93	0.93	0.93	0.92
81	0.96	0.93	0.91	0.90	0.90	0.89	0.89	0.89
80	0.93	0.90	0.88	0.87	0.86	0.86	0.86	0.85
79	0.91	0.87	0.85	0.84	0.83	0.82	0.82	0.82
78	0.89	0.84	0.82	0.80	0.80	0.79	0.79	0.79
77	0.87	0.81	0.78	0.77	0.76	0.76	0.76	0.75
76	0.84	0.78	0.75	0.74	0.73	0.73	0.72	0.72
75	0.82	0.75	0.72	0.71	0.70	0.70	0.69	0.69
74	0.79	0.72	0.69	0.68	0.67	0.66	0.66	0.66
73	0.76	0.69	0.66	0.65	0.64	0.63	0.63	0.62
72	0.74	0.66	0.63	0.62	0.61	0.60	0.60	0.59
71	0.71	0.63	0.60	0.59	0.58	0.57	0.57	0.57
70	0.68	0.60	0.57	0.56	0.55	0.55	0.54	0.54
69	0.65	0.57	0.54	0.53	0.52	0.52	0.51	0.51
68	0.62	0.54	0.51	0.50	0.49	0.49	0.48	0.48
67	0.59	0.51	0.47	0.47	0.46	0.46	0.46	0.45
66	0.56	0.48	0.45	0.44	0.44	0.43	0.43	0.43
65	0.52	0.45	0.43	0.41	0.41	0.40	0.40	0.40
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34
62	0.43	0.36	0.34	0.33	0.32	0.32	0.32	0.32
61	0.39	0.33	0.31	0.30	0.30	0.29	0.29	0.29
60	0.36	0.30	0.28	0.27	0.27	0.27	0.26	0.26
59	0.32	0.27	0.25	0.25	0.25	0.24	0.24	0.24
58	0.29	0.24	0.23	0.22	0.21	0.21	0.21	0.21
57	0.25	0.21	0.20	0.19	0.19	0.19	0.18	0.18
56	0.22	0.18	0.17	0.16	0.16	0.16	0.16	0.16
55	0.18	0.15	0.14	0.14	0.13	0.13	0.13	0.13
54	0.14	0.12	0.11	0.11	0.11	0.11	0.10	0.10
53	0.11	0.09	0.08	0.08	0.08	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05
51	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: For negative values of Q_U or Q_L, P_U or P_L is equal to 100 minus the table value for P_U or P_L. If the value of Q_U or Q_L does not correspond exactly to a figure in the table, use the next higher figure.

Table 00165-1

QUALITY LEVEL ANALYSIS BY THE STANDARD DEVIATION METHOD							
P_U or P_L PERCENT WITHIN LIMITS FOR POSITIVE VALUES OF Q_U OR Q_L	UPPER QUALITY INDEX Q_U OR LOWER QUALITY INDEX Q_L						
	n = 12 to n = 14	n = 15 To n = 18	n = 19 to n = 25	n = 26 to n = 37	n = 38 to n = 69	n = 70 to n = 200	n = 201 to n = ∞
100	2.83	3.03	3.20	3.38	3.54	3.70	3.83
99	2.09	2.14	2.18	2.22	2.26	2.29	2.31
98	1.91	1.93	1.96	1.99	2.01	2.03	2.05
97	1.77	1.79	1.81	1.83	1.85	1.86	1.87
96	1.67	1.68	1.70	1.71	1.73	1.74	1.75
95	1.58	1.59	1.61	1.62	1.63	1.63	1.64
94	1.50	1.51	1.52	1.53	1.54	1.55	1.55
93	1.44	1.44	1.45	1.46	1.46	1.47	1.47
92	1.37	1.38	1.39	1.39	1.40	1.40	1.40
91	1.32	1.32	1.33	1.33	1.33	1.34	1.34
90	1.26	1.27	1.27	1.27	1.28	1.28	1.28
89	1.21	1.22	1.22	1.22	1.22	1.22	1.23
88	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.12	1.12	1.12	1.12	1.12	1.13	1.13
86	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.04	1.04	1.04	1.04	1.04	1.04	1.04
84	1.00	1.00	1.00	1.00	0.99	0.99	0.99
83	0.96	0.96	0.96	0.96	0.95	0.95	0.95
82	0.92	0.92	0.92	0.92	0.92	0.92	0.92
81	0.88	0.88	0.88	0.88	0.88	0.88	0.88
80	0.85	0.85	0.85	0.84	0.84	0.84	0.84
79	0.81	0.81	0.81	0.81	0.81	0.81	0.81
78	0.78	0.78	0.78	0.78	0.77	0.77	0.77
77	0.75	0.75	0.75	0.74	0.74	0.74	0.74
76	0.71	0.71	0.71	0.71	0.71	0.71	0.71
75	0.68	0.68	0.68	0.68	0.68	0.68	0.67
74	0.65	0.65	0.65	0.65	0.65	0.64	0.64
73	0.62	0.62	0.62	0.62	0.62	0.61	0.61
72	0.59	0.59	0.59	0.59	0.59	0.58	0.58
71	0.56	0.56	0.56	0.56	0.56	0.55	0.55
70	0.53	0.53	0.53	0.53	0.53	0.53	0.52
69	0.50	0.50	0.50	0.50	0.50	0.50	0.50
68	0.48	0.48	0.47	0.47	0.47	0.47	0.47
67	0.45	0.45	0.45	0.44	0.44	0.44	0.44
66	0.42	0.42	0.42	0.42	0.41	0.41	0.41
65	0.39	0.39	0.39	0.39	0.39	0.39	0.39
64	0.37	0.37	0.36	0.36	0.36	0.36	0.36
63	0.34	0.34	0.34	0.34	0.33	0.33	0.33
62	0.31	0.31	0.31	0.31	0.31	0.31	0.31
61	0.29	0.29	0.28	0.28	0.28	0.28	0.28
60	0.26	0.26	0.26	0.26	0.26	0.25	0.25
59	0.23	0.23	0.23	0.23	0.23	0.23	0.23
58	0.21	0.21	0.20	0.20	0.20	0.20	0.20
57	0.18	0.18	0.18	0.18	0.18	0.18	0.18
56	0.15	0.15	0.15	0.15	0.15	0.15	0.15
55	0.13	0.13	0.13	0.13	0.13	0.13	0.13
54	0.10	0.10	0.10	0.10	0.10	0.10	0.10
53	0.08	0.08	0.08	0.08	0.08	0.08	0.08
52	0.05	0.05	0.05	0.05	0.05	0.05	0.05
51	0.03	0.03	0.03	0.03	0.03	0.03	0.02
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: For negative values of Q_U or Q_L, P_U or P_L is equal to 100 minus the table value for P_U or P_L. If the value of Q_U or Q_L does not correspond exactly to a figure in the table, use the next higher figure.

Table 00165-2

PAY FACTOR	REQUIRED QUALITY LEVEL FOR A GIVEN SAMPLE SIZE (n) AND A GIVEN PAY FACTOR							
	n = 3	n = 4	n = 5	n = 6	n = 7	n = 8	n = 9	n = 10 to n = 11
1.05	100	100	100	100	100	100	100	100
1.04	90	91	92	93	93	93	94	94
1.03	80	85	87	88	89	90	91	91
1.02	75	80	83	85	86	87	88	88
1.01	71	77	80	82	84	85	85	86
1.00	68	74	78	80	81	82	83	84
0.99	66	72	75	77	79	80	81	82
0.98	64	70	73	75	77	78	79	80
0.97	62	68	71	74	75	77	78	78
0.96	60	66	69	72	73	75	76	77
0.95	59	64	68	70	72	73	74	75
0.94	57	63	66	68	70	72	73	74
0.93	56	61	65	67	69	70	71	72
0.92	55	60	63	65	67	69	70	71
0.91	53	58	62	64	66	67	68	69
0.90	52	57	60	63	64	66	67	68
0.89	51	55	59	61	63	64	66	67
0.88	50	54	57	60	62	63	64	65
0.87	48	53	56	58	60	62	63	64
0.86	47	51	55	57	59	60	62	63
0.85	46	50	53	56	58	59	60	61
0.84	45	49	52	55	56	58	59	60
0.83	44	48	51	53	55	57	58	59
0.82	42	46	50	52	54	55	57	58
0.81	41	45	48	51	53	54	56	57
0.80	40	44	47	50	52	53	54	55
0.79	38	43	46	48	50	52	53	54
0.78	37	41	45	47	49	51	52	53
0.77	36	40	43	46	48	50	51	52
0.76	34	39	42	45	47	48	50	51
0.75	33	38	41	44	46	47	49	50
REJECT	QUALITY LEVELS LESS THAN THOSE SPECIFIED FOR A 0.75							

NOTE: If the computed QUALITY LEVEL does not correspond exactly to a figure in the table, use the next lower value.

Table 00165-2

PAY FACTOR	REQUIRED QUALITY LEVEL FOR A GIVEN SAMPLE SIZE (n) AND A GIVEN PAY FACTOR						
	n = 12 to n = 14	n = 15 to n = 18	n = 19 to n = 25	n = 26 to n = 37	n = 38 to n = 69	n = 70 to n = 200	n = 201 to n = ∞
1.05	100	100	100	100	100	100	100
1.04	95	95	96	96	97	97	99
1.03	92	93	93	94	95	95	97
1.02	89	90	91	92	93	94	95
1.01	87	88	89	90	91	93	94
1.00	85	86	87	89	90	91	93
0.99	83	85	86	87	88	90	92
0.98	81	83	84	85	87	88	90
0.97	80	81	83	84	85	87	89
0.96	78	80	81	83	84	86	88
0.95	77	78	80	81	83	85	87
0.94	75	77	78	80	81	83	86
0.93	74	75	77	78	80	82	84
0.92	72	74	75	77	79	81	83
0.91	71	73	74	76	78	80	82
0.90	70	71	73	75	76	79	81
0.89	68	70	72	73	75	77	80
0.88	67	69	70	72	74	76	79
0.87	66	67	69	71	73	75	78
0.86	64	66	68	70	72	74	77
0.85	63	65	67	69	71	73	76
0.84	62	64	65	67	69	72	75
0.83	61	63	64	66	68	71	74
0.82	60	61	63	65	67	70	72
0.81	58	60	62	64	66	69	71
0.80	57	59	61	63	65	67	70
0.79	56	58	60	62	64	66	69
0.78	55	57	59	61	63	65	68
0.77	52	56	57	60	62	64	67
0.76	51	55	56	58	61	63	66
0.75	51	53	55	57	59	62	65
REJECT	QUALITY LEVELS LESS THAN THOSE SPECIFIED FOR A 0.75						

NOTE: If the computed QUALITY LEVEL does not correspond exactly to a figure in the table, use the next lower value.

00165.50 Statistical Acceptance Sampling and Testing - The Contractor shall sample and test Materials for acceptance, as required by the Contract. The Contractor may statistically evaluate test results for purposes of quality control or to predict a Pay Factor or Composite Pay Factor. The following apply:

(a) Statistical Acceptance - The Engineer will perform statistical analysis according to 00165.40 for acceptance and to determine a Pay Factor (PF) or Composite Pay Factor (CPF). The Engineer's determination of the PF or CPF shall be controlling.

(b) Pay Adjustments - As an incentive to produce quality Materials, the Engineer's acceptance will be based upon the following:

(1) Specification Materials - For Materials accepted by a PF, when all constituents of a Material have a PF of 1.00 or greater, that Material will be considered specification Materials. For Materials accepted by a CPF, all Materials with a CPF of 1.0000 or greater will be considered specification Materials. Materials with a CPF greater than 1.0000, when specified, may earn a CPF adjustment of greater than 1.0000, up to a maximum of 1.0500.

(2) Non-specification Materials - For Materials accepted by a PF, when any constituent of a Material has a PF of less than 1.00, that Material will be considered non-specification Material. For Materials accepted by a CPF, all Materials with a CPF less than 1.0000 will be considered non-specification Materials. A lot containing non-specification Materials will be evaluated as described in 00165.50(c).

(c) Non-specification Materials:

(1) Isolation of a Partial Sublot - The Engineer may isolate from a sublot or adjoining sublots any Material that the Contractor's test results show to be non-specification. The Contractor shall perform additional testing or provide samples to the Agency as directed. The Engineer will accept or reject the Material according to 00150.25.

(2) Isolation of an Entire Sublot - The Engineer may isolate a sublot or a series of sublots in which the Contractor's test results show the Material to be non-specification. The Contractor shall perform additional testing or provide samples to the Agency as directed. The isolated Material will be evaluated as a separate lot. The Engineer will accept or reject the Material according to 00150.25.

(3) A Lot-in-Progress - The Contractor shall shut down production when any of the following occurs:

- The CPF for a lot-in-progress drops below 1.0000, and the Contractor is taking no corrective action;
- The CPF is less than 0.7500; or
- Any constituent test is continually out of Specification limits, regardless of whether or not the CPF is below 0.7500.

The Contractor shall not resume production until the Engineer has determined that Specification Materials can be produced, and has given approval to resume.

(4) An Entire Lot - The Engineer may reject an entire lot of Materials with a CPF between 0.7500 and 1.0000, or may take action according to 00150.25.

For a lot of Material with a CPF below 0.7500, the Engineer will take one or more of the following actions:

a. Remain in Place - Allow Materials to remain in place with an appropriate price reduction that may range from 25% to 100% (no payment);

b. Corrective Work - Require corrective work, at the Contractor's expense, with an appropriate price reduction that may range from zero (full payment) to 100% (no payment); or

c. Remove and Replace - Require complete removal and replacement with Specification Materials. No payment will be made for the rejected Materials, the cost of removal, or for the costs of sampling and testing.

00165.70 Use of Materials without Acceptable Materials Conformance Documents:

(a) General - The Contractor shall not incorporate Materials into the Project prior to submittal of Materials Conformance Documents acceptable to the Engineer. The Engineer may waive this requirement temporarily if Materials are necessary for immediate traffic safety.

(b) Materials Incorporated for Immediate Traffic Safety - If Materials are incorporated into the Project for immediate traffic safety before acceptable Materials Conformance Documents are available, no payment will be made for the value of the Materials, or the costs of incorporating them, until Materials Conformance Documents have been submitted to and approved by the Engineer, or the Materials are otherwise found through testing to comply with Specifications.

(c) Contractor's Request for Testing Assistance - If acceptable Materials Conformance Documents are not available, the Contractor may either have the necessary tests performed at a private laboratory or request in writing that the Engineer:

- Determine if the Agency or its agents can sample and test;
- Estimate the cost to the Contractor for the testing service; and
- Estimate the time required to obtain the test results.

The Engineer will provide this information to the Contractor in writing. If the Contractor requests the Engineer, in writing, to proceed, the Engineer will arrange for the sampling and testing, at the Contractor's expense. If these tests determine the Material complies with the Specifications, the Materials may be incorporated into the Project, or for Materials previously incorporated according to (b) above, payment will be authorized.

00165.75 Storage and Handling of Materials - The Contractor shall store and handle Materials so as to preserve their quality and fitness for incorporation into the Work. The Contractor shall restore all storage sites to their original condition according to 00140.90, or to comply with any applicable permits, orders, or agreements, at the Contractor's expense.

Stored Materials:

- Shall be readily accessible for inspection;
- May be stored on approved parts of the Right-of-Way; and
- May be stored on private property if written permission of the owner or lessor is obtained.

Measurement

00165.80 Measurement - No separate measurement will be made of Work performed under this Section.

Payment

00165.90 Incidental Basis - No separate or additional payment will be made for sampling, testing, certification, or other associated Work performed under this Section, whether performed by the Contractor, manufacturer, producer or Supplier. No payment will be made for providing quality control personnel.

00165.91 Fabrication Inspection Expense - Fabrication of certain items outside of the State creates additional shop and plant inspection expense to the Agency. It is impractical, and extremely difficult, to determine the actual additional expenses incurred. Therefore, each time that inspection by or on behalf of the Agency is necessary, payment to the Contractor will be reduced by an amount computed at the following rates:

Zone	Place of Fabrication	Reduction in Payment
1	All of State of Oregon, and those portions of adjacent states within 50 airline miles of the Oregon border	$0
2	Outside of Zone 1, and up to 300 airline miles from the Oregon border	$200 per Calendar Day
3	Outside of Zone 2, up to 3,000 airline miles from the Oregon border, and within the continental United States.	Round trip coach airfare from Portland, Oregon plus $200 per Calendar Day
4	Outside of Zone 3, or outside of the continental United States.	Round trip coach airfare from Portland, Oregon plus $250 per Calendar Day

Calendar Day charges begin on the first day the Agency's Inspector begins travel to begin work at the fabrication site, and continue without interruption through the final day of travel back to the State. The Contractor will be notified in writing of the beginning and ending dates of the Calendar Days used in computing payment reduction.

This Subsection applies to all fabricated items or manufactured Materials that are inspected by or on behalf of the Agency, which include, but are not limited to:

- Structural steel fabrication;
- Prestressed concrete members;
- Precast concrete;
- Signs;
- Preservative treatment of wood products;
- Epoxy coating of reinforcing steel; and
- Other items specifically identified in the Specifications as requiring fabrication site or in-plant inspection by the Agency.

Section 00170 - Legal Relations and Responsibilities

Description

00170.00 General - The Contractor shall comply with all laws, ordinances, codes, regulations and rules (collectively referred to as "Laws" in this Section) that relate to the Work or to those engaged in the Work. Where the provisions of the Contract are inconsistent or in conflict, the Contractor shall comply with the more stringent standard.

The Contractor shall indemnify, defend, and hold harmless the Agency and its representatives from liability arising from or related to the violation of Laws by those engaged in any phase of the Work. This provision does not apply to Work performed by Agency employees.

In any litigation, the entire text of any order or permit issued by a governmental or regulatory authority, as well as any documents referenced or incorporated therein by reference, shall be admissible for the purpose of Contract interpretation.

The characterization of provisions of the Contract as material provisions or the failure to comply with certain provisions as a material breach of the Contract shall in no way be construed to mean that any other provisions of the Contract are not material or that failure to comply with any other provisions is not a material breach of the Contract.

All rights and remedies available to the Agency under applicable Laws are incorporated herein by reference and are cumulative with all rights and remedies under the Contract.

The Contract shall not be construed against either party regardless of which party drafted it. Other than as modified by the Contract, the applicable rules of contract construction and evidence shall apply. This Contract shall be governed by and construed and enforced according to the laws of the State of Oregon without regard to principles of conflict of laws.

Any dispute between the Agency and the Contractor that arises from or relates to this Contract and that is not resolved under the provisions of Section 00199 shall be brought and conducted solely and exclusively within the Circuit Court for the State of Oregon in the county where the Agency's main office is located; provided, however, if a dispute must be brought in a federal forum, then it shall be brought and conducted solely and exclusively within the United States District Court for the District of Oregon. In no event shall this Subsection be construed as a waiver by the State of Oregon on any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States, or otherwise, from any claim or from the jurisdiction of any court. CONTRACTOR BY EXECUTION OF THE CONTRACT HEREBY CONSENTS TO THE IN PERSONAM JURISDICTION OF THE COURTS REFERENCED IN THIS SECTION.

It is the Agency’s intention to make all payments due under the Contract if funds are legally available for such purpose. The Agency reasonably believes that at the time of entering into the Contract sufficient funds are available and authorized for expenditure to finance the cost of the Contract within the Agency’s appropriation or limitation, or other funding sources. Agency’s payment of amounts under the Contract is contingent on the Agency receiving adequate appropriations, limitations or other expenditure authority or funds to allow the Agency to continue to make payments under the Contract. In the event the Agency becomes aware that sufficient funds are not available and authorized, the Agency will provide prompt written notice to the Contractor, and the Agency may terminate the Contract as provided in 00180.90(c).

Provisions and Requirements

00170.01 Other Agencies Affecting Agency Contracts - Representatives of regulatory bodies or units of government whose Laws may apply to the Work shall have access to the Work according to 00150.20(d). These may include but are not limited to those in the following (a), (b), (c), and (d).

(a) Federal Agencies:

Agriculture, Department of
- Forest Service
- Natural Resource Conservation Service

Army, Department of the
- Corps of Engineers

Commerce, Department of
- National Marine Fisheries Service

Defense, Department of

Energy, Department of

Environmental Protection Agency

Federal Energy Regulatory Commission

Geology Survey

Health and Human Services, Department of

Homeland Security, Department of
- U.S. Coast Guard

Housing and Urban Development, Department of

Interior, Department of
- Heritage, Conservation, and Recreation Service
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Mines
- Bureau of Reclamation
- Geological Survey
- Minerals Management Service
- Office of Surface Mining, Reclamation, and Enforcement

Minerals Management Service

National Oceanic and Atmospheric Administration

Solar Energy and Energy Conservation Bank

U.S. Fish and Wildlife Service

Labor, Department of
- Mine Safety and Health Administration
- Occupational Safety and Health Administration

Transportation, Department of
- Federal Highway Administration

Water Resources Council

(b) State of Oregon Agencies:

Administrative Services, Department of

Agriculture, Department of
- Natural Resources Division
- Soil and Water Conservation District

Columbia River Gorge Commission

Consumer and Business Services, Department of
- Insurance Division
- Oregon Occupational Safety and Health Division

Energy, Office of

Environmental Quality, Department of

Fish and Wildlife, Department of

Forestry, Department of

Geology and Mineral Industries, Department of

Human Resources, Department of

Labor and Industries, Bureau of

Land Conservation and Development Department

Parks and Recreation, Department of

State Lands, Department of

Water Resources Department

(c) Local Agencies:

City Councils

County Courts

County Commissioners, Boards of

Design Commissions

Historical Preservation Commissions

Lane Regional Air Pollution Authority

Planning Commissions

Port Districts

Special Districts

(d) Oregon Federally Recognized Tribal Governments:

Burns Paiute Tribe

Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians

Confederated Tribes of Grand Ronde

Confederated Tribes of Siletz

Confederated Tribes of Umatilla Indian Reservation

Confederated Tribes of Warm Springs

Coquille Tribe

Cow Creek Band of Umpqua Indians

Klamath Tribe

00170.02 Permits, Licenses, and Taxes - As required to accomplish the Work, the Contractor shall do the following:

- Obtain all necessary permits and licenses, except for those noted in 00170.03;
- Pay all applicable charges, fees and taxes, except for those noted in 00170.03;
- Give all notices required by applicable Laws, or under the terms of the Contract;
- Comply with ORS 274.530 relating to lease of stream beds by Oregon Division of State Lands;
- License, in the State of Oregon, all vehicles subject to licensing;
- Comply with ORS 477.625 and ORS 527.670 relating to clearing and fire hazards on forest lands; and
- Comply with all orders and permits issued by a governmental authority, whether local, State, or federal.

00170.03 Furnishing Right-of-Way and Permits - Unless required to be obtained in the name of the Contractor, the Agency will obtain and pay for the following when they are required by the applicable Laws or by Plans or Specifications:

- All necessary Rights-of-Way;
- Permits required for crossing or encroaching upon navigable streams;
- Permits required for removing materials from or depositing materials in waterways;
- Permits required for operating in Agency-controlled source of Materials or disposal area;
- System development fees charged by local units of government;
- Building construction permits, not including specialty work such as heating, ventilation, air conditioning, or electrical;
- Cost of referencing and replacing endangered survey monuments; and
- Environmental permits, including erosion control permits.

00170.04 Patents, Copyrights, and Trademarks - Prior to use of designs, devices, materials, or processes protected by patent, copyright, or trademark, the Contractor shall obtain from the Entity entitled to enforce the patent, copyright, or trademark all necessary evidence of Contractor's legal right to use such design, device, material, or process.

The Contractor shall indemnify, defend and hold harmless the Agency and all third parties and political subdivisions having a possessory or ownership interest or regulatory authority over the Project or Project Site from claims of patent, copyright or trademark infringement, and from costs, expenses and damages the Contractor or Agency may be obligated to pay as a result of such infringement during or after completing the Work.

00170.05 Assignment of Antitrust Rights - The Contractor irrevocably assigns to the Agency any claim for relief or cause of action the Contractor acquires during the term of the Contract, or which may accrue thereafter, by reason of any violation of:

- Title 15 (Commerce and Trade), United States Code;
- ORS 646.725; or
- ORS 646.730.

In connection with this assignment, it is an express obligation of the Contractor to take no action that would in any way impair or diminish the value of the rights assigned to the Agency according to the provisions of this Subsection. Further, it is the express obligation of the Contractor to take all action

necessary to preserve the rights assigned. It is an express obligation of the Contractor to advise the Agency's legal counsel:

- In advance, of its intention to commence any action involving such claims for relief or causes of action;
- Immediately upon becoming aware of the fact that an action involving such claims for relief or causes of action has been commenced by some other person or persons;
- Of the date on which it notified the obligor(s) of any such claims for relief or causes of action of the fact of the Contractor's assignment to the Agency according to the provisions of this Subsection; and
- Immediately upon the discovery of any such antitrust claim for relief or cause of action.

In the event any payment is made to the Contractor under any such claims for relief, the Contractor shall promptly pay the full sum over to the Agency. In the event the Contractor fails to make such payment, the Agency may deduct the amount from monies due or to become due the Contractor under the Contract.

00170.07 Record Requirements - For purposes of this Subsection, the term "Contractor" includes the Contractor, all Subcontractors, Material Suppliers, and providers of rented operated Equipment (except non-DBE truck drivers), at all tiers, for all subcontracts with first-tier Subcontractors, all subcontracts between the first-tier Subcontractors and their Subcontractors and any other lower-tier subcontracts, and "Related Entities" as that term is defined in OAR 734-010-0400. The Material Suppliers included in this definition are those for Aggregates, asphalt cement concrete, portland cement concrete and the supply and fabrication of structural steel items, and Material Suppliers that provide quotes.

(a) Records Required - The Contractor shall maintain all records, whether created before or after execution of the Contract, or during Contract performance, or after Contract completion, to clearly document:

- The Contractor's performance of the Contract or a subcontract;
- The Contractor's ability to continue performance of the Contract or a subcontract; and
- All claims arising from or relating to performance under the Contract or a subcontract.

These records shall include all records, including fiscal records, regardless of when created for the Contractor's business. The records for the Contractor's business include, without limitation:

- Bidding estimates and records, worksheets, tabulations or similar documents.
- Job cost detail reports, including monthly totals.
- Payroll records (including, without limitation, the ledger or register, and tax forms) and all documents that establish the periods, individuals involved, the hours for the individuals, and the rates for the individuals.
- Records that identify the Equipment used by the Contractor and Subcontractors in the performance of the Contract or subcontracts, including, without limitation, Equipment lists, rental contracts and any records used in setting rental rates.
- Invoices from vendors, rental agencies, and Subcontractors.
- Material quotes, invoices, purchase orders and requisitions.
- Contracts with Subcontractors and contracts with Material Suppliers, Suppliers and providers of rented equipment.
- Contracts or documents of other arrangements with any Related Entity as defined in OAR 734-010-0400.

- General ledger.
- Trial Balance.
- Financial statements (including, without limitation, the balance sheet, income statement, statement of cash flows, and financial statement notes).
- Income tax returns.
- All worksheets used to prepare bids or claims, or to establish the cost components for the Pay Items, including, without limitation, the labor, benefits and insurance, Materials, Equipment, and Subcontractors.

The following are examples, but not an exhaustive list, of records that would be included, if generated by the Contractor. If the Contractor generates such records, or equivalent records, they are included among the records subject to 00170.07.

- Daily time sheets and supervisors' daily reports.
- Collective bargaining agreements.
- Earnings records.
- Journal entries and supporting schedules.
- Insurance, welfare, and benefits records.
- Material cost distribution worksheet.
- Subcontractors' and lower-tier Subcontractors' payment certificates.
- Payroll and vendor's cancelled checks.
- Cash disbursements journal.
- All documents related to each and every claim together with all documents that support the amount of damages as to each claim.
- Additional financial statements (including, without limitation, the balance sheet, income statement, statement of cash flows, and financial notes) preceding the execution of the Contract and following final payment of the Contract.
- Depreciation records on all business Equipment maintained by the business involved, its accountant, or other Entity. (If a source other than depreciation records is used to develop cost for the Contractor's internal purposes in establishing the actual cost of owning and operating Equipment, all such other source documents.)

The Contractor shall maintain all fiscal records in material compliance with generally accepted accounting principles, or other accounting principles that are accepted accounting principles and practices for the subject industry and adequate for the nature of the Contractor's business, and in such a manner that providing a complete copy is neither unreasonably time-consuming nor unreasonably burdensome for the Contractor or the Agency. Failure to maintain the records in this manner shall not be an excuse for not providing the records.

The Contractor shall include in its subcontracts, purchase orders, and all other written agreements, a provision requiring all Subcontractors, Material Suppliers and providers of rented operated Equipment (except non-DBE truck drivers), at all tiers, to comply with 00170.07. The Contractor shall also require all Subcontractors, Material Suppliers, and providers of rented operated Equipment (except non-DBE truck drivers), at all tiers, and Related Entities to include in their contracts, purchase orders, and all other written agreements, a provision requiring all lower-tier Subcontractors, Material Suppliers and providers of rented operated Equipment (except non-DBE truck drivers) to comply with 00170.07. The Material Suppliers to which this applies are those for Aggregates, asphalt cement concrete, portland cement concrete and the supply and fabrication of

structural steel items and Material Suppliers that provide Material quotes and Related Entities as defined in OAR 734-010-0400.

(b) Access to Records - The Contractor shall provide the Engineer access to or a copy of all Contractor records upon request. A Project Manager's authority to request or access records is subject to OAR 734-010-0400(9). During the record retention period the Engineer, employees of the Agency, representatives of the Agency, or representatives of regulatory bodies or units of government may:

- Inspect, examine and copy or be provided a copy of all Contractor records;
- Audit the records, a Contract or the performance of a Contract;
- Inspect, examine and audit the records when, in the Agency's sole discretion, the records may be helpful in the resolution of any claim, litigation, administrative proceeding or controversy arising out of or related to a Contract.

Reasons for access to audit, inspect, examine and copy records include without limitation, general auditing, reviewing claims, checking for collusive bidding, reviewing or checking payment of required wages, performance and contract compliance, workplace safety compliance, evaluating Related Entities, environmental compliance, and qualifications for performance of the Contract, including the ability to perform and the integrity of the Contractor.

Where such records are stored in a computer or in other digital media, the Engineer may request, and the Contractor shall provide, a copy of the data files and such other information or access to software to allow the Engineer review of the records.

Nothing in 00170.07 is intended to operate as a waiver of the confidentiality of any communications privileged under the Oregon Evidence Code. Nothing in 00170.07 limits the records or documents that can be obtained by legal process.

(c) Record Retention Period - The Contractor shall maintain the records and keep the records accessible and available at reasonable times and places for at least 3 years from the date of final payment under the Contract, or until the conclusion of all audits, litigation, administrative proceedings, disputes and claims arising out of or related to the Contract, whichever date is later.

(d) Public Records Requests - If records provided under this section contain any information that may be considered exempt from disclosure as a trade secret under either ORS 192.345(2) or ORS 646.461(4), or under other grounds specified in Oregon Public Records Law, ORS 192.311 through ORS 192.478, the Contractor shall clearly designate on or with the records the portions which the Contractor claims are exempt from disclosure, along with a justification and citation to the authority relied upon. Entire records or documents should not be designated as a trade secret or otherwise exempt from disclosure. Only specific information within a record or document should be so designated.

To the extent allowed by the Oregon Public Records Law or other applicable law related to the disclosure of public records, the Agency will not disclose records or portions of records the Contractor has designated as trade secrets to a third party, who is not a representative of the Agency, to the extent the records are exempt from disclosure as trade secrets under the Oregon Public Records Law or other applicable law, except to the extent the Agency is ordered to disclose in accordance with the Oregon Public Records Law or by a court of competent jurisdiction. Application of the Oregon Public Records Law or other applicable law shall determine whether any record, document or information is actually exempt from disclosure.

In addition, in response to a public records request, the Agency will not produce or disclose records so identified as exempt by the Contractor to any person other than representatives of the Agency,

and others with authorized access under 00170.07(b), without providing the Contractor a copy of the public records request, unless:

- The Contractor consents to such disclosure; or
- The Agency is prohibited by applicable law or court order from providing a copy of the public records request to the Contractor.

00170.08 Electronic Document Management - The requirements of this Subsection do not apply to claims. Claims must be submitted on paper documents according to Section 00199.

Following Notice to Proceed, the Contractor shall submit all documents for this Contract to the Agency in an electronic format using Doc Express®. No paper documents, faxes or other similar paper methods or media are permitted, unless otherwise allowed or directed by the Engineer. The Contractor shall be solely responsible for submitting documents to the Agency using Doc Express® for itself and for Subcontractors, Suppliers, vendors and other third parties. Only documents submitted by the Contractor and recorded in Doc Express® as received will be considered valid and received by the Agency.

Following Notice to Proceed, all documents for this Contract will be managed in Doc Express®, unless otherwise allowed or directed by the Engineer. Following Notice to Proceed, the Contractor shall use Doc Express® to submit documents to the Agency, and the Agency will use Doc Express® to submit documents to the Contractor.

The Contractor shall comply with naming conventions, drawer structure, and other Doc Express® instructions as specified in the ODOT Doc Express® User Guide for Construction Contractors, as may be revised from time to time and available from the Engineer.

The Contractor shall provide all Subcontractors, Suppliers, vendors, and any other third parties receiving payment from the Contractor or any Subcontractor, Supplier, vendor, or any other third party, with read-only access to the Doc Express® drawer that contains payment documents from the Agency and the Contractor. The Contractor may provide Subcontractors, Suppliers, vendors, and any other third parties receiving payment from the Contractor or any Subcontractor, Supplier, vendor or other third party with read-only access to other Doc Express® drawers at the Contractor's discretion. The Contractor shall not grant write access to Subcontractors, Suppliers, vendors or any other third parties or their respective officers, employees or agents.

Documents submitted according to this Subsection, from the Agency to the Contractor and from the Contractor to the Agency, are official documents for the Contract and will be accepted as such by both parties.

By submitting documents that originate from the Contractor to the Agency using Doc Express®, the Contractor is certifying that the documents are true and accurate and that if the document was required to be signed, it has been signed by a person with appropriate authority. By submitting documents to the Agency using Doc Express® that originate from a Subcontractor, Supplier, vendor, manufacturer or other third party, the Contractor is certifying that the documents are a true and complete copy of the documents the Contractor received, that if the document was required to be signed, it has been signed, and that the Contractor does not know, nor does it have reason to believe, that the documents are not true and accurate or signed by a person without appropriate authority.

In the event of a conflict between this Subsection and the Standard Specifications or other Special Provisions, this Subsection shall control except for 00199.30.

Costs associated with obtaining and maintaining access to Doc Express® and the use of Doc Express® are Incidental to Mobilization.

Failure to submit documents electronically, as required by this Subsection, may result in payments being withheld according to 00195.50(e).

The Contractor shall be responsible for causing access to Doc Express® to be disabled for any Entity or individual that is no longer assigned, employed or under contract in relation to the Project or whose access is to be disabled due to improper activity. The Contractor's obligation to disable access applies to its own officers, employees and agents and to all Subcontractors, Suppliers, vendors and other third parties and their respective officers, employees and agents.

The Agency reserves the right to suspend or disable, or cause to be suspended or disabled, the access to Doc Express® for any Entity or individual at any time.

Use and access for Doc Express® is provided "as is". The Agency does not warrant that access to or functioning of Doc Express® will be error free, uninterrupted or meet the Contractor's needs. The Agency is not responsible for any damage that may occur due to error, omission, lack of timeliness or other malfunction of Doc Express® or its supporting systems. The Agency disclaims all liability arising from interference or interruption, viruses, telephone faults, malicious damage by anyone, electronic system downtime, overloading of the Internet or sites or any cause beyond the control of the Agency. The Agency reserves the right to temporarily suspend or cause to be suspended access to Doc Express®, without notice, because of maintenance, repair or any other reason deemed necessary for the proper functioning of Doc Express® by the Agency or Info Tech, Inc.

In no event shall the State of Oregon, the Oregon Transportation Commission or the Agency or their respective members, officers, agents and employees be liable for any claims, suits, actions, losses, liabilities, damages, costs or expenses, including but not limited to attorney fees, of whatsoever nature, resulting from or arising out of the use of Doc Express® by the Contractor or Subcontractors, Suppliers, vendors or other third parties at any level or their respective officers, employees or agents.

The Contractor's indemnification, defense and hold harmless obligations under the Contract shall apply to the terms, conditions and requirements of this Subsection 00170.08 and to use of Doc Express® and the acts, errors and omissions of the Contractor, Subcontractors, Suppliers, vendors and other third parties and their respective officers, employees and agents respecting access to and use of Doc Express®.

The terms, conditions and requirements of this Subsection 00170.08 and Subsection 00150.30 shall be included in all contracts with all Subcontractors, Suppliers, vendors and other third parties at all levels for which access to Doc Express® will or may be required.

(a) User Terms and Conditions - The Contractor shall comply with, shall require its officers, employees and agents to comply with, and shall require all Subcontractors, Suppliers, vendors and other third parties to comply with and to require their officers, employees and agents using or accessing Doc Express® to comply with this Subsection 00170.08 and the following Additional User Terms and Conditions, all as may be revised from time to time:

As an officer, employee or agent of the Contractor or any Subcontractor, Supplier, vendor or other third party, respecting my use of or access to Doc Express®, I agree to the following, all as may be revised from time to time:

- The terms, conditions and requirements of Subsection 00170.08 of the Contract;
- The Info Tech, Inc. Doc Express® Privacy Policy and Terms of Use and the Digital Millennium Copyright Act (DMCA) Policy, accessible from the Doc Express® registration site;
- The ODOT Doc Express® User Guide for Construction Contractors available from the Engineer; and
- The following Additional User Terms and Conditions:

My use of and access to Doc Express® are conditioned on my agreement to and my compliance with the foregoing and these Additional User Terms and Conditions.

I may have access to sensitive personnel, business, financial and/or security related information ("Confidential Information") through use of Doc Express®, and, except to the limited extent necessary to perform my duties, I will maintain its confidential status and will not share, publish or disseminate Confidential Information or other information obtained through Doc Express®, without regard to how ODOT may treat any such Confidential Information or other information. All information is also subject to the Oregon Public Records law (see 00170.07(d)). In addition, if I know or have reason to believe any information was inadvertently or improperly included in Doc Express®, I will immediately notify my employer for purposes of notification to the Contractor and the Contractor's notification to ODOT.

I will not access any information I am not authorized to use or access and I will not browse or otherwise use or access information, files or documents that exceed the minimum necessary to perform my duties.

If my authorized use of and access to Doc Express® includes submitting documents into Doc Express® (or "read-write" access), I will not submit any documents or information into Doc Express® except those I am authorized to submit and necessary to perform my duties.

I have no expectation of privacy, rights or ownership of anything I may access, create, store, send or receive within Doc Express®, respecting any documents or information, including but not limited to Confidential Information of any individual or Entity. For audit or system security purposes, ODOT may monitor and/or record all activity conducted within Doc Express®. This includes but is not limited to the login identification information, times, dates and duration of access, as well as resources or documents accessed.

Unauthorized access or activities that could compromise the system or Confidential Information are strictly prohibited and patterns of unauthorized or unusual activity will result in access being immediately disabled, and possible further investigation.

If a breach of these terms and conditions or a security incident occurs, I will immediately notify my employer for purposes of notification to the Contractor and the Contractor's notification to ODOT.

I will not share my password or other means of access with any other individual or Entity. Violation of this restriction or of any of these other Terms and Conditions will result in my access being immediately disabled.

I understand that my use of and access to Doc Express® is conditioned on my relationship to my employer and my employer's relationship to one or more of: ODOT, the Contractor, a Subcontractor, Supplier, vendor or other third party, and that if I am no longer so employed or my employer no longer has such relationship, I will immediately cease my use of and access to Doc Express® and will immediately notify my employer for purposes of notification to the Contractor and the Contractor's notification to ODOT.

(b) Digital Signatures and Requirements - Unless otherwise allowed or directed by the Engineer:

- For all Change Orders that require signature by the Contractor for this Contract, the Contractor, by a person with appropriate authority, shall sign using a Doc Express® digital signature.

- Change Orders that require signature by the Contractor, but do not have a Doc Express® digital signature from the Contractor verifiable by the Engineer, will be considered as not received and of no effect.
- Documents other than Change Orders that contain digital signatures, but do not have a digital signature verifiable by the Engineer, or that were signed by a person without appropriate authority, will be considered as not received and of no effect.
- Notice requirements will not be satisfied and payments may be withheld for any affected work items until the required documents with verifiable digital signatures have been received.

(c) Electronic Submittal Requirements - Unless otherwise allowed or directed by the Engineer, all documents submitted to the Agency for this Contract that require a signature, other than Change Orders, shall be signed by a person with appropriate authority by applying:

- An original handwritten signature to a document and scanning the document into PDF format;
- An electronic signature to a document and converting the document into PDF format;
- A third-party verifiable digital signature to a PDF document; or
- A Doc Express® electronic signature when prompted during submission of the document into Doc Express®.

Documents that require a signature, but do not have a signature in accordance with this Subsection, or were signed by a person without appropriate authority; or documents that were signed with a digital signature but are submitted in a form such that the digital signature is not verifiable by the Engineer, will be considered as not received and of no effect. Notice requirements will not be satisfied and payments may be withheld for any affected work items until the required documents with compliant signatures have been received.

Unless otherwise allowed or directed by the Engineer, all documents submitted to the Agency for this Contract that do not require a signature shall be submitted using Doc Express®.

00170.10 Required Payments by Contractors - The Contractor shall comply with ORS 279C.505 and ORS 279C.515 during the term of the Contract.

(a) Prompt Payment by Contractor for Labor and Materials - As required by ORS 279C.505, the Contractor shall:

- Make payment promptly, as due, to all Entities supplying labor or Materials under the Contract;
- Pay all contributions or amounts due the Industrial Accident Fund, whether from the Contractor or a Subcontractor, incurred in the performance of the Contract;
- Not permit any lien or claim to be filed against the State or any political subdivision thereof, on account of any labor or Material furnished in performance of the Contract; and
- Pay to the Department of Revenue all sums withheld from employees according to ORS 316.167.

(b) Prompt Payment by Contractor to First-Tier Subcontractor(s) - According to ORS 279C.580(3)(a), after the Contractor has determined and certified to the Agency that one or more of its Subcontractors has satisfactorily performed subcontracted Work, the Contractor may request payment from the Agency for the Work, and shall pay the Subcontractor(s) within 10 Calendar Days out of such amounts as the Agency has paid to the Contractor for the subcontracted Work.

(c) Interest on Unpaid Amount - If the Contractor or a first-tier Subcontractor fails, neglects, or refuses to make payment to an Entity furnishing labor or Materials in connection with the Contract within 30 Days after the Contractor's receipt of payment, the Contractor or first-tier Subcontractor shall owe the Entity the amount due plus interest charges that begin at the end of the 10 day period within which payment is due under ORS 279C.580(3) and that end upon final payment, unless payment is subject to a good-faith dispute as defined in ORS 279C.580(5)(b). As required by ORS 279C.515(2), the rate of interest on the amount due shall be 9 percent per annum. The amount of interest shall not be waived.

(d) Agency's Payment of the Contractor's Prompt Payment Obligations - If the Contractor fails, neglects or refuses to make prompt payment of any invoice or other demand for payment for labor or services furnished to the Contractor or a Subcontractor by any Entity in connection with the Contract as such payment becomes due, the Agency may pay the Entity furnishing the labor or services and charge the amount of the payment against monies due or to become due the Contractor under the Contract. (The Agency has no obligation to pay these Entities, and ODOT will not normally do so, but will refer them to the Contractor and the Contractor's Surety.)

The payment of a claim by the Agency in the manner authorized in this Subsection shall not relieve the Contractor or the Contractor's Surety from obligations with respect to any such claims.

(e) Right to Complain to the Construction Contractors Board - If the Contractor or a Subcontractor fails, neglects, or refuses to make payment to an Entity furnishing labor or Materials in connection with the Contract, the Entity may file a complaint with the Construction Contractors Board, unless payment is subject to a good-faith dispute as defined in ORS 279C.580(5)(b).

(f) Notice of Claim Against Bond - An Entity (which by definition includes a natural person) claiming not to have been paid in full for labor or Materials supplied for the prosecution of the Work may have a right of action on the Contractor's Payment Bond as provided in ORS 279C.600 and ORS 279C.605.

The Commissioner of the Bureau of Labor and Industries (BOLI) may have a right of action on the Contractor's and Subcontractors' public works bonds and Payment Bonds for workers who have not been paid in full, as provided in ORS 279C.600 and ORS 279C.605.

(g) Paid Summary Report - The Contractor shall submit a “Paid Summary Report", form 734-2882, to the Engineer certifying payments made to all of the following:

- All Subcontractors
- Committed DBE suppliers
- Non-committed DBE suppliers and service providers with estimated total payments for the Project over $10,000.

For this purpose, a committed DBE firm is one that was identified by the Contractor to meet an assigned DBE goal including DBE firms substituting for DBE firms committed as a condition of Contract Award.

Submit the completed and signed Paid Summary Report to the Engineer within 20 Calendar Days of receipt of payment from the Agency for each month in which payments were made to each Subcontractor, each committed DBE Supplier, and each non-committed DBE Supplier or service provider with estimated total payments for the Project over $10,000. At the completion of the Project, submit form 734-2882 recapping the total amounts paid to each Subcontractor, each committed DBE Supplier, and each non committed DBE Supplier or service provider with estimated total payments for the Project over $10,000.

The Contractor shall require each Subcontractor at every tier to comply with the requirement to submit form 734-2882 within 20 Calendar Days of receipt of payment from its controlling contractor and provide a recap of the total amounts paid at the completion of the Project or completion of their Work.

Forms shall be submitted to an email address provided to the Contractor at the preconstruction conference.

00170.20 Public Works Bond - Before starting Work, the Contractor and Subcontractors shall each file with the Construction Contractors Board, and maintain in full force and effect, a separate public works bond, in the amount of $30,000 unless otherwise exempt, as required by ORS 279C.830(2) and ORS 279C.836. The Contractor shall verify Subcontractors have filed a public works bond before the Subcontractor begins Work.

00170.32 Protection of Navigable Waters - The Contractor shall comply with all applicable Laws, including, without limitation, the Federal River and Harbor Act of March 3, 1899 and its amendments.

The Contractor shall not interfere with waterway navigation or impair navigable depths or clearances, except as U.S. Coast Guard or Corps of Engineer permits allow.

00170.60 Safety, Health, and Sanitation Provisions - The Contractor shall comply with all Laws concerning safety, health, and sanitation standards. The Contractor shall not require workers to perform Work under conditions that are hazardous, dangerous, or unsanitary.

Workers exposed to traffic shall wear upper body garments or safety vests that are highly visible and meet the requirements of 00221.20.

Workers exposed to falling or flying objects or electrical shock shall wear hard hats.

Upon their presentation of proper credentials, the Contractor shall allow inspectors of the U.S. Occupational Safety and Health Administration (OSHA) and the Oregon Occupational Safety and Health Division (OR-OSHA) to inspect the Work and Project Site without delay and without an inspection warrant.

According to ORS 468A.715 and ORS 468A.720, the Contractor or a Subcontractor who performs Project Work involving asbestos abatement shall possess a valid DEQ asbestos abatement license.

00170.61 Industrial Accident Protection:

(a) Workers' Compensation - The Contractor shall provide workers' compensation coverage for on-the-job injuries as required by 00170.70(d).

(b) Longshoremen's and Harbor Workers' Compensation - If Work to be performed is over or adjacent to navigable waters, the Longshoremen's and Harbor Workers' Compensation Act, (Chapter 18, Title 33 of the USC) may apply, and the Contractor shall be responsible for complying with its provisions (which may include the provision of additional workers' compensation benefits to employees).

00170.62 Labor Nondiscrimination - The Contractor shall comply with all Laws concerning equal employment opportunity, including, without limitation, those prohibiting discrimination because of race, religion, color, sex, disability, or national origin.

It is a material term of this Contract that the Contractor certifies by entering into this Contract that the Contractor has a written policy and practice that meets the requirements described in ORS 279A.112 (House Bill 3060, 2017) for preventing sexual harassment, sexual assault and discrimination against

employees who are members of a protected class and that the Contractor shall maintain the policy and practice in force during the entire term of this Contract.

00170.63 Payment for Medical Care - According to ORS 279C.530, the Contractor shall promptly, as due, make payment to any person, copartnership, association or corporation furnishing medical, surgical and hospital care services or other needed care and attention, incident to sickness or injury, to the employees of the Contractor, of all sums that the Contractor agrees to pay for the services and all moneys and sums that the Contractor has collected or deducted from the wages of employees under any law, contract or agreement for the purpose of providing or paying for the services.

00170.65 Minimum Wage and Overtime Rates for Public Works Projects:

(a) General - The Contractor is responsible for investigating local labor conditions. The Agency does not imply that labor can be obtained at the minimum hourly wage rates specified in State or federal wage rate publications, and no increase in the Contract Amount will be made if wage rates paid are more than those listed.

As required by ORS 279C.520, the Contractor shall comply with ORS 652.220 and shall not unlawfully discriminate against any of the Contractor's employees in the payment of wages or other compensation for work of comparable character on the basis of an employee's membership in a protected class. "Protected class" means a group of persons distinguished by race, color, religion, sex, sexual orientation, national origin, marital status, veteran status, disability, or age. The Contractor's compliance with this provision constitutes a material element of the Contract and failure to comply constitutes a material breach that entitles the Agency to exercise any remedies available under the Contract, including, but not limited to, termination for default.

As required by ORS 279C.520, the Contractor shall not prohibit any of the Contractor's employees from discussing the employee's rate of wage, salary, benefits or other compensation with another employee or another person and shall not retaliate against an employee who discusses the employee's rate of wage, salary, benefits or other compensation with another employee or another person.

(b) State Prevailing Wage Requirements - The Contractor shall comply with the prevailing wage provisions of ORS 279C.800 through ORS 279C.870.

(1) Minimum Wage Rates - The Bureau of Labor and Industries (BOLI) determines and publishes the existing State prevailing wage rates in the publication *Prevailing Wage Rates for Public Works Contracts in Oregon*. The Contractor shall pay workers not less than the specified minimum hourly wage rate according to ORS 279C.838 and ORS 279C.840, and shall include this requirement in all subcontracts.

See the Project Wage Rates page included with the Special Provisions for additional information about which wage rates apply to the Project and how to access the applicable wage rates.

The applicable BOLI wage rates will be included in the Contract.

(2) Payroll and Certified Statements - As required in ORS 279C.845, the Contractor and every Subcontractor shall submit written certified statements to the Engineer on the form prescribed by the Commissioner of BOLI in OAR 839-025-0010 certifying compliance with wage payment requirements and accurately setting out the Contractor's or Subcontractor's weekly payroll records for each worker employed on the Project.

The Contractor and Subcontractors shall preserve the certified statements for a period of 6 years from the date of completion of the Contract.

(3) Additional Retainage:

a. Agency - As required in ORS 279C.845(7) the Agency will retain 25% of any amount earned by the Contractor on the Project until the Contractor has filed the certified statements required in ORS 279C.845 and in FHWA Form 1273, if applicable. The Agency will pay to the Contractor the amount retained within 14 Days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements.

b. Contractor - As required in ORS 279C.845(8) the Contractor shall retain 25% of any amount earned by a first-tier Subcontractor on the Project until the first-tier Subcontractor has filed with the Agency the certified statements required in ORS 279C.845 and in FHWA Form 1273, if applicable. Before paying any amount retained, the Contractor shall verify that the first-tier Subcontractor has filed the certified statement. Within 14 Days after the first-tier Subcontractor files the required certified statement, the Contractor shall pay the first-tier Subcontractor any amount retained.

(4) Owner/Operator Data - The Contractor shall furnish data to the Engineer for each owner/operator providing trucking services. Furnish the data before the time the services are performed and include without limitation for each owner/operator:

- Driver's name;
- Copy of driver license;
- Vehicle identification number;
- Copy of vehicle registration;
- Motor vehicle license plate number;
- Motor Carrier account number;
- Copy of ODOT Motor Carrier 1A Permit; and
- Name of owner/operator from the side of the truck.

(c) State Overtime Requirements - As a condition of the Contract, the Contractor shall comply with the pertinent provisions of ORS 279C.520 and ORS 279C.540.

(1) Maximum Hours of Labor and Overtime Pay - According to ORS 279C.540, no person shall be employed to perform Work under this Contract for more than 10 hours in any 1 Day, or 40 hours in any 1 week, except in cases of necessity, emergency, or where public policy absolutely requires it. In such instances, the Contractor shall pay the employee at least time and a half pay:

- For all overtime in excess of 8 hours a day or 40 hours in any 1 week when the work week is 5 consecutive days, Monday through Friday; or
- For all overtime in excess of 10 hours a day or 40 hours in any 1 week when the work week is 4 consecutive days, Monday through Friday; and
- For all Work performed on Saturday and on any legal holiday specified in ORS 279C.540.

For additional information on requirements for overtime and establishing a work schedule see OAR 839-025-0050 and OAR 839-025-0034.

(2) Notice of Hours of Labor - The Contractor shall give written notice to employees of the number of hours per day and days per week the employees may be required to work. Provide the notice either at the time of hire or before commencement of work on this Contract, or by posting a notice in a location frequented by employees.

(3) Exception - The maximum hours of labor and overtime requirements under ORS 279C.540 will not apply to the Contractor's Work under this Contract if the Contractor is a party to a collective bargaining agreement in effect with any labor organization. For a collective bargaining agreement to be in effect it shall be enforceable within the geographic area of the Project, and its terms shall extend to workers who are working on the Project (see OAR 839-025-0054).

(d) State Time Limitation on Claim for Overtime - According to ORS 279C.545, any worker employed by the Contractor is foreclosed from the right to collect any overtime provided in ORS 279C.540 unless a claim for payment is filed with the Contractor within 90 Days from the completion of the Contract, provided the Contractor posted and maintained a circular as specified in this provision. Accordingly, the Contractor shall:

- Cause a circular, clearly printed in boldfaced 12-point type and containing a copy of ORS 279C.545, to be posted in a prominent place alongside the door of the timekeeper's office or in a similar place that is readily available and freely visible to any or all workers employed to perform Work; and
- Maintain such circular continuously posted from the inception to the completion of the Contract on which workers are or have been employed.

(e) Additional Requirements When Federal Funds are Involved - When federal funds are involved, the following requirements shall apply in addition to the requirements of 00170.65(a) through 00170.65(d). The Contractor shall include these provisions in all subcontracts as well as ensure that all Subcontractors include these provisions in their lower-tier subcontracts.

(1) FHWA Requirements - For Federal-aid projects, the Contractor shall comply with the provisions of FHWA Form 1273, *Required Contract Provisions Federal-aid Construction Contracts*.

(2) Minimum Wage Rates - The Contractor shall pay each worker in each trade or occupation employed to perform any work under the Contract not less than the existing State (BOLI) prevailing wage rate or the applicable federal prevailing wage rate required under the Davis-Bacon Act (40 U.S.C. 3141 et seq.), whichever is higher. The Contractor shall include this provision in all subcontracts.

See the Project Wage Rates page included with the Special Provisions for additional information about which wage rates apply to the Project and how to access the applicable wage rates.

The applicable Davis-Bacon and BOLI wage rates will be included in the Contract.

(3) Payroll and Certified Statements - In addition to providing the payroll information and certified statements required under ORS 279C.845 (see 00170.65(b)(2)), the Contractor and every Subcontractor shall submit written certified statements that also meet the requirements in Section IV of FHWA Form 1273, except the Contractor and every Subcontractor shall preserve the certified statements for a period of 6 years from the date of completion of the Contract.

(4) Overtime - With regard to overtime pay, the Contractor shall comply with the overtime provision affording the greatest compensation required under FHWA Form 1273 and ORS 279C.540.

00170.70 Insurance:

(a) Insurance Coverages -

Contractor - The Contractor shall obtain the insurance specified below prior to the execution of the Contract. The Contractor shall maintain the insurance in full force at the Contractor's expense throughout the duration of the Contract and all warranty periods that apply.

Subcontracting - If the Contractor specifies prior to the execution of the Contract that a Subcontractor will satisfy an insurance requirement, that is permitted to be satisfied by a Subcontractor, the Contractor shall obtain Agency approval of Subcontractor and Subcontractor's insurance coverage(s), as required by 00180.21, prior to commencement of Subcontracted work. After the Contractor receives Agency approval of the Subcontractor, the Contractor may contractually obligate the Subcontractor to obtain and maintain, at the Subcontractor's expense or at the Contractor's expense, the insurance permitted.

The Contractor shall require that all Subcontractors carry insurance coverage that the Contractor deems appropriate based on the risks of the subcontracted work. The Contractor shall obtain proof of the required insurance coverages, as applicable, from any Subcontractor providing Services related to the Contract.

Neither the insurance provided by Subcontractor(s) nor any agreements Contractor or Subcontractor(s) may enter into shall place any limitation on the liability or indemnification obligations of the Contractor under applicable law or the Contract.

Insurance Provisions - The Contractor and Subcontractor(s), if any, shall obtain insurance from insurance companies or entities that are authorized to transact the business of insurance and issue coverage in the State and that are acceptable to the Agency. Insurance coverage shall be primary and noncontributory with any other insurance and self-insurance, with the exception of Workers' Compensation. The Contractor, or appropriate Subcontractor, but not the Agency, shall pay for all deductibles, self-insurance retentions and self-insurance, if any.

- **Commercial General Liability** – The Contractor shall provide Commercial General Liability Insurance written on an occurrence basis and covering the Contractor's liability for bodily injury and property damage. This insurance shall include personal and advertising injury liability, products and completed operations coverage, and contractual liability coverage. Coverage may be written in combination with Commercial Automobile Liability Insurance with separate limits for Commercial General Liability and Commercial Automobile Liability. Combined single limit per occurrence shall not be less than the dollar amount specified in the Special Provisions. The annual aggregate limit shall not be less than the dollar amount specified in the Special Provisions. The policy shall be endorsed to state that the annual aggregate limit of liability shall apply separately to the Contract.

  When Work to be performed includes operations or activity within 50 feet of any railroad property, bridge, trestle, track, roadbed, tunnel, underpass or crossing, the Contractor shall provide the Contractual Liability – Railroads CG 24 17 endorsement, or equivalent, on the Commercial General Liability policy.

- **Commercial Automobile Liability** – The Contractor shall provide Commercial Automobile Liability Insurance covering all owned, non-owned, and hired vehicles for bodily injury and property damage. This coverage may be written in combination with the Commercial General Liability Insurance with separate limits for Commercial Automobile Liability and Commercial General Liability. Combined single limit per occurrence shall not be less than the dollar amount specified in the Special Provisions. If this coverage is written in combination with the

Commercial General Liability, the policy shall be endorsed to state that the Commercial General Liability annual aggregate limit shall apply separately to the Contract.

- **Pollution Liability** - If indicated by Special Provision, the Contractor or Subcontractor, whichever is performing the pollution related Work, shall provide Pollution Liability Insurance written on an occurrence or claims made basis and covering the Contractor's or Subcontractor's liability, for bodily injury, property damage, and environmental damage resulting from sudden, accidental, and gradual pollution, and related clean-up costs. If the coverage is obtained by the Contractor, the coverage may be written in combination with the Commercial General Liability Insurance with separate limits for Pollution Liability and Commercial General Liability. Combined single limit per occurrence shall not be less than the dollar amount specified in the Special Provisions. The annual aggregate limit shall not be less than the dollar amount specified in the Special Provisions. The policy shall be endorsed to state that the annual aggregate limit of liability shall apply separately to the Contract.

- **Asbestos Liability** - If indicated by Special Provision, the Contractor, or Subcontractor, whichever is performing asbestos related Work, shall provide the Pollution Liability coverage with an Asbestos Liability endorsement. If an endorsement cannot be obtained, the Contractor or Subcontractor shall provide separate Asbestos Liability Insurance at the same combined single limit per occurrence and annual aggregate limit as the Pollution Liability Insurance with the policy endorsed to state that the annual aggregate limit of liability shall apply separately to the Contract.

- **Lead Liability** - If indicated by Special Provision, the Contractor or Subcontractor, whichever is performing lead related Work, shall provide the Pollution Liability coverage with a Lead Liability endorsement. If an endorsement cannot be obtained, the Contractor or Subcontractor shall provide separate Lead Liability Insurance at the same combined single limit per occurrence and annual aggregate limit as the Pollution Liability Insurance with the separate policy endorsed to state that the annual aggregate limit of liability shall apply separately to the Contract.

- **Commercial Automobile Liability with Pollution Coverage** - If indicated by Special Provision, the Contractor or Subcontractor, whichever is performing the pollution related Work, shall provide Commercial Automobile Liability Insurance with Pollution coverage covering the Contractor's or Subcontractor's liability for bodily injury, property damage, natural resource damage, and environmental damage arising out of the use of all owned, non-owned, or hired vehicles while performing Work under the Contract. Combined single limit per occurrence shall not be less than the dollar amount specified in the Contract. If the coverage is obtained by the Contractor, the coverage may be written in combination with the Commercial General Liability Insurance with separate limits for Commercial Automobile Liability with Pollution Coverage and Commercial General Liability. If this coverage is written in combination with the Commercial General Liability, the policy shall be endorsed to state that the Commercial General Liability annual aggregate limit shall apply separately to the Contract.

- **Marine Insurance (watercraft)** - If indicated by Special Provision, the Contractor or Subcontractor, whichever is performing watercraft related Work, entails the use of watercraft, including but not limited to barges, tug boats, work boats, and supply boats, shall provide the following insurance:

  - **Marine Liability Insurance** - For the performance of the Work that requires the use of any watercraft, whether owned, non-owned, leased, rented, or chartered by Contractor or any Subcontractors, Marine Liability insurance shall not be less than the dollar amount specified in the Special Provisions per occurrence for bodily injury and property damage. Such insurance shall also include coverage for collision liability, tower's liability, marine

contractual liability, wreck/debris removal, and liability for seepage, pollution, containment and cleanup.

- **Hull and Machinery Insurance** - Including collision liability, with sister-ship clause un-amended, with limits of liability at least equal to the full value of all vessels used in connection with performance of the Work required under this Contract and with navigational limitations adequate for the Contractor to perform the specified Work. Where vessels engage in towing operations, said insurance shall include full towers' liability with the sister-ship clause un-amended.

- **Protection and Indemnity Insurance** - To be evidenced through a full entry with a Group P&I Club, including collision liability, towers' liability, marine contractual liability, tankermans' liability, and specialist operations. Alternatively, if a full entry in a Group P&I Club is not available or applicable, Protection and Indemnity Insurance coverage shall be evidenced on the SP-23 form or equivalent, including, by endorsement or otherwise, collision liability, tower's liability, specialist operations, and liability for seepage, pollution, containment and cleanup, with extensions for marine contractual liability, shall not be less than the dollar amount specified in the Special Provisions.

- **Pollution Liability Insurance** - If pollution coverage is provided outside of a P&I Club entry or outside of Protection and Indemnity Insurance coverage evidenced on the SP-23 form or equivalent, the amount shall not be less than the dollar amount specified in the Special Provisions. Pollution liability coverage shall cover bodily injury, property damage, including cleanup costs and defense costs resulting from sudden and gradual pollution conditions of contaminants or pollutants into or upon the land, the atmosphere or any water course or body of water.

With respect to the aforementioned Hull & Machinery Insurance, Protection and Indemnity Insurance and Pollution Insurance, the policy or policies shall be endorsed as follows:

- Other than owner provisions of all policies shall be deleted with respect to the naming of Company as an Additional Assured/Insured;
- Delete any as owner clause and any other language, which limits or purports to limit the coverage afforded to an insured or an additional insured who is not a ship-owner, with coverage to be afforded to all additional insureds in any capacity in which they may be held liable; and
- Operator warrants that COFR's are on file with the U.S. Coast Guard as per Federal requirements.

If Subcontractor(s) are utilized to perform any Work that requires the use of watercraft under the Contract, all such Subcontractor(s) shall maintain insurance including limits, coverages, terms and conditions as required herein unless said Subcontractor(s) are insured by Contractor. Where Contractor provides coverage for a Subcontractor, the Contractor shall issue a Certificate of Insurance, along with related endorsement(s) required to effect coverage, evidencing Subcontractor's "Additional Insured/Assured" status under Contractor's coverage.

An Excess Marine Liability insurance policy may be used to meet the required limits of insurance. Excess coverage must follow form and be as broad as that provided by the underlying primary liability insurance policies.

ORS 15.320 provides that Oregon law applies to the Contract. The parties also agree that Oregon law applies to the Contract, even if ORS 15.320 is determined to be inapplicable or invalid.

(b) Extended Reporting - If any of the required insurance is permitted to be and is on a "claims made" basis, the Contractor or Subcontractor who provided the insurance coverage, shall obtain an extended reporting period on the claims made policy or maintain the claims made policy, for a duration of at least 24 months from the date the applicable work has been completed and accepted by the Agency or the date of Final Acceptance. This extended reporting requirement shall be satisfied with documentation of one of the following:

- Extended Reporting Endorsement;
- Tail Coverage; or
- Maintaining the applicable continuous claims made policy with liability coverage.

The Contractor or Subcontractor shall furnish certification of this extended reporting requirement as a condition to receive Third Notice under 00150.90(b) and 00180.50(g).

(c) Excess/Umbrella Liability - A combination of primary and Excess/Umbrella Insurance may be used to meet the required limits of insurance. Excess/Umbrella coverage must be at least as broad as that provided by the underlying primary insurance policies. In addition, the limits of the underlying primary insurance must be sufficient to prevent any gap between such minimum limits and the attachment point of the coverage provided by the Excess/Umbrella Liability policy.

(d) Additional Insured - The liability insurance coverages of 00170.70(a) shall include an Additional Insured Endorsement specifying the "State of Oregon, the Oregon Transportation Commission and the Department of Transportation, and their respective officers, members, agents, and employees" as Additional Insureds, but only with respect to the Contractor's activities to be performed under the Contract. Coverage shall be primary and non-contributory with any other insurance and self-insurance. The liability coverages of 00170.70(a) that are permitted by the Agency to be obtained by an appropriate Subcontractor shall include all of the foregoing as Additional Insureds and shall also include the Contractor and its officers and employees as Additional Insureds.

Additional Insured Endorsements on the Commercial General Liability shall be written on ISO Form CG 20 10 07 04, or equivalent, with respect to liability arising out of ongoing operations and ISO Form CG 20 37 07 04, or equivalent, with respect to liability arising out of completed operations. Additional Insured Endorsements shall be submitted with the Certificate(s) of Insurance and must be acceptable to the Agency.

(e) Workers' Compensation - All employers, including the Contractor and Subcontractor(s), if any, that employ subject workers, as defined in ORS 656.027, shall comply with ORS 656.017 and shall provide Workers' Compensation Insurance coverage, unless such employers meet the requirement for an exemption under ORS 656.126(2). The coverage shall include Employer's Liability Insurance with limits not less than $500,000 each accident.

The Contractor shall certify in the Contract that the Contractor is registered by the Oregon Workers' Compensation Division either as a carrier-insured employer, a self-insured employer, an exempt employer, or is an independent contractor who will perform the Work without the assistance of others.

The Contractor shall require and verify that its insurance carrier files a guaranty contract with the Oregon Workers' Compensation Division before performing any Work.

All employers, including the Contractor and Subcontractor(s), if any, exempt under ORS 656.126(2) and subject to any other state's Workers' Compensation law, shall provide Workers' Compensation Insurance coverage as required by applicable Workers' Compensation laws. The coverage shall also include Employer's Liability Insurance with limits not less than $500,000 each accident.

If the Contractor's and Subcontractor's, if any, operations include use of watercraft on navigable waters and employ persons in applicable positions, a Maritime Coverage Endorsement must be added to the Workers' Compensation policy, unless coverage for captain and crew is provided in a Protection and Indemnity policy.

If the Contractor and Subcontractor, if any, conducts its operations in proximity to navigable waters and employ persons in applicable positions, United States Longshore and Harbor Workers' Compensation Act coverage must be endorsed onto the Workers' Compensation policy.

The Contractor shall require compliance with these requirements in all Subcontractor contracts.

(f) Notice of Cancellation or Change - The Contractor shall provide at least 30 Days' written notice to the Agency before cancellation of, material change to, potential exhaustion of aggregate limits, or non-renewal of the required insurance coverages. If a Subcontractor is providing insurance to meet the contract requirements, the Contractor shall provide at least 30 Days' written notice to the Agency before cancellation of, material change to, potential exhaustion of aggregate limits, or non-renewal of the required insurance coverage(s). Any failure to comply with the reporting provisions of this insurance shall not affect the coverage(s) provided to the State, Agency, County, City, or other applicable political jurisdiction or to the Agency's governing body, board, or Commission and its members, and the Agency's officers, agents, and employees.

(g) Certificate(s) of Insurance - As evidence of the insurance coverages required by the Contract, the Contractor shall furnish Certificate(s) of Insurance to the Agency at the time(s) provided in 00130.50(a). As evidence of insurance coverages required by the Contract but permitted by the Agency under 00170.70(a) to be obtained by an appropriate Subcontractor, the Contractor shall furnish Certificate(s) of Insurance to the Agency for such coverages together with the Contractor's request under 00180.21 for approval of the subcontract with that Subcontractor. The Certificate(s) shall:

- List the "State of Oregon, the Oregon Transportation Commission and the Department of Transportation, and their respective officers, members, agents and employees" as a Certificate holder and as an endorsed Additional Insured;
- Include all required endorsements or copies of the applicable policy language effecting coverage required by the Contract;
- Specify that all liability insurance coverages shall be primary and non-contributory with any other insurance and self-insurance, with exception of Workers' Compensation;
- Include a list of all policies that fall under the Excess/Umbrella Insurance if Excess or Umbrella Insurance is used to meet the minimum insurance requirement.

(h) Agency Acceptance - All insurance and insurance providers are subject to Agency acceptance. If requested by Agency, the Contractor shall provide complete copies of insurance policies, endorsements, self-insurance documents and related insurance documents to Agency's representatives responsible for verification of the insurance coverages required by the Contract.

(i) Insurance Requirement Review - The Contractor agrees to periodic review of insurance requirements by Agency under the Contract and to provide updated requirements as mutually agreed upon by the Contractor and Agency.

(j) Builder's Risk - If specified by Special Provision, the Contractor shall obtain, at its expense, and keep in effect during the term of the Contract, Builder's Risk Insurance on an all risks of direct physical loss basis, including, without limitation, earthquake and flood damage, for an amount equal to at least the value specified in the Special Provisions. The policy shall not contain a coinsurance clause or any collapse exclusions. Any deductible shall not exceed $50,000 for each loss, except

that the earthquake and flood deductible shall not exceed 5% of each loss or $50,000, whichever is greater. The policy shall include the State of Oregon as loss payee.

(k) Builder's Risk Installation Floater - The Contractor shall obtain, at its expense, and keep in effect during the term of the Contract, Builder's Risk Installation Floater Insurance covering the Contractor's labor, Materials and Equipment to be used for completion of the Work performed under the Contract. The minimum amount of coverage to be carried shall be equal to the full amount of the contractor´s labor, equipment, materials, or fixtures to be installed, in-transit, or stored off-site during the performance of the Contract. This insurance shall include as loss payees the State of Oregon, the Owner, the Contractor and Subcontractors as their interests may appear.

00170.71 Independent Contractor Status - The service or services to be rendered and the Work to be completed under this Contract are those of an independent contractor as defined in ORS 670.600. The Contractor is not an officer, employee, or agent of the Agency or the State as those terms are used in ORS 30.265.

00170.72 Indemnity/Hold Harmless - To the fullest extent permitted by law, and except to the extent otherwise void under ORS 30.140, the Contractor shall indemnify, defend (with counsel approved by the Agency) and hold harmless the Agency, Agency's Authorized Representative, Architect/Engineer, Architect/Engineer's consultants, and their respective officers, directors, agents, employees, partners, members, stockholders and affiliated companies (collectively "Indemnitees") from and against all liabilities, damages, losses, claims, expenses (including reasonable attorney fees), demands and actions of any nature whatsoever that arise out of, result from or are related to the following:

- Any damage, injury, loss, expense, inconvenience or delay described in this Subsection.
- Any accident or occurrence that happens or is alleged to have happened in or about the Project Site or any place where the Work is being performed, or in the vicinity of either, at any time prior to the time the Work is fully completed in all respects.
- Any failure of the Contractor to observe or perform any duty or obligation under the Contract Documents that is to be observed or performed by the Contractor, or any breach of any agreement, duty, obligation, responsibility, covenant, provision, requirement, representation or warranty of the Contractor contained in the Contract Documents or in any subcontract.
- The negligent acts or omissions of the Contractor, a Subcontractor or anyone directly or indirectly employed by them or any one of them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder.
- Any failure to comply with all applicable Laws by the Contractor or any Subcontractor, or anyone employed by any one of them, or anyone for whose acts they may be liable.
- Any lien filed upon the Project or bond claim in connection with the Work.

Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Subsection.

In claims against any person or Entity indemnified under this Subsection by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Subsection shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

Notwithstanding the Contractor's foregoing defense obligations, neither the Contractor nor any attorney engaged by the Contractor shall defend any claim in the name of the Agency, nor purport to act as legal representative of the Agency or any of its agencies, without the prior written consent of

the Agency's legal counsel, which in the case of ODOT is the Oregon Attorney General. The Agency may, at any time at its election, assume its own defense and settlement in the event that it determines that the Contractor is prohibited from defending the Agency, or that the Contractor is not adequately defending the Agency's interests, or that an important governmental principle is at issue or that it is in the best interests of the Agency to do so. The Agency reserves all rights to pursue any claims it may have against the Contractor.

00170.74 Employee Drug Testing Program - As required by ORS 279C.505(2), the Contractor shall have in place, and maintain during the period of the Contract, an employee drug-testing program. The Agency retains the right to audit and/or monitor the program. On request by the Engineer, the Contractor shall furnish a copy of the employee drug-testing program.

00170.78 Conflict of Interest - The Contractor shall not give or offer any gift, loan, or other thing of value to any member of the Agency's governing body or employee of the Agency in connection with the award or performance of any Contract.

The Contractor shall not rent, lease, or purchase Materials, supplies, or Equipment, with or through any Agency employee or member of the Agency's governing body.

No ex-employee of the Agency who has worked for the Agency on any phase of the Project within the prior 2 years may be employed by the Contractor to perform Work on the Project.

The Contractor shall also be and remain in compliance with the Agency's Conflict of Interest Guidelines. (See 00120.40(g) and 00180.21(b).)

00170.79 Third Party Beneficiary - There are no third-party beneficiaries of the Contract.

00170.80 Responsibility for Damage to Work:

(a) Responsibility for Damage in General - The Contractor shall perform Work, and furnish Materials and Equipment for incorporation into the Work, at the Contractor's own risk, until the entire Project has been completed and accepted by the Agency. The Contractor shall repair all damages to Work performed, Materials supplied, and Equipment incorporated into the Work, except as otherwise provided in this Section.

(b) Repair of Damage to Work - Until Final Acceptance, the Contractor shall promptly rebuild, repair, restore, and make good damages to all portions of the permanent or temporary Work, except to the extent the Agency has assumed responsibility according to the provisions of (c) below. The Contractor shall perform all repairs of damage to Work at no additional cost to the Agency, except for repairs necessitated by damage caused by:

- Acts of God or Nature, as defined in Section 00110; or
- Actions of governmental authorities.

(c) Responsibility for Damage to Work Caused by Public Traffic - The Contractor may apply for relief of responsibility for damage to Work caused by Public Traffic by submitting a signed Contractor's Request for Relief of Responsibility, form 734-2768, to the Engineer by mail, personal delivery, courier, scanned and submitted via email, or other agreed-upon method.

The Engineer will process a maximum of two forms per month and return the forms within 7 Calendar Days indicating each item as "approved" or "denied".

The approval of the Engineer is limited, and is made only for the purposes of determining relief of responsibility for damage to completed portions of the Work caused by Public Traffic. The

completed portions of the Work are not considered complete, and are not finally accepted for any other purposes under the Contract.

If the Contractor disagrees with the Engineer's findings, the Contractor may request a Region level review according to 00199.40(b).

(1) Request for Relief - The Agency will only accept a request for relief from and will only assume responsibility for damages caused by Public Traffic, to the following completed portions of the Work:

- A segment of Roadway, drainage facilities, Slopes, lighting, traffic control devices and access facilities;
- A Bridge or other Structure within a segment of Roadway;
- Traffic signals and appurtenances at an intersection;
- Permanent, passive traffic control devices;
- Complete circuits of a highway lighting system; and
- Portions of a building open to public use.

The Agency will approve a request for the Agency to assume responsibility for damages to the completed portions of the Work caused by Public Traffic only under the following conditions:

- The completed portions of the Work are completed according to Contract Change Orders, the Plans or approved stage construction Plans;
- The traffic control complies with approved traffic control Plans; and
- All required Materials conformance and quality compliance documents pertaining to the completed portions of the Work are on file with the Engineer (see Section 00165).

(2) Scope of Relief - When the Agency assumes responsibility for damage to completed portions of the Work caused by Public Traffic, any damages will be repaired by the Contractor on a Changed Work basis, or by Agency forces, or by other means as determined by the Engineer. If completed portions of the Work are damaged by Public Traffic before Final Inspection, and the Agency requires the Contractor to repair the damages, the Engineer will reimburse the Contractor for the Changed Work at 75% of the total amount calculated according to Section 00197.

If completed portions of the Work are damaged by Public Traffic after Final Inspection, and the Agency requires the Contractor to repair the damages, the Engineer will reimburse the Contractor for the Work at 100% of the total amount calculated according to Section 00197.

If any additional Work is performed by the Contractor on completed portions of the Work for which the Agency has assumed responsibility for damages caused by Public Traffic, and the Work is performed outside of the approved stage construction Plans or approved traffic control Plans, the Contractor shall become fully responsible and liable, and shall make good all damages caused by Public Traffic at no additional cost to the Agency.

(d) Vandalism and Theft - Vandalism includes damage to or destruction of Work or portions of Work that remain on the Project Site resulting from vandalism, criminal mischief, arson, or other criminal or illegal behavior.

The Contractor shall provide reasonable protection of the Work from vandalism until Third Notification. If reasonable protection has been provided, the Contractor's responsibility for damage resulting from vandalism will be limited to $5,000.00 per occurrence. Requests for reimbursement

of amounts in excess of $5,000.00 shall be in writing and directed to the Engineer. Upon receipt, the Engineer will investigate, evaluate the amount of damages and their cause, determine the number of occurrences, and determine whether, and how much, the Contractor will be compensated.

Theft includes the loss of Work or portions of Work that are lost or stolen or otherwise unaccounted for from the Project Site or from Materials or fabrication locations. The Contractor shall remain solely responsible for all losses caused by theft, including, without limitation, theft that occurs in conjunction with vandalism.

00170.82 Responsibility for Damage to Property and Facilities:

(a) In General - As used in this Subsection, the term "Contractor" shall include the Contractor's agents, Subcontractors, and all workers performing Work under the Contract; and the term "damage" shall include without limitation soiling or staining surfaces by tracking or splashing mud, asphalt, and other materials, as well as damage of a more serious nature.

The Contractor shall be solely responsible for damages arising from:

- The Contractor's operations;
- The Contractor's negligence, gross negligence, or intentional wrongful acts; and
- The Contractor's failure to comply with any Contract provision.

The Agency may withhold funds due the Contractor or the Contractor's Surety until all lawsuits, actions, and claims for injuries or damages are resolved, and satisfactory evidence of resolution is furnished to the Agency.

(b) Protection and Restoration of Agency Property and Facilities - The following requirements apply to Highways, Highway Structures and other improvements that are existing, under construction, or completed. The Contractor shall:

- Provide adequate protection to avoid damaging Agency property and facilities;
- Be responsible for damage to Agency property and facilities caused by or resulting from the Contractor's operations; and
- Clean up and restore such damage by repair, rebuilding, replacement, or compensation, as determined by the Engineer.

(c) Protection and Restoration of Non-Agency Property and Facilities - The Contractor shall determine the location of properties and facilities that could be damaged by the Contractor's operations, and shall protect them from damage. The Contractor shall protect monuments and property marks until the Engineer has referenced their location and authorized their removal. The Contractor shall restore property or facilities damaged by its operations to the condition that existed before the damage, at no additional compensation.

The Contractor shall provide temporary facilities when needed, (e.g., to maintain normal service or as directed by the Engineer), until the required repair, rebuilding, or replacement is accomplished.

The Contractor shall protect specific service signs, (e.g., business logos, and tourist-oriented directional signs (TODS)) from damage, whether the signs are to remain in place or be placed on temporary supports. The Contractor shall repair or replace damaged signs at no cost to the Agency. Liquidated damages will be assessed against the Contractor in the amount of $200 per Day for each sign out of service for more than 5 Calendar Days because of the Contractor's operations.

00170.85 Responsibility for Defective Work - The Contractor shall make good any defective Work, Materials or Equipment incorporated into the Work, according to the provisions of Section 00150.

(a) Latent Defects - The Contractor shall remain liable for all latent defects resulting from causes other than fraud or gross mistakes that amount to fraud until the expiration of all applicable statutes of limitation and ultimate repose, the Performance Bond, Warranty Bond, or warranty period, whichever expires last. The Contractor shall remain liable for all latent defects resulting from fraud or gross mistakes that amount to fraud regardless of when those latent defects may be discovered, and regardless of whether such discovery occurs outside any applicable statutes of limitation or ultimate repose or any applicable Performance Bond, Warranty Bond, or warranty period.

(b) Contractor Furnished Warranties:

(1) Contractor Warranty for Specific Items - For those Items with Specifications referencing this 00170.85(b)(1) warranty, the Contractor warrants that the Work for those Items, including Changed Work, Additional Work, Incidental Work, On-Site Work, and Extra Work, and Materials and Equipment incorporated into the Work, shall meet the technical and performance Specifications required under the Contract. The warranty period will be identified in each applicable Specification or elsewhere in the Contract and will begin on the date of Second Notification. The Contractor shall be responsible for making good the Work, and for all repairs of damage to the Work and other improvements, natural and artificial structures, systems, equipment, and vegetation caused by, or resulting in whole or in part from, defects in warranted Materials, Equipment, and workmanship. The Contractor shall be responsible for all costs caused by, or resulting in whole or in part from, defects in warranted Materials, Equipment, or workmanship.

When the Agency makes written notification of failure of an item covered by this warranty, the warranty period will stop for the effected item or the portion of the effected item that failed, as applicable, until the required repairs or replacements are made and accepted. All repaired or replaced items shall meet current Specifications, unless otherwise specified in the Contract, and will be warranted for the remaining warranty period.

This warranty provision shall survive expiration or termination of the Contract.

(2) General Warranty for Local Agency Projects - For those Contracts that are developed, advertised, awarded, and administered by Local Agencies, and do not contain federal funding, this 00170.85(b)(2) warranty applies.

The Contractor shall warrant all Work and workmanship, including Changed Work, Additional Work, Incidental Work, On-Site Work, and Extra Work, and Materials and Equipment incorporated in the Work, for 1 year from the date of Second Notification, except that warranties according to 00170.85(b)(1) and manufacturers' warranties and extended warranties according to 00170.85(c) shall not be abridged.

The Contractor shall be responsible for meeting the technical and performance Specifications required, making good the Work, and for all repairs of damage to the Work and other improvements, natural and artificial structures, systems, equipment, and vegetation caused by, or resulting in whole or in part from, occurrences beginning during the warranty period and are the result of defects in Materials, Equipment, and workmanship. The Contractor shall be responsible for all costs associated with completing the repair of the defects and for associated Work including, but not limited to, permitting, mobilization, traffic control, erosion control, surface restoration, site cleanup and remediation caused by, or resulting in whole or in part from, defects in Materials, Equipment, or workmanship, and other Work determined by the Engineer to be necessary to complete the repair of the defects.

Within 10 Calendar Days of the Agency's written notice of defects, the Contractor, or the Contractor's Surety, shall vigorously and continuously correct and repair the defects and all related damage. If the Contractor or the Contractor's Surety fails to correct and repair the defects, the Agency may have the correction and repair done by others. The Contractor or Contractor's Surety shall promptly reimburse the Agency for all expenses incurred to correct and repair the defects.

In the event of an emergency, where delay could result in serious loss or damage, the Agency may make emergency corrections and repairs without written notice. The Contractor or Contractor's Surety shall promptly reimburse the Agency for all expenses incurred to correct and repair the defects.

Corrections, repairs, replacements or changes shall be warranted for an additional 1 year period beginning on the date of the Agency's acceptance of the corrections, repairs, replacements or changes.

Without limiting the general applicability of other survival clauses under the Contract, this warranty provision shall survive expiration or termination of the Contract.

(c) Manufacturer Warranties and Guarantees:

(1) Manufacturer Warranties - For those Specification Sections referencing 00170.85(c)(1), the Contractor shall furnish Warranties from the Manufacturer and signed by a Manufacturer's Representative.

The warranty period will be specified in the applicable Specification Section for which it applies.

The warranty period will begin on the date of Second Notification.

When the Agency makes written notification to the Manufacturer of failure of an item covered by this warranty, the warranty period will stop for the effected item or the portion of the effected item that failed, as applicable, until the required repairs or replacements are made and accepted. All repaired or replaced items shall meet current Specifications, unless otherwise specified in the Contract, and will be warranted for the remaining warranty period.

If, in the opinion of the Engineer, temporary repairs are necessary, the temporary repairs will be made by the Agency or an independent contractor at the Manufacturer's expense. The Manufacturer shall replace all temporary repairs at no additional cost to the Agency.

The Manufacturer shall provide all required traffic control during repair or replacement of failed items at no additional cost to the Agency.

Warranty work shall be performed when weather permits.

(2) Trade Practice Guarantees - For those Items installed on the Project that have customary trade practice guarantees, the Contractor shall furnish the guarantees to the Engineer at the completion of the Contract.

00170.89 Protection of Utility, Fire-control, and Railroad Property and Services; Repair; Roadway Restoration:

(a) Protection of Utility, Fire-Control, and Railroad Property and Services; Coordination - The Contractor shall avoid damaging the properties of Utilities, Railroads, railways, and fire-control authorities during performance of the Work. The Contractor shall cooperate with and facilitate the relocation or repair of all Utilities and Utility services, as required under 00150.50, and of Railroad and fire-control property and railways.

The Contractor shall conduct no activities of any kind around fire hydrants until the local fire-control authority has approved provisions for continued service.

The Contractor shall immediately notify any Utility, Railroad, or fire-control authority whose facilities have been damaged.

If an Entity has a valid permit from the proper authority to construct, reconstruct, or repair Utility, Railroad, or fire-control service in the Roadway, the Contractor shall allow the permit holder to perform the work.

(b) Restoration of Roadway after Repair Work - The Contractor shall restore the Roadway to a condition at least equal to that which existed before the repair work addressed under this Subsection was performed, as directed by the Engineer, at no additional cost to the Agency.

00170.92 Fencing, Protecting Stock, and Safeguarding Excavations - The Contractor shall be responsible for loss, injury, or damage that results from its failure to restrain stock and persons.

(a) At the Contractor's Expense - The Contractor shall restrain stock to lands on which they are confined using temporary fences or other adequate means. The Contractor shall provide adequate temporary fences or other protection around excavations to prevent animals and unauthorized persons from entering.

The Contractor shall repair, at Contractor's expense and to the Engineer's satisfaction, fences damaged by the Contractor's operations and the operations of the Contractor's agents, employees and Subcontractors.

(b) At the Agency's Expense - The Contractor shall construct fences, or move and reconstruct fences, as shown on the Contract Documents or as directed by the Engineer. The Contractor shall tear down and remove fencing within the Right-of-Way when no longer needed, as part of the removal Work described in and paid for according to Section 00310.

00170.93 Trespass - The Contractor shall be responsible for its own, its agents' and employees', and its Subcontractors' trespass or encroachment upon, or damage to, property during performance of the Contract.

00170.94 Use of Explosives - The Contractor shall comply with all Laws pertaining to the use of explosives. The Contractor shall notify anyone having facilities near the Contractor's operations of the Contractor's intended use or storage of explosives. The Contractor shall be responsible for all damage resulting from its own, its agents' and employees', and its Subcontractors' use of explosives. (See 00330.41(e) and Section 00335.)

Section 00180 - Prosecution and Progress

00180.00 Scope - This Section consists of requirements for assignment of the Contract, subcontracting, time for performance, Contract responsibility, suspensions, terminations, and related provisions.

00180.05 Assignment/Delegation of Contract - Unless the Agency gives prior written consent, which will not be unreasonably withheld, the Contractor shall not assign, delegate, sell, or otherwise transfer or dispose of any rights or obligations under the Contract, whether voluntarily or involuntarily, and whether by merger, consolidation, dissolution, operation of law, or any other manner, including, without limitation:

- The power to execute or duty to perform the Contract; or
- Any of its right, title or interest in the Contract.

Any purported or attempted assignment, delegation, sale, transfer or disposition without prior Agency consent shall be voidable.

If written Agency consent is given to assign, delegate, sell, or otherwise transfer or dispose of any rights or obligations under the Contract, such consent shall not relieve the Contractor or its Surety of any part of their duties, obligations, responsibilities, or liabilities under or pursuant to the Contract.

00180.06 Assignment of Funds Due under the Contract - Assignment of funds due or to become due under the Contract to the Contractor will not be permitted unless:

- The assignment request is made on the form provided by the Agency;
- The Contractor secures the written consent of the Contractor's Surety to the assignment; and
- The Engineer gives prior written consent to the assignment, which will not be unreasonably withheld.

00180.10 Responsibility for Contract - The Contractor shall direct and coordinate the operations of its employees, Subcontractors and agents performing Work, and see that the Engineer's orders are carried out promptly. The Contractor's failure to direct, supervise and control its employees, Subcontractors and agents performing Work will result in one or more of the following actions, as the Engineer deems appropriate:

- Suspension of the Work;
- Withholding of Contract payments, as necessary to protect the Agency;
- Ordering removal of individuals from the Project Site; or
- Termination of the Contract.

00180.15 Agency's Right to Do Work at Contractor's Expense - Except as otherwise provided in 00150.75 and 00220.60, if the Contractor neglects to prosecute the Work properly or fails to perform any provision of the Contract, the Agency may, after 2 Calendar Days' written notice, correct the deficiencies at the Contractor's expense. In situations where the Engineer reasonably believes there is danger to life or property, the Agency may immediately and without notice correct the deficiencies at the Contractor's expense.

Action by the Agency under this provision will not prejudice any other remedy it may have.

00180.20 Subcontracting Limitations:

(a) General - The Contractor's own organization shall perform Work amounting to at least 30% of the original Contract Amount. The value of subcontracted Work is the full compensation to be paid to the Subcontractor(s) for all pay items in the subcontract(s).

(b) Own Organization - The term "own organization", as used in Section 00180, includes only employees of the Contractor, Equipment owned or rented by the Contractor, Incidental rental of operated Equipment, truck hauling of Materials not included in or requiring a subcontract, and Materials and Equipment to be incorporated into the Work purchased or produced by the Contractor.

(c) Rental of Operated Equipment - The use of Equipment rented with operators, except truck hauling of materials which is addressed in 00180.20(e), will be allowed without a subcontract only when the following requirements are met:

(1) Written Request - The Contractor has submitted to the Engineer a written request describing the work or service to be provided, its estimated cost, and its estimated duration. The Engineer must approve the request before the work or service is provided.

(2) Limitations - The use of Equipment rented with operators is limited to performing minor, Incidental, short-duration work or services under the direct supervision of the Contractor or Subcontractor, with Equipment not customarily owned, rented, leased, or operated by a Contractor, or with Equipment that is temporarily unavailable to the Contractor.

(3) Submittals - The Contractor shall provide the Engineer with a copy of the rental agreement or purchase order covering the work or service to be provided. The Contractor shall make certain that the provider of approved work or services submits payrolls required under Section 00170 and complies with applicable Contract provisions, including, without limitation, 00170.07. The work or service provider will not be considered a Subcontractor under the Contract, but the work or services will be considered to have been performed by the Contractor's own organization for the purposes of determining compliance with 00180.20(a).

(4) Revocation of Approval - The Engineer may revoke approval for the work or services provided through rented, operated Equipment at any time the Engineer determines that the work is outside that authorized under 00180.20(c)(2). Unless the Contractor promptly submits to the Engineer a subcontract agreement for consent under 00180.21, the work or service provider shall be immediately removed from the Project Site.

(d) Disadvantaged Business Enterprise (DBE) - Every agreement to perform Work, including, without limitation, subcontracts, trucking services agreements, purchase orders, and rental agreements, shall indicate whether the Work will be performed by a DBE or non-DBE.

(e) Trucking - This Section does not apply to delivery of Materials by or for or from a Supplier. This Subsection applies to all truck hauling of Materials not performed with trucks owned (or rented) and operated by the Contractor. If the services under Rental of Operated Equipment or Trucking are provided by a committed DBE firm, a subcontract is required under 00180.21. For this purpose a committed DBE firm is one that was identified by the Contractor to meet an assigned DBE goal including DBE firms substituting for DBE firms committed as a condition of Contract Award.

(1) Trucking Services Agreement - The Contractor shall submit at the preconstruction conference one or more proposed trucking services agreements for all trucking services for hauling materials. The proposed agreements shall include:

- Statement specifying whether the services will be provided by a DBE;

- Statement specifying whether the services will be provided by an owner/operator;
- Prompt payment clause (10 days) (ORS 279C.580);
- Interest penalty clause (ORS 279C.580);
- Lower-tier clause (ORS 279C.580);
- Statement about the provider's ability to file a complaint with the Construction Contractors Board (ORS 279C.515);
- Statement that workers shall be paid not less than the specified minimum hourly rate of wage (ORS 279C.830) as applicable;
- Provision requiring the provider to have a public works bond filed with the Construction Contractors Board before starting work on the Project, unless exempt under ORS 279C.836(4) or (9), or has elected to not file a bond under ORS 279C.836(7) or (8), or is otherwise not applicable;
- Insurance clauses that include Commercial Automobile Liability and Workers Compensation (ORS 656.017 unless exempt under ORS 656.126);
- Provision requiring the provider to comply with applicable Contract provisions, including, without limitation, Record Requirements in 00170.07; and
- Construction Contractors Board License Number if applicable.

The Agency must review and consent to the proposed trucking services agreements prior to use.

(2) Limitations - The approved trucking services agreements shall be used for all trucking services for hauling Materials not provided by trucks owned (or rented) and operated by the Contractor except for trucking services provided by committed DBEs that require a subcontract under 00180.21. The Contractor shall execute a trucking services agreement with every trucking services provider for hauling Materials prior to the trucking services provider doing any Work on the Project Site.

(3) Submittals - The Contractor shall provide the Engineer with an executed copy of the trucking services agreement not later than 2 Days after the trucking services provider for hauling Materials has started work. The Contractor shall make certain that the provider of approved trucking services submits payrolls required under Section 00170, complies with applicable Contract provisions, including, without limitation, 00170.07, and complies with applicable trucking services agreement provisions. The work or service provider will not be considered a Subcontractor under the Contract, but the work or services will be considered to have been performed by the Contractor's own organization for the purposes of determining compliance with 00180.20(a). If the trucking services are provided by an owner/operator:

- Attach a copy of the data required under 00170.65(b)(4) to the trucking services agreement; and
- Each truck shall have the name of the owner/operator clearly displayed on the side of the truck.

(4) Revocation of Approval - The Engineer may revoke approval for trucking services provided under the trucking services agreement at any time the Engineer determines that the work or service is outside that authorized under 00180.20(e). Upon revocation of approval, the service provider shall be immediately removed from the Project Site.

00180.21 Subcontracting:

(a) General - The Contractor shall not subcontract or perform any portion of the Contract by other than the Contractor's own organization without the Agency's prior written consent. A request for consent to subcontract, at any tier, solely for the furnishing of a labor force will not be considered.

A written request for consent to subcontract any portion of the Contract at any tier shall be submitted to the Engineer, and when required by the Engineer, shall be accompanied by background information showing that the organization proposed to perform the Work is experienced and equipped for such Work. The Agency will review the Contractor's submission to verify compliance with Contract requirements, confirm the percentage of Work subcontracted, and evaluate the proposed Subcontractor's ability to perform the Work. If the Agency approves the Contractor's request to subcontract, the Agency will provide its consent to the Contractor's request as follows:

- If the Subcontractor is not providing any of the insurance coverages as permitted under 00170.70(a), the Agency will respond within 7 Calendar Days after the Engineer's receipt of the request.
- If the Subcontractor is providing any of the insurance coverages as permitted under 00170.70(a), the Agency will respond within 35 Calendar Days after the Engineer's receipt of the request. (28 Calendar Days for the Agency to review and approve the Certificates of Insurance required by 00170.70(f) plus 7 Calendar Days to review and approve the subcontract request.)

The Engineer may revoke consent to subcontract. If the Engineer revokes consent to subcontract, the Subcontractor shall be immediately removed from the Project Site.

(b) Submittal of Requests - The Contractor must submit requests for consent to subcontract any portion of the Contract, at any tier, on the Agency's form, available from the Engineer. The Contractor shall attach a duplicate original subcontract agreement. The Contractor must also submit in writing any amendments or modifications proposed to Agency-approved subcontract agreements, at any tier, before the affected Work begins. The Agency's written consent will be required before such amendments or modifications become effective.

The Contractor and proposed Subcontractors shall review the Agency's Conflict of Interest Guidelines, and if any disclosures are required, they shall complete the Conflict of Interest Disclosure Form(s) and submit them with the request for consent to subcontract. The ODOT Conflict of Interest Guidelines and Conflict of Interest Disclosure Form are available on the ODOT Procurement Office website (see 00110.05(e)).

If disclosures are not required under the Agency's Conflict of Interest Guidelines, no disclosures need be submitted.

The Subcontractors shall also otherwise be and remain in compliance with the Agency's Conflict of Interest Guidelines. (See 00170.78.)

(c) Substitution of Disclosed Subcontractors - The Contractor may only substitute a previously undisclosed first-tier Subcontractor according to the provisions of ORS 279C.585. The Contractor shall provide the Engineer with a written notification that identifies the name of the proposed new Subcontractor and the reason for the substitution. Authorized reasons for substitution are limited to the following circumstances (see ORS 279C.585(1) through ORS 279C.585(10)):

- The disclosed Subcontractor fails or refuses to execute a written contract that is reasonably based either upon the Project Plans and Specifications, or the terms of the Subcontractor's written Bid, after having had a reasonable opportunity to do so;

- The disclosed Subcontractor becomes bankrupt or insolvent;
- The disclosed Subcontractor fails or refuses to perform the contract;
- The disclosed Subcontractor fails or refuses to meet the bond requirements of the prime Contractor that had been identified prior to the Bid submittal;
- The Contractor demonstrates to the Agency that the Subcontractor was disclosed as the result of an inadvertent clerical error;
- The disclosed Subcontractor does not hold a license from the Construction Contractors Board and is required to be licensed by the board;
- The Contractor determines that the Work performed by the disclosed Subcontractor is not in substantial compliance with the Plans and Specifications, or that the Subcontractor is substantially delaying or disrupting the progress of the Work;
- The disclosed Subcontractor is ineligible to work on a public improvement according to the applicable statutory provisions;
- The substitution is for "good cause" as defined by State Construction Contractors Board rule; or
- The substitution is reasonably based on the Contract alternates chosen by the Agency.

(d) Terms of Subcontracts - All subcontracts shall provide that Work performed under the subcontract shall be conducted and performed according to, and shall include, the pertinent requirements, provisions, terms, and conditions of the Contract. Compliance with 00170.07 is required. All subcontracts, including Contractor's with the first-tier Subcontractors and those of the first-tier Subcontractors with their Subcontractors, and any other lower-tier subcontracts shall contain a clause or condition that if the Contractor or a Subcontractor fails, neglects, or refuses to make payment to an Entity furnishing labor or Materials in connection with the Contract, the Entity may file a complaint with the Construction Contractors Board, unless payment is subject to a good-faith dispute as defined in ORS 279C.580. Additionally, according to the provisions of ORS 279C.580, subcontracts shall include:

(1) A payment clause that obligates the Contractor to pay the first-tier Subcontractor for satisfactory performance under the subcontract within 10 Calendar Days out of amounts the Agency pays to the Contractor under the Contract.

(2) A clause that requires the Contractor to provide the first-tier Subcontractor with a standard form that the first-tier Subcontractor may use as an application for payment or as another method by which the Subcontractor may claim a payment due from the Contractor.

(3) A clause that requires the Contractor, except as otherwise provided in this Subsection, to use the same form and regular administrative procedures for processing payments during the entire term of the subcontract. The Contractor may change the form or the regular administrative procedures the Contractor uses for processing payments if the Contractor:

- Notifies the Subcontractor in writing at least 45 Calendar days before the date on which the Contractor makes the change; and
- Includes with the written notice a copy of the new or changed form or a description of the new or changed procedure.

(4) An interest penalty clause that obligates the Contractor, if the Contractor does not pay the first-tier Subcontractor within 30 Calendar Days after receiving payment from the Agency, to pay the first-tier Subcontractor an interest penalty on amounts due in each payment the Contractor does not make in accordance with the payment clause included in the subcontract under 00180.21(d)(1). The Contractor or first-tier Subcontractor is not obligated to pay an interest penalty if the only reason that the Contractor or first-tier Subcontractor did not make

payment when payment was due is that the Contractor or first-tier Subcontractor did not receive payment from the Agency or the Contractor when payment was due. The interest penalty applies to the period that begins on the day after the required payment date and ends on the date on which the amount due is paid; and shall be computed at the rate specified in 00170.10(c).

(5) A clause that requires the Contractor's first-tier Subcontractor to include a payment clause and an interest penalty clause that conform to the standards of ORS 279C.580 (see 00180.21(d)(1) and 00180.21(d)(4)) in each of the first-tier Subcontractor's subcontracts and to require each of the first-tier Subcontractor's Subcontractors to include such clauses in its subcontracts with each lower-tier Subcontractor or Material supplier.

These payment clauses shall require the Contractor to return all retainage withheld from the Subcontractor, whether held by the Contractor or the Agency, as specified in 00195.50(d).

As required by ORS 279C.800 through ORS 279C.870, subcontracts shall include:

- A provision requiring the Subcontractor to have a public works bond filed with the Construction Contractors Board before starting Work on the Project, unless exempt.
- A provision requiring that the workers shall be paid not less than the specified minimum hourly rate of wage.

As and when applicable, the Contractor shall require in its subcontracts that Subcontractors maintain the certifications required by ORS 279A.107.

(e) Contractor's Responsibilities - As a condition of the Agency's grant of consent to subcontract, whether or not stated in the subcontract agreement itself, the Contractor shall remain solely responsible for administration of the subcontract, including, but not limited to:

- Performance of subcontracted Work;
- Progress of subcontracted Work;
- Payments for accepted subcontracted Work; and
- Disputes and claims for additional compensation regarding subcontracted Work.

The Engineer's consent to subcontract will not create a contract between the Agency and the Subcontractor, will not convey to the Subcontractor any rights against the Agency, and will not relieve the Contractor or the Contractor's Surety of any of their responsibilities under the Contract.

(f) Failure to Comply - Failure to comply with 00180.21 will be cause for the Engineer to take action reasonably necessary to obtain compliance. This action may include, but is not limited to:

- Suspension of the Work;
- Withholding of Contract payments as necessary to protect the Agency; and
- Termination of the Contract.

(g) Mentor-Protégé Agreement - If the Contractor enters into a subcontract with an Emerging Small Business (ESB) Subcontractor, the Agency may offer the Contractor and its ESB Subcontractor an opportunity to enter into a Project specific Mentor-Protégé Agreement.

The Project specific Mentor-Protégé Agreement will be paid for and specified by Change Order.

00180.22 Payments to Subcontractors and Agents of the Contractor - To the extent practicable, the Contractor shall pay in the same units and on the same basis of measurement as listed in the Schedule of Items for subcontracted Work or other Work not done by the Contractor's own organization. The Agency will not be responsible for any overpayment or losses resulting from

overpayment by the Contractor to Subcontractors and to its other agents, work providers, service providers, and trucking services providers.

If requested, the Engineer will make estimates of the Work quantities performed by Subcontractors or by others on the Project, and of Materials eligible for advances on Materials in the progress payments. These estimates are approximate only, and will be made in units of measure as listed in the Schedule of Items. The Agency does not guarantee the accuracy of these estimates, and an incorrect estimate will not bind the Agency in final settlement.

If requested in writing by a first-tier Subcontractor, the Contractor shall send to the Subcontractor, within 10 Calendar Days of receiving the request, a copy of that portion of any invoice or request for payment submitted to the Agency, or pay document provided by the Agency to the Contractor, specifically related to any labor, Equipment, or Materials supplied by the first-tier Subcontractor.

00180.30 Materials, Equipment, and Work Force - The Contractor shall furnish suitable and sufficient Materials, Equipment, and personnel to properly prosecute and complete the Work. The Contractor shall use only Equipment of adequate size and condition to meet the requirements of the Work and Specifications, and to produce a satisfactory quality of Work. Upon receipt of the Engineer's written order, the Contractor shall immediately remove, and not use again on the Project without the Engineer's prior written approval, Equipment that, in the Engineer's opinion, fails to meet Specifications or produce a satisfactory product or result.

The work force shall be trained and experienced for the Work to be performed. Upon receipt of the Engineer's written order, the Contractor shall immediately remove from the Project Site, and shall not employ again on the Project without the Engineer's prior written approval, any supervisor or employee of the Contractor or any Subcontractor who, in the Engineer's opinion, does not perform satisfactory Work or whose conduct interferes with the progress of the Work.

If the Contractor fails to remove Equipment or persons as ordered, or fails to furnish suitable and sufficient Materials, Equipment and personnel for the proper prosecution of the Work, the Engineer may suspend the Work by written notice until such orders are complied with and such deficiencies are corrected, or the Engineer may terminate the Contract under the provisions of 00180.90(a).

00180.31 Required Materials, Equipment, Products, and Methods - The Engineer's decisions under this Section are final. Substitutions after Award will be considered as provided below unless specified as the subject of an exemption per ORS 279C.345. See 00120.16 for possible substitutions before Bid Opening.

(a) General - When the Equipment and methods to be used are not specified in the Contract, any Equipment or methods that accomplish the Work as required by the Contract will be permitted.

When the Contract specifies certain Equipment or methods, the Contractor shall use the Equipment or methods specified unless otherwise authorized by the Engineer in writing.

(b) Substitution of Materials, Products, and Equipment to be Incorporated into the Work - After execution of the Contract, the Engineer may approve substitution of Materials, products, and Equipment to be incorporated into the Work as follows:

(1) Reasons for Substitution - The Engineer will consider substitution only if:

- The proposed Materials, products, or Equipment are equal to or superior to the specified items in construction, efficiency and utility; or
- Due to reasons beyond the control of the Contractor, the specified Materials, products, or Equipment cannot be delivered to the Project in sufficient time to complete the Work in proper sequence.

(2) Submittal of Request - The Contractor shall submit requests for substitution to the Engineer, including manufacturers' brochures and other information needed to verify equality of the proposed item(s).

(c) Substitution of Equipment Specified to Perform Work - The Agency encourages development of new or improved Equipment and innovative use of Equipment. When the Specifications require Equipment of a particular size or type to be used to perform certain portions of the Work, the Contractor may submit a request to the Engineer to use Equipment of a different size or type. The request will not be considered as a cost reduction proposal under 00140.70. The request shall:

- Be in writing and include a full description of the Equipment proposed and its intended use;
- Include the reasons for requesting the substitution; and
- Include evidence, obtained at the Contractor's expense and satisfactory to the Engineer, that the proposed Equipment is capable of functioning as well as or better than the specified Equipment.

The Engineer will consider the Contractor's request and will provide a written response to the Contractor, either permitting or denying use of the proposed Equipment.

Permission may be granted on a trial basis to test the quality of Work actually produced, subject to the following:

- There will be no cost to the Agency, either in Contract Amount or in Contract Time;
- The permission may be withdrawn by the Engineer at any time if, in the Engineer's opinion, the Equipment is not performing in all respects equivalent to the Equipment specified in the Contract;
- If permission is withdrawn, the Contractor shall perform the remaining Work with the originally-specified Equipment; and
- The Contractor shall remove and replace non-specification work resulting from the use of the Contractor's proposed Equipment, or otherwise correct it as the Engineer directs, at no additional compensation.

(d) Substitution of Methods - The Agency encourages development of new, improved, and innovative construction methods. When the Plans or Specifications require a certain construction method for a portion of the Work, the Contractor may submit a request for a change by following the provisions of 00140.70, "Cost Reduction Proposals".

00180.32 Alternative Materials, Equipment, and Methods - Whenever the Contract authorizes certain alternative Materials, Equipment, or methods of construction for the Contractor's use to perform portions of the Work, and leaves the selection to the Contractor, the Agency does not guarantee that all listed alternative Materials, Equipment, or methods of construction can be used successfully throughout all or any part of the Work.

The Contractor shall employ only those alternatives that can be used to satisfactorily perform the Work. No additional compensation will be paid for corrective work necessitated by the Contractor's use of an inappropriate alternative.

00180.40 Limitation of Operations:

(a) In General - The Contractor shall comply with all Contract provisions and shall:

- Conduct the Work at all times so as to cause the least interference with traffic, and
- Not begin Work that may allow damage to Work already started.

(b) On-Site Work - The Contractor shall not begin On-Site Work until the Contractor has:

- Received Notice to Proceed;
- Filed with the Construction Contractors Board the public works bond as required in 00170.20;
- An approved Project Work schedule;
- An approved Traffic Control Plan;
- An approved Pollution Control Plan;
- An approved Erosion and Sediment Control Plan;
- Met with the Engineer at the required preconstruction conference; and
- Assembled all Materials, Equipment, and labor on the Project Site, or has reasonably assured that they will arrive on the Project Site, so the Work can proceed according to the Project Work schedule.

00180.41 Project Work Schedules - The Contractor shall submit a Project Work schedule meeting the requirements of this Subsection to the Engineer. The Project Work schedule is intended to identify the sequencing of activities and time required for prosecution of the Work. The schedule is used to plan, coordinate, and control the progress of construction. Therefore, the Project Work schedule shall provide for orderly, timely, and efficient prosecution of the Work, and shall contain sufficient detail to enable both the Contractor and the Engineer to plan, coordinate, analyze, document, and control their respective Contract responsibilities. Sufficient detail shall also include all required double shifts, overtime work, or combination of both necessary to complete Contract Work within the Contract Time.

Contractor's activity related to developing, furnishing, monitoring, and updating these required schedules is Incidental.

The Contractor shall submit a supplemental "look ahead" Project Work schedule each week to the Engineer. The "look ahead" Project Work schedule is supplemental to the Type A, B, or C schedule specified below. The supplemental "look ahead" Project Work schedule shall:

- Identify the sequencing of activities and time required for prosecution of the Work.
- Provide for orderly, timely, and efficient prosecution of the Work.
- Contain sufficient detail to enable both the Contractor and the Engineer to plan, coordinate, analyze, document, and control their respective Contract responsibilities.

The supplemental "look ahead" Project Work schedule shall be written in common terminology and show the planned Work activities broken down into logical, separate activities by area, stage, and size and include the following information:

- The resources the Contractor, Subcontractors, or services will use.
- The locations of each activity that will be done including the limits of the Work by mile posts, stations, or other indicators.
- The time frames of each activity by Calendar Days, shifts, and hours.
- All anticipated Shoulder, lane, and road closures.

At a minimum, the Contractor shall prepare a bar chart that:

- Shows at least 3 weeks of activity including the week the bar chart is issued.
- Uses a largest time scale unit of 1 Calendar Day. Smaller time scale units may be used if needed.
- Is appropriate to the activities.
- Identifies each Calendar Day by month and day.

Include the Contract name, Contract number, Contractor's name, and date of issue on each page of the bar chart.

The Contractor shall submit the supplemental "look ahead" Project Work schedule starting at First Notification and continuing each week until Second Notification has been issued and all punch list items and final trimming and clean-up has been completed. The Contractor shall meet with the Engineer each week to review the supplemental "look ahead" Project Work schedule. If the Engineer or the Contractor determines that the current supplemental "look ahead" Project Work schedule requires changes or additions, either notations can be made on the current schedule or the Engineer may require the submittal of a revised supplemental "look ahead" Project Work schedule. Review of the current and subsequent supplemental "look ahead" Project Work schedules does not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

One of the following Type "A", "B", or "C" schedules will be required under the Contract. The type of schedule will be identified in the Special Provisions.

(a) Type "A" Schedule - When a Type "A" schedule is required, the Contractor shall do the following:

(1) Schedule - At least 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Engineer four copies of a Project Work schedule, including a time-scaled bar chart and narrative, showing:

- Expected beginning and completion dates of each activity, including all staging; and
- Elements of the Traffic Control Plan as required under 00221.06.

The schedule shall show detailed Work activities as follows:

- Construction activities;
- The time needed for completion of the Utility relocation work;
- Submittal and approval of Materials samples and shop drawings;
- Fabrication, installation, and testing of special Materials and Equipment; and
- Duration of Work, including completion times of all stages and their sub phases.

For each activity, the Project Work schedule shall list the following information:

- A description in common terminology;
- The quantity of Work, where appropriate, in common units of measure;
- The activity duration in Calendar Days; and
- Scheduled start, completion, and time frame shown graphically using a time-scaled bar chart.

The schedule shall show the Work broken down into logical, separate activities by area, stage, or size. The duration of each activity shall be verifiable by manpower and Equipment allocation, in common units of measure, or by delivery dates.

The bar chart shall be prepared as follows:

- The length of bar shall represent the number of workdays scheduled.
- The time scale shall be appropriate for the duration of the Contract.
- The time scale shall be in Calendar Days.
- The smallest unit shown shall be 1 Calendar Day.
- The first day and midpoint of each month shall be identified by date.
- Distinct symbols shall be used to denote multiple shift, holiday, and weekend Work.

Each page of the bar chart shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the bar chart shall be drawn on a reasonable size of paper up to a maximum of 36 inch by 36 inch, using multiple sheets when needed.

Within 7 Calendar Days after the preconstruction conference, the Engineer and the Contractor shall meet to review the Project Work schedule as submitted. The Engineer will review the schedule for compliance with all Contract Time limitations and other restraints. Review of this and subsequent schedules by the Engineer shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract. Within 10 Calendar Days of this meeting, the Contractor shall resubmit to the Engineer four copies of the Project Work schedule, including required revisions.

(2) Review by the Engineer - The Project Work schedule may need revision as the Work progresses. Therefore, the Contractor shall periodically review the Project Work schedule and progress of the Work with the Engineer. If the Engineer or the Contractor determines that the Project Work schedule no longer represents the Contractor's own plans or expected time for the Work, a meeting shall be held between the Engineer and the Contractor. At this meeting, the Contractor and the Engineer shall review Project events and any changes for their effect on the Project Work schedule.

The Contractor shall compile an updated Project Work schedule incorporating any changes to the Project completion time(s). The bar chart shall reflect the updated information. The Contractor shall submit four copies of the updated Project Work schedule to the Engineer within 7 Calendar Days after the meeting. The report shall include without limitation the following:

- Sufficient narrative to describe the past progress, anticipated activities, and stage Work;
- A description of any current and expected changes or delaying factors and their effect on the construction schedule; and
- Proposed corrective actions.

(b) Type "B" Schedule - When a Type "B Schedule is required, the Contractor shall do the following:

(1) Initial Schedule - At least 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Engineer four copies of a time-scaled bar chart Project Work schedule showing:

- Expected beginning and completion date of each activity, including all staging; and
- Elements of the Traffic Control Plan as required under 00221.06.

The initial schedule shall show all Work intended for the first 60 Days of the Contract to the level of detail described in (2) below, and shall show the priority and interdependence (sequencing and network logic) of all major segments of the remainder of the Work.

(2) Detailed Schedule - In addition to the above requirements, and within 30 Calendar Days after the Notice to Proceed, the Contractor shall provide the Engineer one digital copy and four paper copies of a detailed time-scaled bar chart Project Work schedule indicating the critical course of the Work. The digital copy shall be compatible with the current version of Microsoft Project, the current version of Primavera P6 by Oracle, or another scheduling program approved by the Engineer.

Detailed work schedule activities shall include the following:

- Construction activities;
- The time needed for completion of the Utility relocation work;
- Submittal and approval of Material samples and shop drawings;
- Procurement of critical Materials;
- Fabrication, installation, and testing of special Material and Equipment; and
- Duration of Work, including completion times of all stages and their sub phases.

For each activity, the Project Work schedule shall list the following information:

- A description in common terminology;
- The quantity of Work, where appropriate, in common units of measure;
- The activity duration in normal workdays; and
- Scheduled start, completion, and time frame shown graphically using a time-scaled bar chart.

The schedule shall show the Work broken down into logical, separate activities by area, stage, or size. The duration of each activity shall be verifiable by manpower and Equipment allocation, in common units of measure, or by delivery dates.

The bar chart shall be prepared as follows:

- The length of bar shall represent the number of normal workdays scheduled.
- The time scale shall be appropriate for the duration of the Contract.
- The time scale shall be in normal workdays (every day except Saturday, Sunday, and legal holidays).
- The smallest unit shown shall be 1 Calendar Day.
- The first day and midpoint of each month shall be identified by date.
- Distinct symbols shall be used to denote multiple shift, holiday, and weekend Work.

The bar chart drawing(s) shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the bar chart shall be drawn on a reasonable size of paper up to a maximum of 36 inch x 36 inch, using multiple sheets when needed.

Within 10 Calendar Days after submission of the Project schedule the Engineer and the Contractor shall meet to review the Project schedule as submitted. Within 10 Days of the review meeting, the Contractor shall resubmit to the Engineer one digital and four paper copies of the Project schedule, including required revisions.

The accepted Project schedule shall represent all Work, as well as the planned sequence and time for the Work. Review of this and subsequent schedules by the Engineer shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

(3) Review and Reporting - The Project Work schedule may require revision as the Work progresses. Therefore, the Contractor shall monitor and when necessary revise the Project Work schedule as follows:

a. Review with the Engineer - The Contractor shall perform ongoing review of the Project Work schedule and progress of the Work with the Engineer. If the Engineer or the Contractor determines that the Project Work schedule no longer represents the Contractor's own plans or expected time for the Work, a meeting shall be held between the Engineer and the Contractor. At this meeting, the Contractor and the Engineer shall review Project events and any changes for their effect on the Project Work schedule. After any necessary action has been agreed upon, the Contractor shall make required changes to the Project Work schedule.

The Contractor shall collect information on all activities worked on or scheduled to be worked on during the previous report period, including shop drawings, Material procurement, and Contract Change Orders that have been issued. Information shall include commencement and completion dates on activities started or completed, or if still in progress, the remaining time duration.

The Contractor shall develop detailed sub-networks to incorporate changes, Additional Work, and Extra Work into the Project Work schedule. Detailed sub-networks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. The restraints shall include those activities from the Project Work schedule that initiated the sub-network as well as those restrained by it.

The Contractor shall evaluate this information and compare it with the Contractor's Project schedule. If necessary, the Contractor shall make an updated bar chart schedule to incorporate the effect changes may have on the Project completion time(s). For any activity that has started, the Contractor shall add a symbol to show the actual date the activity started and the number of normal workdays remaining until completion. For activities that are finished, a symbol shall be added to show the actual date. The Contractor shall submit one digital and four paper copies of the updated bar chart to the Engineer within 7 Days after the progress meeting, along with a progress report as required by "b." below.

b. Progress Report - The Contractor shall submit a progress report to the Engineer each month. The report shall include the following:

- Sufficient narrative to describe the past progress, anticipated activities, and stage Work;
- A description of any current and expected changes or delaying factors and their effect on the construction schedule; and
- Proposed corrective actions.

(c) Type "C" Schedule - When a Type "C" Schedule is required, the Contractor shall do the following:

(1) Initial Schedule - At least 10 Calendar Days prior to the preconstruction conference, the Contractor shall provide to the Engineer one digital copy and four paper copies of a time-scaled bar chart Project Work schedule. The digital copy shall be compatible with the current version of Microsoft Project, the current version of Primavera P6 by Oracle, or another scheduling program approved by the Engineer. The initial schedule shall show:

- The expected beginning and completion date of each activity, including all stages and phases;
- The time needed for completion of the Utility relocation work; and
- The elements of the traffic control plan as required under 00221.06.

A logic diagram and a time-scaled bar chart will be acceptable in lieu of a time-scaled logic diagram.

The initial schedule shall show all Work intended for the first 60 Days of the Contract to the level of detail described in (2) below, and shall show the priority and interdependence (sequencing and network logic) of all major segments of the remainder of the Work.

(2) Detailed Project Work Schedule - In addition to the above requirements, and within 30 Calendar Days after First Notification, the Contractor shall provide the Engineer one digital copy and four paper copies of a detailed time-scaled critical path method (CPM) network Project Work schedule and computer analysis printout, both clearly indicating the critical path. The digital copy shall be compatible with the current version of Microsoft Project, the current version of Primavera P6 by Oracle, or another scheduling program approved by the Engineer. The first submitted detailed time-scaled critical path method (CPM) network Project Work schedule shall also contain a listing of the quantity of Work for each activity, when appropriate, in common units of measure.

Detailed work schedule activities shall include the following:

- Construction activities;
- Any limitations of operation specified in 00180.40;
- The time needed for completion of the Utility relocation work;
- Implementation of TCP for each stage and phase;
- Submittal and approval of Material samples, mix designs, and shop drawings;
- Agency timeframes to process and return Contractor submitted plans, Working Drawings, Equipment lists and other submittals;
- Procurement of critical Materials;
- Fabrication, installation, and testing of special Material and Equipment;
- Duration of Work, including completion times of all stages and their sub-phases; and
- Specified cure times for all concrete elements.

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable and consistent with the description in the Project narrative required in (3) below.

Detailed sub-networks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. In the restraints, include those activities from any Project Work schedule that initiated the sub-network as well as those restrained by it.

The time scale used on the Contractor's detailed time-scaled critical path method (CPM) network Project Work schedule shall be appropriate for the duration of the activities and the Project duration. The time scale shall be in normal workdays, defined as every day except Saturday, Sunday and legal holidays, with calendar dates identified no less than the first and midpoint of each calendar month. The smallest unit shown shall be 1 Day. The network shall show the length of the activity or part scaled to accurately represent the number of normal workdays scheduled. Distinct symbols or graphics shall be used to show multiple shift, holiday, or weekend work.

The schedule network drawing(s) shall include a title block showing the Contract name and number, Contractor's name, date of original schedule, and all update dates; and a legend containing the symbols used, their definitions, and the time scale, shown graphically. To ensure readability the drawings shall be on a reasonable size of paper up to a maximum of 36 inch x 36 inch, using multiple sheets when needed.

The Contractor shall include a tabulation of each activity in the computer mathematical analysis of the network diagram. The following information represents the minimum required for each activity:

- Event (node) number(s) for each activity;
- Maintain event (node) numbers throughout the Project;
- Activity description;
- Original duration of activities (in normal workdays);
- Estimated remaining duration of activities (in normal workdays);
- Earliest start date and actual start date (by calendar date);
- Earliest finish date and actual finish date (by calendar date);
- Latest start date (by calendar date);
- Latest finish date (by calendar date); and
- Slack or float time (in workdays).

Computer print-outs shall consist of at least a node sort and an "early start/total-float" sort.

Within 14 Calendar Days after submission of the detailed time-scaled critical path method (CPM) network Project Work schedule, the Engineer and the Contractor shall meet to review the detailed time-scaled critical path method (CPM) network Project Work schedule as submitted. Within 7 Calendar Days of the meeting, the Contractor shall resubmit to the Engineer one digital and four paper copies of the detailed time-scaled critical path method (CPM) network Project Work schedule, including required revisions.

This first accepted detailed time-scaled critical path method (CPM) network Project Work schedule, also called the accepted Project Work schedule, shall represent all Work, as well as the planned sequence and time for the Work. Review and acceptance of any Project Work schedules and Project narratives by the Engineer shall not relieve the Contractor of responsibility for timely and efficient execution of the Contract.

(3) Project Narrative - In addition to the above requirements, and within 30 Calendar Days after First Notification, the Contractor shall provide to the Engineer a final written Project

narrative that discusses the planning, coordinating, scheduling and resourcing of the Work. The Project narrative shall include the following written description:

- Plans for staging the Project.
- All critical activities.
- All near critical activities defined as those with less than 30 Days of float.
- All Subcontractor activities that are critical, near critical, and those that are greater than two weeks in duration.
- Labor resourcing, by stage and phase, to include the number of crews, average crew size and planned night/weekend shifts including that of Subcontractors.
- Equipment allocation, by stage and phase to include mobilization, demobilization and planned activities including that of Subcontractors.
- Notifications required under the Contract during each stage and phase which may include but is not limited to road closures, lanes closures, night work, cold plane Pavement removal, and pile driving.
- Provide discussion on addressing reasonably predictable weather conditions and their impact on all weather sensitive activities. Also, provide discussion on other weather limitations that may affect the Project schedule.
- Submittal and approval of material samples, mix designs, and shop drawings.
- Procurement of critical materials.
- Plans for dealing with "unique" construction items.
- Coordination of utilities and any immediate concerns for impacts/delays.
- Constructability issues.
- Cost Reduction Proposals and/or immediate requests for changes to the Specifications.
- Concerns/issues that need to be addressed within the first 90 Days following First Notification.

The accepted Project narrative shall represent all critical and near critical Work, as well as the planned sequence and time for the Work.

(4) Review and Reporting - The Project Work schedule may require revision as the Work progresses. Therefore, the Contractor shall monitor and when necessary revise the Project Work schedule as follows:

a. Review with the Engineer - The Contractor shall perform ongoing review of the accepted Project Work schedule and progress of the Work with the Engineer. If the Engineer or the Contractor determines that the accepted Project Work schedule no longer represents the Contractor's own plans or expected time for the Work, a meeting shall be held between the Engineer and the Contractor. At this meeting, the Contractor and the Engineer shall review Project events and any changes for their effect on the accepted Project Work schedule. After any necessary action has been agreed upon, the Contractor shall make required changes to the accepted Project Work schedule and associated Project narrative. Upon acceptance by the Engineer, this will become the new accepted Project Work schedule and associated Project narrative.

The Contractor shall collect information on all activities worked on or scheduled to be worked on during the previous report period, including shop drawings, Material procurement, and Contract Change Orders that have been issued. Information shall include actual start and completion dates on activities started or completed, or if still in progress, the remaining time duration.

The Contractor shall develop detailed sub-networks to incorporate changes, Additional Work, and Extra Work into the Project Work schedule. Detailed sub-networks shall include all necessary activities and logic connectors to describe the Work and all restrictions on it. The restraints shall include those activities from the Project Work schedule that initiated the sub-network as well as those restrained by it. The procedure for acceptance of the revised or updated Project Work schedule as the new accepted Project Work schedule will be as provided above.

The Contractor shall evaluate this information each month and compare it with the accepted Project Work schedule. The Contractor shall make an updated bar chart schedule to incorporate the effect changes may have on the Project completion time(s). For any activity that has started, the Contractor shall add a symbol to show the actual date the activity started and the number of normal workdays remaining until completion. For activities that are finished, a symbol shall be added to show the actual date. The Contractor shall submit, digitally and in paper, copies of the updated bar chart to the Engineer within 7 Days after the progress meeting, along with a progress report as required by "b." below.

b. Progress Report - Each month the Contractor shall submit a progress report and an update of the Project Work schedule to the Engineer. The report and updated schedule shall be submitted both digitally and in paper copy and shall include the following:

- A sufficient description, in narrative form, to describe the past progress, anticipated activities, and stage Work;
- A description of any current and expected changes or delaying factors and their effect on the construction schedule;
- Proposed corrective actions;
- Proposals to keep the Project on schedule in the event of a delay; and
- Any changes to the logic as compared to the accepted Project Work schedule.

(d) Substitution of Schedules - When a Type "A" schedule is required, a Type "B" or Type "C" schedule may be substituted for the Type "A" schedule.

When a Type "B" schedule is required, a Type "C" schedule may be substituted for the Type "B" schedule.

(e) Specified Contract Time Not Superseded by Schedule Revisions - The completion dates in any Project Work schedule and any revised or updated Project Work schedules shall be within the Contract Time(s) specified for the Project, or within adjusted Contract Times approved according to 00180.80(c). Acceptance of any Project Work schedule or any revised or updated Project Work schedules shall not constitute approval of any completion dates that exceed such Contract Time(s). If the Contractor believes that additional Contract Time is due, the Contractor shall submit, with a revised Project Work schedule, a request for adjustment of Contract Time according to 00180.80(c). A request for an adjustment of Contract Time will be evaluated using the most recently accepted Project Work schedule.

(f) Float Time - Float time shown on the Project Work schedule, including any time between a Contractor's scheduled completion date and the specified Contract Time(s), does not exist for the exclusive use of either party to the Contract and belongs to the Project.

(g) Schedules Do Not Constitute Notice - Submittal of a Project Work schedule, with supporting Project narrative, does not constitute or substitute for any notice the Contractor is required under the terms of the Contract to give the Agency.

(h) Failure to Provide Schedule - The Project Work schedule is essential to the Agency. The Contractor's failure to provide the schedule, schedule information, progress reports, Project narratives, or schedule updates when required will be cause to suspend the Work, or to withhold Contract payments as necessary to protect the Agency, until the Contractor provides the required information to the Engineer.

00180.42 Preconstruction Conference - Unless otherwise approved in writing by the Engineer, before any Work is performed and within 30 Calendar Days of the Notice to Proceed, the Contractor shall meet with the Engineer for a preconstruction conference at a time mutually agreed upon.

00180.43 Commencement and Performance of Work - From the time of commencement of the Work to the time of Final Acceptance the Contractor shall:

- Provide adequate Materials, Equipment, labor, and supervision to perform and complete the Work within the Contract Time or the adjusted Contract Time;
- Perform the Work as vigorously and as continuously as conditions permit, and according to a Project Work schedule that ensures completion within the Contract Time or the adjusted Contract Time;
- Not voluntarily suspend or slow down operations without prior written approval from the Engineer, and if approved submit an updated Project Work schedule according to 00180.41 that ensures completion within the Contract Time or the adjusted Contract Time; and
- Not resume suspended Work without the Engineer's written authorization.

00180.50 Contract Time to Complete Work:

(a) General - The time allowed to complete the Work or Pay Item is stipulated in the Solicitation Documents, and will be known as the "Contract Time". (See 00110.20.)

(b) Kinds of Contract Time - The Contract Time will be expressed in one or more of the following ways:

(1) Fixed Date Calculation - The calendar date on which the Work or Pay Item shall be completed; or

(2) Calendar Day Calculation - The number of Calendar Days from a specified beginning point in which the Work or Pay Item shall be completed.

(c) Beginning of Contract Time - When the Contract Time is stated in Calendar Days, counting of Contract Calendar Days will begin on the day the Contractor begins On-Site Work as defined in 00110.20.

(d) Recording Contract Time - All Contract Time will be recorded and charged to the nearest one-half Day.

On Contracts with Calendar Day counts, the Engineer will furnish the Contractor a weekly statement of Contract Time charges. The statement will show the number of Calendar Days counted for the preceding week and the number of Calendar Days remaining prior to the established completion date for the specified Work in 00180.50(h).

For Contracts with fixed completion dates for Pay Items, the Engineer will furnish the Contractor a weekly statement of Contract Time charges only after expiration of the Contract Time. The statement will show the number of Calendar Days of liquidated damages that have been assessed, if any.

These statements will include any exclusions from, or adjustments to, Contract Time.

(e) Exclusions from Contract Time - Regardless of the way Contract Time is expressed in the Contract, certain Calendar Days will not be charged against Contract Time. These exclusions will be allowed when the Contractor is prevented from performing Work due to one of the following reasons, resulting in delay:

- Acts of God or Nature;
- Court orders enjoining prosecution of the Work;
- Strikes, labor disputes or freight embargoes that, despite the Contractor's reasonable efforts to avoid them, cause a shutdown of the entire Project or one or more major operations. "Strike" and "labor dispute" may include union action against the Contractor, a Subcontractor, a materials Supplier, or the Agency; or
- Suspension of the Work by written order of the Engineer for reasons other than the Contractor's failure or neglect.

(f) Time Calculation Protest - In the event the Contractor disputes the accuracy of the statement of Contract Time charges, it shall immediately contact the Engineer and attempt to resolve the dispute. If the dispute cannot be resolved informally, the Contractor shall submit a formal written protest to the Engineer within 7 Calendar Days of the date the Engineer mailed or delivered the statement. Failure to submit a formal written protest within the 7 Calendar Day period constitutes the Contractor's approval of the time charges, or adjusted time charges, itemized in the statement.

(g) End of Contract Time - When the Engineer determines that the On-Site Work has been completed, except for the items listed below, the Engineer will issue a Second Notification.

The Second Notification will list:

- The date the time charges stopped;
- Final trimming and cleanup tasks (see 00140.90);
- Equipment to be removed from the Project Site;
- Minor corrective work not involving additional payment to be completed; and
- Submittals, including, without limitation, all required certifications, bills, forms, warranties, certificate of insurance coverage (00170.70(b)), and other documents, required to be provided to the Engineer before Third Notification will issue.

The Contractor shall complete all tasks listed in the Second Notification in an expeditious manner within the time frame proposed by the Contractor and accepted by the Engineer. Unless otherwise agreed by the Agency, failure of the Contractor to complete all tasks listed in the Second Notification within the time frame accepted, will result in the Agency rescinding the Second Notification. Counting of time charges will resume upon expiration of the accepted time frame.

00180.60 Notice of Delay - The Contractor shall notify the Engineer of any delay that will likely prevent completion of the Work or a Pay Item by the date specified in the Project Work schedule. The notice shall be in writing and shall be submitted within 7 Calendar Days of when the Contractor knew or should have known of the delay. The notice shall include, to the extent available, the following:

- The reasons or causes for the delay;
- The estimated duration of the delay and the estimated resulting cumulative delay in Contract completion;
- Except for 00180.50(e) and 00180.65 delays, whether or not the Contractor expects to request an adjustment of Contract Time due to the delay;

- Whether or not the Contractor expects to accelerate due to the delay; and
- Whether or not the Contractor expects to request additional compensation due to the delay. Except for 00180.50(e) and 00180.65 delays, failure to include this information will constitute waiver of the Contractor's right to later make such a request.

00180.65 Right-of-Way and Access Delays - Right-of-Way and access delays will be taken into consideration in adjusting Contract Time, and in approving additional compensation if the performance of the Work is delayed because of the Agency's failure to make available to the Contractor:

- Necessary Rights-of-Way;
- Agency-owned or Agency-controlled Materials sources that are offered in the Contract for the Contractor's use; or
- Access to, or rights of occupancy of, buildings and other properties the Contractor is required to enter or to disturb according to Contract requirements.

If the ending date of an anticipated delay is stated in the Special Provisions, only the delay occurring after that date will be considered for adjusting Contract Time or providing additional compensation.

00180.70 Suspension of Work:

(a) General - The Engineer has authority to suspend the Work, or part of the Work, for any of the following causes:

- Failure of the Contractor to correct unsafe conditions;
- Failure of the Contractor to carry out any provision of the Contract;
- Failure of the Contractor to carry out orders issued by the Engineer, the Agency, or any regulatory authority;
- Existence of conditions unsuitable to proper or safe performance of the Work; or
- Any reason considered by the Agency to be in the public interest.

When Work has been suspended for any reason, the Contractor shall not resume Work without the Engineer's written authorization.

(b) Contractor's Responsibilities during and after Suspension - During periods of suspension of the Work, the Contractor shall continue to be responsible for protecting and repairing the Work according to 00170.80, and for ensuring that a single designated representative responsible for the Project remains available according to 00150.40.

When Work is resumed after suspension, unless otherwise specified in the Contract, the Contractor shall perform the following at no additional compensation:

- Replace or repair any Work, Materials, and Equipment to be incorporated into the Work that was lost or damaged because of the temporary use of the Project Site by the public; and
- Remove Materials, Equipment, and temporary construction necessitated by temporary maintenance during the suspension, as directed by the Engineer.

(c) Compensation and Allowances for Suspension - Compensation and allowance of additional Contract Time due to suspension of any portion of the Work will be authorized only for Agency-initiated suspensions for reasons other than the Contractor's failure or neglect. (See 00180.50(e), 00180.65, and 00195.40.)

00180.80 Adjustment of Contract Time:

(a) General - Contract Time established for the Work will be subject to adjustment, either by increase or decrease, for causes beyond the control of the Contractor, according to the terms of this Subsection. After adjustment, the Contract Time will become, and be designated as, the "Adjusted Contract Time". Except as provided in 00180.65 and 00195.40, an adjustment of Contract Time shall be the Contractor's only remedy for any delay arising from causes beyond the control of the Contractor.

(b) Contractor's Request Not Required - The Engineer may increase or decrease the Contract Time or the Adjusted Contract Time if Change Orders or Extra Work orders issued actually increase or decrease the amount of time required to perform the Work. The Engineer may also increase Contract Time in the event of Right-of-Way and Access delays (see 00180.65), and those delays due to causes beyond the Contractor's control specified in 00180.50(e). The Engineer will promptly inform the Contractor of adjustments made to Contract Time according to this Subsection, and will include the reasons for adjustment.

If the Agency anticipates delay during performance of the Contract, and specifies its expected duration in the Special Provisions, the Engineer will only consider additional delay beyond the stipulated duration in determining whether to adjust Contract Time.

(c) Contractor's Request Required - In the event the Contractor believes that additional Contract Time is due, the Contractor shall submit to the Engineer a timely request for adjustment of Contract Time. The Engineer will not consider untimely requests. The Agency regards as timely only those requests for adjustment of Contract Time that:

- Accompany a proposed revised Project Work schedule submitted according to 00180.41, for comparison with the last revision of the Project Work schedule; or
- Are not otherwise deemed waived and are submitted within 45 Days after the date of Second Notification, if Second Notification has been issued.

The Engineer will not grant an adjustment of Contract Time for events that occurred prior to the date of the last revision of the Project Work schedule. The Engineer will not authorize, nor the Agency pay, acceleration costs incurred by the Contractor prior to its submittal of a request for adjustment of Contract Time to which the acceleration costs relate.

The Contractor's request for adjustment of Contract Time shall be submitted to the Engineer on a form provided by, or in a format acceptable to, the Engineer, and shall include a copy of the written notice required under 00180.60. The request shall include without limitation:

- Consent of the Contractor's Surety if the request totals more than 30 Calendar Days of additional Contract Time;
- Sufficient detail for the Engineer to evaluate the asserted justification for the amount of additional Contract Time requested;
- The cause of each delay for which additional Contract Time is requested, together with supporting analysis and data;
- Reference to the Contract provision allowing Contract Time adjustment for each cause of delay;
- The actual or expected duration of delay resulting from each cause of delay, expressed in Calendar Days; and
- A schedule analysis based on the current approved Project Work schedule for each cause of delay, indicating which activities are involved and their impact on Contract completion.

(d) Basis for Adjustment of Contract Time - In the adjustment of Contract Time, the Engineer will consider causes that include, but are not limited to:

- Failure of the Agency to submit the Contract and bond forms to the Contractor for execution within the time stated in 00130.50, or to submit the Notice to Proceed within the time stated in 00130.90;
- Errors, changes, or omissions in the Supplemental Drawings, quantities, or Specifications;
- Performance of Extra Work;
- Failure of the Agency or Entities acting for the Agency to act promptly in carrying out Contract duties and obligations;
- Acts or omissions of the Agency or Entities acting for the Agency that result in unreasonable delay referenced in 00195.40;
- Causes cited in 00180.50(e); and
- Right-of-way and access delays referenced in 00180.65.

The Engineer will not consider requests for adjustment of Contract Time based on any of the following:

- Contentions that insufficient Contract Time was originally specified in the Contract;
- Delays that do not affect the specified or Adjusted Contract Time;
- Delays that affect the Contractor's planned early completion, but that do not affect the specified or adjusted Contract Time;
- Shortage or inadequacy of Materials, Equipment or labor;
- Late delivery of Materials and Equipment to be incorporated into the Work, except under those conditions referenced in 00180.50(e);
- Different area of Material source in 00160.40(a);
- Substitution of Equipment in 00180.31(c);
- Reasonably predictable weather conditions; or
- Other matters within the Contractor's control or Contract responsibility.

(e) Consideration and Response by Agency - The Engineer will only consider a Contractor's request for Contract Time adjustment submitted according to the requirements of 00180.80(c). The Engineer may elect not to consider claimed delays that do not affect the specified or adjusted Contract Time required to complete the Work.

The Engineer may adjust Contract Time for causes not specifically identified by the Contractor in its request.

The Engineer will review a properly submitted request for Contract Time adjustment, and within a reasonable time will advise the Contractor of the Engineer's findings. If the Contractor disagrees with the Engineer's findings, the Contractor may request review according to the procedure specified in 00199.40.

00180.85 Failure to Complete on Time; Liquidated Damages:

(a) Time is of the Essence - Time is of the essence in the Contractor's performance of the Contract. It is essential and in the public interest that the Contractor prosecute the Work vigorously to Contract completion and within Contract Time or adjusted Contract Time.

The Agency does not waive any rights under the Contract by permitting the Contractor to continue to perform the Contract, or any part of it, after the Contract Time or adjusted Contract Time has expired.

(b) Liquidated Damages - Delays in the Contractor's performance of the Work will cause the Agency to sustain damages; increase risk to, inconvenience, and interfere with the traveling public and commerce; and increase costs to taxpayers. Because the Agency finds it is unduly burdensome and difficult to demonstrate the exact dollar value of such damages, the Contractor agrees to pay to the Agency, not as a penalty but as liquidated damages, the amount(s) determined as specified below for each Calendar Day the Work remains incomplete after the expiration of the Contract Time or adjusted Contract Time applicable to that Work. The liquidated damages shall constitute payment in full only of damages incurred by the Agency due to the Contractor's failure to complete the Work on time.

Payment by the Contractor of liquidated damages does not release the Contractor from its obligation to fully and timely perform the Contract according to its terms. Nor does acceptance of liquidated damages by the Agency constitute a waiver of the Agency's right to collect any additional damages it may sustain by reason of the Contractor's failure to fully perform the Contract according to its terms.

If the Contract is terminated according to 00180.90(a), and if the Work has not been completed by other means on or before the expiration of Contract Time or adjusted Contract Time, liquidated damages will be assessed against the Contractor for the duration of time reasonably required to complete the Work.

(1) Single Contract Time - The liquidated damages per Calendar Day* for failure to complete the Work on time as required by 00180.50(h) when a single Contract Time is listed under 00180.50(h) will be established using the following formula:

The Liquidated Damages per Calendar Day* are 21.2 percent of C divided by T as defined in this Section.

C = The Contractor's Bid amount for the Contract.
T = The total Calendar Days between the latest completion date or time listed under 00180.50(h) in the Solicitation Documents and the Bid Opening that will result in the greatest value for T.

* Calendar Day amounts are applicable when the Contract Time is expressed on the Calendar Day or fixed date basis.

(2) Multiple Contract Times - The liquidated damages per Calendar Day* for failure to complete the Work on time as required by 00180.50(h) when multiple Contract Times are listed under 00180.50(h) will be established for each individual Contract Time as follows:

The Agency-determined percentage of the value of all Work required to be complete by a given Contract Time multiplied by the rate determined using the formula specified in 00180.85(b)(1).

When multiple Contract Times are listed under 00180.50(h), the Agency-determined percentages of the value of Work required to be complete by the Contract Times listed under 00180.50(h) will be listed in the Special Provisions.

If liquidated damages should become payable concurrently under any combination of liquidated damage rates, the rate that will be assessed will be the highest applicable rate.

* Calendar Day amounts are applicable when the Contract Time is expressed on the Calendar Day or fixed date basis.

00180.90 Termination of Contract and Substituted Performance:

(a) Termination for Default - Termination of the Contract for default may result if the Contractor:

- Fails to comply with the requirements for records;
- Violates any material provision of the Contract;
- Disregards applicable laws and regulations or the Engineer's instructions;
- Refuses or fails to supply enough Materials, Equipment or skilled workers for prosecution of the Work in compliance with the Contract;
- Fails to make prompt payment to Subcontractors;
- Makes an unauthorized general assignment for the benefit of the Contractor's creditors;
- Has a receiver appointed because of the Contractor's insolvency;
- Is adjudged bankrupt and the court consents to the Contract termination; or
- Otherwise fails or refuses to faithfully perform the Contract according to its terms and conditions.
- Has liquidated and delinquent debt owed to the State or any department or agency of the State.

If the Contract is terminated by the Agency, upon demand the Contractor and the Contractor's Surety shall provide the Engineer with immediate and peaceful possession of the Project Site, and of all Materials and Equipment to be incorporated into the Work, whether located on and off the Project Site, for which the Contractor received progress payments under 00195.50.

If the Contract is terminated for default, neither the Contractor nor its Surety shall be:

- Relieved of liability for damages or losses suffered by the Agency because of the Contractor's breach of Contract; or
- Entitled to receive any further progress payments until the Work is completed. However, progress payments for completed Work that remain due and owing at the time of Contract termination may be made according to the terms of 00195.50, except that the Engineer will be entitled to withhold sufficient funds to cover costs incurred by the Agency as a result of the termination. Final payment to the Contractor will be made according to the provisions of Section 00195.

If a termination under this provision is determined by a court of competent jurisdiction to be unjustified, the termination shall be deemed a termination for public convenience.

(b) Substituted Performance - According to the Agency's procedures, and upon the Engineer's recommendation that sufficient cause exists, the Agency, without prejudice to any of its other rights or remedies and after giving the Contractor and the Contractor's Surety at least 10 Calendar Days' written notice, may:

- Terminate the Contract;
- Substitute the Contractor with another Entity to complete the Contract;
- Take possession of the Project Site;
- Take possession of Materials on the Project Site;
- Take possession of Materials not on the Project Site, for which the Contractor received progress payments under 00195.50;
- Take possession of Equipment on the Project Site that is to be incorporated into the Work;

- Take possession of Equipment not on the Project Site that is to be incorporated into the Work, and for which the Contractor received progress payments under 00195.50; and
- Finish the Work by whatever method the Agency deems expedient.

If, within the 10 Calendar Day notice period provided above, the Contractor and/or its Surety corrects the basis for declaration of default to the satisfaction of the Engineer, or if the Contractor's Surety submits a proposal for correction that is acceptable to the Engineer, the Contract will not be terminated.

(c) Termination for Public Convenience - The Engineer may terminate the Contract for convenience in whole or in part whenever the Engineer determines that termination of the Contract is in the best interest of the public.

The Engineer will provide the Contractor and the Contractor's Surety 7 Calendar Days' written notice of termination for public convenience. After such notice, the Contractor and the Contractor's Surety shall provide the Engineer with immediate and peaceful possession of the Project Site, and of Materials and Equipment to be incorporated into the Work, whether located on and off the Project Site, for which the Contractor received progress payments under 00195.50.

Compensation for Work terminated by the Engineer under this provision will be determined according to the provisions of 00195.70(b).

Section 00190 - Measurement of Pay Quantities

Description

00190.00 Scope - The Engineer will measure pay quantities for accepted Work according to the United States standard measure unless otherwise provided in the Contract. Unless otherwise specified in the Contract, the Engineer will round off all quantity computations using the following convention:

- The final significant digit will not be changed when the succeeding digit is less than 5.
- The final significant digit will be increased by one when the succeeding digit is 5 or greater.

The measurement provisions contained in the Specifications for each Pay Item will supplement or modify the above convention by:

- Imposing measurement limitations
- Describing measurement or computation procedures
- Giving conversion factors or adjustment conditions
- Providing for determination of reasonably accurate and representative Pay Item quantities

Measurements required or allowed to be made by the Contractor will be subject to the Engineer's verification. The Engineer's decision about measurement is final.

00190.10 Measurement Guidelines - Measurement of quantities will be made on the following bases, unless otherwise specified in the Contract:

(a) Unit Basis - Unit will be each, unless otherwise specified in the Contract and will be determined by actual count of units in place.

(b) Length Basis - Length will be feet or mile, unless otherwise specified in the Contract and will be determined by measuring the length at least to the nearest 0.1 foot or at least to the nearest 0.1 mile, as applicable, unless otherwise specified in the Contract. Measurements will be limited to the dimensions shown or specified, or as directed by the Engineer.

(c) Area Basis - Area will be square foot, square yard, or acre, unless otherwise specified in the Contract and will be determined by measuring the width and the length (or height) at least to the nearest 0.1 foot and computed at least to the nearest 0.1 square foot, nearest 0.1 square yard, or nearest 0.1 acre, as applicable, unless otherwise specified in the Contract.

(d) Weight Basis - Weight will be pound or ton, unless otherwise specified in the Contract and will be determined as follows:

(1) Pound - Pound weight will be determined by the net weight identified on the manufacturer's packaged labels, subject to periodic check weighing. Weight by pound will be measured at least to the nearest 1.0 pound unless otherwise specified in the Contract.

Provide a certificate with each shipment together with a certified copy of the weight of each delivery. If the check weight is less than the manufacturer weight by more than 0.4%, the discrepancy will be resolved by the Engineer.

(2) Ton - Ton weight will be determined on Contractor-provided scales as required under 00190.20 unless otherwise allowed by the Specifications. Weight by ton will be measured at least to the nearest 0.01 ton unless otherwise specified in the Contract.

If bituminous materials, portland cement, lime, and similar bulk Materials are shipped by truck or rail, the supplier's shipping invoice with net scale weights, or volumes converted to weights, may be used for Pay Item quantity determination in place of weights determined on the Contractor-provided vehicle scales.

Shipping invoice weights of the supplier's truck or transport shall be subject to periodic check weighing on the Contractor's vehicle scales, or other scales designated, according to 00190.20. If the check weight is less than the supplier weight by more than 0.4%, the discrepancy will be resolved by the Engineer.

No payment will be made:

- For quantities in excess of the supplier weight
- When Materials have been lost, wasted, or otherwise not incorporated into the Work
- For additional hauling costs resulting from the check weighing

(e) Volume Basis - Volume will be cubic yard truck measure or in-place measure, gallons, foot board measure (FBM), or thousand foot board measure (MFBM), unless otherwise specified in the Contract and will be measured at least to the nearest 0.1 cubic yard, nearest 1.0 gallon, nearest 0.1 FBM, or nearest 0.1 MFBM, as applicable, unless otherwise specified in the Contract.

Truck measure will be the measured and calculated maximum "water level" capacity of the vehicle. Quantities will be determined at the point of delivery, with no allowance for settlement of Material during transit. When required to facilitate measurement, the vehicle load shall be leveled at the point of delivery. Payment will not be made for Material in excess of the maximum "water level" capacity. Deductions will be made for loads below the maximum "water level" capacity.

When bituminous materials are measured by volume, the volume will be measured at 60 °F or will be corrected to the volume at 60 °F using the correction factors found in the MFTP (ODOT TM 321).

(f) Time Basis - Time will be hour, Day, or year, unless otherwise specified in the Contract, and will be measured to at least the nearest 0.5 hour, nearest 1.0 Day, or nearest 1.0 year, as applicable, unless otherwise specified in the Contract.

(g) Standard Manufactured Items - If standard manufactured items, such as fence, wire, plates, rolled shapes, pipe, conduit and other similar items are specified in the Contract by properties such as gauge, unit weight, or section dimensions, the manufacturing tolerances established by the industry involved will be accepted unless more stringent tolerances are cited in the Contract.

(h) Lump Sum Basis - Lump sum, when used, means the Work described shall be completed and accepted without measurement unless changes are ordered in writing by the Engineer. If estimated quantities of the Work to be performed are listed in the Special Provisions, they provide only a basis for adjusting payment amounts. Estimated quantities are approximate only, and are made from a reasonable interpretation of the Contract Documents. Computations based on the details and dimensions shown on the Contract Documents are not guaranteed to equal estimated quantities.

If the Agency issues no Change Order, the Agency will make no pay adjustment for quantities based on the Contractor's computations that overrun or underrun the estimated quantities.

If the Agency issues Change Orders for changes in the Work, the Engineer will measure such changes according to the standards set by 00195.20 to determine adjustment of payment.

00190.20 Contractor to Provide Vehicle Weigh Scales:

(a) General - If the Specifications require measurement by weighing on vehicle weigh scales, the Contractor shall provide vehicle weigh scales and shall transport Materials to the scales. Subject to the Engineer's approval, weights may be determined by plant or hopper scales according to 00190.30.

Contractor-provided scales shall be furnished, installed and maintained by the Contractor or its supplier, or, subject to the Engineer's approval, may be commercial scales located in the vicinity of the Project.

Unless otherwise provided in the Contract, Pay Items to be measured by weight shall include all Contractor costs for providing, maintaining, inspecting, and testing scales; for furnishing appropriate weigh tickets; for self-printing scales; and for transporting Materials to the scales or to check weighing.

(b) Requirements - The scales shall conform to ORS Chapter 618, or the laws of the state in which they are located, and NIST *Handbook 44*, and shall be:

- Licensed by the Oregon Department of Agriculture, or by the analogous regulatory body for scales located outside the State;
- Technically suitable for weighing the Materials;
- Properly installed and maintained; and
- Accurate to the required tolerances.

The weight of any Materials weighed by anyone other than the Engineer will be subject to check weighing as the Engineer directs.

(c) Approaches - Vehicle scale approaches shall be:

- At each end of the scale platform;
- Straight and in line with the platform; and
- Long enough to accommodate combination vehicles longer than the scale platform so that they are level and allow release of brakes before weighing.

(d) Inspections - Contractor shall have all scales certified, that is inspected and their accuracy tested, by the Oregon Department of Agriculture, an analogous regulatory body for scales located outside the State, or a scale service company, as follows:

- Before use if installed at a new site;
- 60 Calendar Days after initial inspection;
- As otherwise required by the Oregon Department of Agriculture, or an analogous regulatory body for scales located outside the State; and
- When the Engineer directs additional inspections.

No Materials weighed on scales without current certifications according to this Subsection will be accepted. The Contractor shall provide a copy of all required certifications to the Engineer.

Testing by a scale service company within the State of Oregon shall comply with ORS Chapter 618.

If additional inspections directed by the Engineer confirm that the scale accuracy is within the required tolerances, the Agency will pay the cost for inspecting and testing the scales. If the scale

accuracy is not within these tolerances, the Contractor shall pay the cost for inspecting and testing the scales.

(e) Inspection Results - If an inspection indicates the scales have been under-weighing (indicating less than the true weight), the Agency will make no additional payment to the Contractor for Materials previously weighed.

If an inspection indicates the scales have been over-weighing (indicating more than the true weight), the weights will be reduced for Materials received after the time the Engineer determines the overweighing began or, if that is not possible, after the last acceptable certification of the scales. The reduction will be the amount of error in excess of the 0.2% maintenance tolerance allowed in the Contract.

(f) Contractor-Provided Weigh Technician - The Contractor shall provide a technician to operate Contractor-provided vehicle weigh scales. The Agency may observe procedures and require check weighing according to the following:

(1) Scale with Automatic Printer - If the scales have an automatic weigh memo printer that does not require manual entry of gross weight information, the Agency may periodically have a representative at the scales to observe the weighing procedures. In addition, the Engineer may periodically check the weight for a load of Materials by directing the haul vehicle to reweigh on a different scale that has been inspected and certified according to 00190.20(b) and 00190.20(d).

If a different scale is not available within a 30-mile round trip from the regular haul route, the Agency will allow check weighing on an approved alternate basis. Check weights within 0.4% of the Contractor-provided weight are acceptable.

The Engineer will resolve discrepancies found by check weighing. Agency employee costs will be paid by the Agency. The Contractor shall pay all other costs resulting from the check weighings, including, without limitation, the use of other scales.

When 2,000 tons or less of all types of Materials are received from a scale, check weighing will be at the discretion of the Engineer.

The Contractor shall make at least one check weighing on projects where more than 2,000 Tons of all types of Materials are received from a scale. If more than 50 Tons per Day of all types of Materials are received from a scale, the Contractor shall make random check weighings at least once every ten Days on which more than 50 Tons is received or at each interval that 10,000 Tons has been weighed, whichever occurs first, or as directed by the Engineer. The check weighing frequency does not apply to total quantities less than 2,000 Tons of all types of Materials from a scale. The Contractor shall provide the Engineer with the results of the check weighing.

(2) Scale Without Automatic Printer - If the scales require manual entry of gross weight information, the Agency may periodically have a representative weigh witness at the scales to observe the weighing procedures. The Contractor shall inform the Engineer of his intent to use a scale without an automatic printer at least 3 working days before weighing begins or before the Contractor changes to a scale that does not have an automatic printer. The Contractor shall pay costs for the weigh witness. The hourly cost of the weigh witness will be as stated in the Special Provisions. In addition, the Engineer may periodically check the weight for a load of Materials by directing the haul vehicle to reweigh on a different scale that has been inspected and certified according to 00190.20(b) and 00190.20(d).

If a different scale is not available within a 30-mile round trip from the regular haul route, the Agency will allow check weighing on an approved alternate basis. Check weights within 0.4% of the Contractor-provided weight are acceptable.

The Engineer will resolve discrepancies found by check weighing. Agency employee costs for check weighings will be paid by the Agency. The Contractor shall pay all other costs resulting from the check weighings, including, without limitation, the use of other scales.

If more than 50 tons per Day of all types of Materials are received from a scale, the Contractor shall make random check weighings at least every tenth day on which more than 50 tons is received or at each interval that 10,000 tons has been weighed, whichever occurs first, or as directed by the Engineer. The Contractor shall make at least one check weighing on all projects where materials are received from a scale without an automatic printer. The Contractor shall provide the Engineer with the results of the check weighing.

(3) Duties of Weigh Technician - The Contractor's weigh technician shall:

- Determine twice a Day, or as otherwise directed by the Engineer, the empty haul weights (tare weights) of hauling vehicles, unless vehicles are tared before each load;
- Furnish daily a listing of the tare weights if 10 or more loads are hauled during that Day;
- Furnish a note listing the net weight for each consecutive ten loads with the following load;
- Furnish a daily listing of the net weights and total weight for each type of Material hauled during that Day; and
- Furnish a legible, serially numbered weigh memo for each load of Materials to the Agency's Materials receiver at the point of delivery, or as directed by the Engineer. The memo shall identify the Project, the Materials, the date, net weight (gross and tare as appropriate), and identification of the vehicle and weigh technician.

(g) Agency-Provided Weigh Technician - If the Contractor provides vehicle weigh scales without a weigh technician meeting the requirements of this Subsection, the Agency will provide a weigh technician at the Contractor's expense. The hourly cost for the weigh technician will be as stated in the Special Provisions. The Contractor shall provide a weighhouse for the weigh technician as specified in the Special Provisions. The Agency's weigh technician will:

- Determine tare weights;
- Prepare weigh memos for each load;
- Compile the weigh records; and
- Not participate in the production of Materials or the loading of haul vehicles.

00190.30 Plant Scales - The Contractor, with the Engineer's written approval, may weigh plant-mixed Materials on scales that have either:

- An automatic weight batching and mixing control printer system; or
- A weigh hopper printer system.

Any additional costs resulting from the use of these scales shall be borne by the Contractor. Check weighing will be done according to 00190.20(f).

Except for 00190.20(c) regarding approaches, the Contractor's use of plant scales shall comply with all provisions of 00190.20.

00190.30

The Engineer's approval for the Contractor's use of plant scales to determine pay weights will be rescinded if check weighing or scale inspections indicate the scales do not consistently determine weights within the tolerances allowed by state law.

Section 00195 - Payment

Description

00195.00 Scope and Limit:

(a) General - The Agency will pay only for measured Pay Item quantities incorporated into the Work or performed according to the terms of the Contract. The Contractor understands and agrees that Pay Item quantities listed in the Schedule of Items do not govern payment.

Payment constitutes full compensation to the Contractor for furnishing all Materials, Equipment, labor, and Incidentals necessary to complete the Work; and for risk, loss, damage, and expense arising from the nature or prosecution of the Work or from the action of the elements, subject to the provisions of 00170.80. The Contractor shall include the costs of bonds and insurance for the Project in the unit price for each Pay Item of Work to be performed.

(b) Essential or Incidental Materials or Work - When the Specifications state that the unit price for a Pay Item is compensation for certain Materials or Work essential or Incidental to the Pay Item, the same Materials or Work will not be measured or paid under any other Pay Item.

Provisions and Requirements

00195.10 Payment For Changes in Materials Costs - On certain projects, as identified in the Special Provisions, an escalation/de-escalation clause with respect to certain materials will be in effect during the life of the Contract.

00195.12 Steel Material Price Escalation/De-Escalation Clause - Subsections 00195.12, 00195.12(a), 00195.12(b), 00195.12(c), and 00195.12(d) contain the price escalation/de-escalation clause relating to steel materials (as defined in 00195.12(d)) that is included in this Contract. This exclusive steel material price escalation/de-escalation clause, and the steel escalation/de-escalation program described in 00195.12 through 00195.12(d), are in effect for the life of this Contract regardless of the number of steel material Pay Items, if any, that are included, and whether or not the Contractor elects to participate in the steel escalation/de-escalation program according to 00195.12(d).

(a) Steel Material Price Escalation/De-Escalation Participation - The Contractor may select individual Pay Items to include in the steel escalation/de-escalation program from those Pay Items listed for this Project under 00195.12(d) by following the directions provided in 00195.12(d). The Contractor is not obligated to select any Pay Items. Before or within seven Calendar Days after the date of the preconstruction conference, the Contractor shall submit in writing to the Project Manager the Pay Items selected by the Contractor to be included in the steel escalation/de-escalation program, in the manner required under 00195.12(d). If the Contractor elects to not participate in the steel escalation/de-escalation program for the Project, no response from the Contractor is required. If the Contractor fails to inform the Project Manager of Pay Items to include in the steel escalation/de-escalation program in the manner and within the time limits stated in 00195.12(d) (or the Contractor otherwise elects not to participate in the program), the Contractor thereby elects not to participate in the program and forfeits all present and future rights to participate in the program for this Project.

The Agency reserves all of its rights under the Contract, including, but not limited to, its rights for suspension of the Work under 00180.70 and its rights for termination of the Contract under 00180.90, and this steel material price escalation/de-escalation provision will not limit those rights. Adjustment for fluctuations in the cost of steel material will apply only to the Pay Items individually selected by the Contractor from the Pay Items listed under 00195.12(d), and will be made using the respective steel cost basis (CB) listed.

(b) Monthly Steel Materials Value (MV) and Base Steel Materials Value (BV) - The Monthly Steel Materials Value (MV) will be established by the Agency from the IDWPUSISTEEL1 Bureau of Labor Statistics (BLS), Producer Price Indexes (PPI) using non-seasonally adjusted indexes only. Preliminary numbers may be referenced on the IDWPUSISTEEL1 BLS PPI for 6 months or more before IDWPUSISTEEL1 BLS PPI determines they are final numbers.

The Base Steel Materials Value (BV) for this Project will be the MV published on the ODOT Estimating website (see 00110.05(e)) for the month of the Bid Opening for this Project. The Agency will only publish values on the ODOT Estimating website for use after the IDWPUSISTEEL1 BLS PPI establishes the numbers as final numbers. The final values of MV and BV will be available at the ODOT Estimating website.

The Agency has no control of when the IDWPUSISTEEL1 BLS PPI establishes final values. The Agency steel material price escalation/de-escalation adjustments made under 00195.12 through 00195.12(d) may not be reflected on payments made to the Contractor for up to 2 months after the IDWPUSISTEEL1 BLS PPI applicable values become final. This timing for steel material price escalation/de-escalation adjustments is an agreed term of this Contract and shall not constitute late payment under ORS 279C.570, nor shall the Agency be responsible to pay interest on any such steel material price adjustments.

If the Agency-selected index ceases to be available for any reason, the Agency in its discretion will select and begin using a substitute price source or index to establish the MV each month. The MV will only apply to Pay Items selected by the Contractor and provided in writing to the Project Manager from the Pay Item list contained under, and in the manner and within the time limits required by, 00195.12(d). The Agency does not guarantee that steel material will be available at any stated or implied materials price.

(c) Monthly Steel Materials Price Adjustment - If the Contractor has properly informed the Project Manager of Pay Items to include in the steel escalation/de-escalation program as required by 00195.12(a) and 00195.12(d), a price adjustment evaluation will be made for the Pay Items individually selected. No adjustments will be made using the BV or MV until such time as they are listed as final values by the IDWPUSISTEEL1 BLS PPI. The price adjustment as calculated in this provision for a given Pay Item will use the MV for the month the Work associated with that Pay Item is performed and added to the monthly progress estimate. A price adjustment for that Pay Item will only be made if the MV for the month the Work associated with the Pay Item is performed and added to the monthly progress estimate differs by more than 10% from the BV. A price adjustment will be made, as and when required by 00195.12 through 00195.12(d), only for the Pay Items, if any, that were selected by the Contractor in the manner and within the time limits required under 00195.12(a) and 00195.12(d).

The Monthly Steel Materials Price Adjustment will be determined as follows:

- If the MV is within 10% ± of the BV, there will be no adjustment.
- If the MV is more than 110% of the BV, then:
  $$PA = (((MV-BV) \div BV) - 0.10) \times (CB \times PIP)$$
- If the MV is less than 90% of the BV, then:
  $$PA = (((MV-BV) \div BV) + 0.10) \times (CB \times PIP)$$

Where:

PA = Price Adjustment, dollars
MV = Monthly Steel Materials Value from BLS PPI for the month determined above (after becomes final)
BV = Base Steel Materials Value from month of the Bid Opening (after becomes final)
PIP = Amount paid for the Pay Item for the month for which the adjustment is made

CB = Cost Basis for the applicable steel material, in percent (see 00195.12(d))

(d) Steel Materials Pay Item Selection - The Agency has a process using estimated quantities to determine which Pay Items containing steel material qualify for the steel escalation/de-escalation program by meeting a minimum threshold, and are therefore included in the eligible Pay Items listed in the Special Provisions.

For purposes of 00195.12 through 00195.12(d), "steel material" means structural and reinforcing steel, steel studs, sheet piling, guardrail, ductile iron pipe and other steel products used for the construction, reconstruction or major renovation of a road or Highway.

The Contractor may elect to participate in the steel escalation/de-escalation program for this Project by marking the list in the Special Provisions, checking each box next to each Pay Item the Contractor wants included in the program and submitting this information in writing, signed and dated by the Contractor, to the Project Manager before or within 7 Calendar Days after the date of the preconstruction conference. The steel material price escalation/de-escalation clause for price adjustments for fluctuations in the cost of steel material will apply only to the Pay Items selected by the Contractor, from the Pay Item list included in the Special Provisions, and provided in writing to the Project Manager in the manner and within the time limits stated above.

If the Contractor fails to inform the Project Manager of Pay Items to include in the steel escalation/de-escalation program in the manner and within the time limits stated above (or the Contractor otherwise elects not to participate in the program), the Contractor thereby elects not to participate in the program and forfeits all present and future rights to participate in the program for this Contract and this Project.

00195.20 Changes to Plans or Character of Work:

(a) Insignificant Changed Work - If the changes made under 00140.30 do not significantly change the character or unit cost of the Work to be performed under the Contract, the Agency will pay for such Work at the Pay Item price.

If the Work involved in the change is measured on a lump sum basis and its character is not significantly changed, payment for the Changed Work will be determined:

- As described in the applicable Section of the Specifications;
- If not described there, on a theoretical unit price determined by dividing the Contractor's lump sum price by the estimated quantity of the Pay Item listed in the Special Provisions; or
- If neither of the above apply, the Engineer will make an equitable adjustment.

(b) Significant Changed Work - If the changes made under 00140.30 significantly alter the character, unit cost, or lump sum cost of the Work, the Agency will adjust the Contract. Adjustments will exclude any loss of anticipated profits. The parties shall agree upon the basis for payment and the amount of adjustment prior to the Contractor commencing the Changed Work. If the basis and amount cannot be agreed upon, the Engineer will make an equitable adjustment, which may increase or decrease the Contract Amount and Contract Time.

Any such adjustments may be less than, but will not be more than the amount justified by the Engineer on the basis of the established procedures set out in Section 00197 for determining rates. This does not limit the application of Section 00199.

The term "Significant Changed Work" shall apply only to that circumstance in which the character of the Work, as changed, differs materially in kind, nature, or unit cost from that involved or included in the originally proposed construction.

00195.30 Differing Site Conditions - Upon written notification, as required in 00140.40, the Engineer will investigate the identified conditions. If the Engineer determines that the conditions materially differ and cause an increase or decrease in the cost or time required to perform any Work under the Contract, an adjustment in the Contract Amount or Contract Time, excluding loss of anticipated profits, will be made, and the Contract modified accordingly, in writing. The Engineer will notify the Contractor as to whether or not an adjustment of the Contract is warranted.

No Contract adjustment which benefits the Contractor will be allowed unless the Contractor has provided the required written notice. Any such adjustments will be made according to 00195.20.

00195.40 Unreasonable Delay by the Agency - If the Contractor believes that performance of all or any portion of the Work is suspended, delayed, or interrupted for an unreasonable period of time in excess of that originally anticipated or customary in the construction industry, due to acts or omissions of the Agency, or persons acting for the Agency, and that additional compensation, Contract Time, or both, are due the Contractor because of the suspension, delay or interruption, the Contractor shall immediately file a written notice of delay according to 00180.60. The Contractor shall then promptly submit a properly supported request for any additional compensation, Contract Time, or both, according to the applicable provisions in 00180.60 through 00180.80 and Section 00199.

The Engineer will promptly evaluate a properly submitted request for additional compensation. If the Engineer determines that the delay was unreasonable, and that the cost required for the Contractor to perform the Contract has increased as a result of the unreasonable suspension, delay or interruption, the Engineer will make an equitable adjustment, excluding profit, and modify the Contract in writing accordingly. The Engineer will notify the Contractor of the determination and whether an adjustment to the Contract is warranted.

Under this provision, no Contract adjustment will be allowed:

- Unless the Contractor has provided the written notice required by 00180.60;
- For costs incurred more than 10 Calendar Days before the Engineer receives the Contractor's properly submitted written request;
- For any portion of a delay that the Engineer deems to be a reasonable delay, or for which an adjustment is provided for or excluded under other terms of the Contract; or
- To the extent that performance would nevertheless have been suspended, delayed or interrupted by causes other than those described in this Subsection.

00195.50 Progress Payments and Retained Amounts:

(a) Progress Payments - The Agency's payment of progress payments, or determination of satisfactory completion of Pay Items or Work or release of retainage under 00195.50(d), shall not be construed as Final Acceptance or approval of any part of the Work, and shall not relieve the Contractor of responsibility for defective Materials or workmanship or for latent defects and warranty obligations.

The estimates upon which progress payments are based are not represented to be accurate estimates. All estimated quantities are subject to correction in the final estimate. If the Contractor uses these estimates as a basis for making payments to Subcontractors, the Contractor assumes all risk and bears any losses that result.

If the estimated amount due the Contractor for any given month is less than $1,000, the Agency will make no payment for that month unless requested by the Contractor.

(1) Progress Estimates - At the same time each month, the Engineer will make an estimate of the amount and value of Pay Item Work completed. The amount of Work completed will be the sum of the estimated number of units completed for unit price Pay Items plus the estimated percentage completed of lump sum Pay Items.

The estimated value of the Work completed will then be determined by using the Contract unit price for unit price Pay Items, and by using one of the following methods to determine the value of the lump sum Pay Items:

- The "theoretical unit price", when the Special Provisions contain an estimated number of units;
- A Contractor-submitted, Engineer-approved Schedule of Values, when there is no theoretical unit price available; or
- Engineer's determination, when there is neither an available theoretical unit price, nor an approved, Contractor-submitted Schedule of Values.

The amounts to be allowed for lump sum Pay Items in progress payments will not exceed the reasonable value of the Work performed, as determined by the Engineer.

Incidentals such as formwork, falsework, shoring, and cribbing shall be included in the unit prices for the various Pay Items requiring their use, unless specified as a separate Pay Item. No payment will be made for Pay Items that include Incidentals until units or portions of such Pay Item Work are in place and completed. The costs of Incidentals will be paid in proportion to the percentage of Pay Item Work completed.

(2) Value of Materials on Hand - The Engineer will also make an estimate of the amount and value of acceptable Materials on hand, (i.e., already delivered and stored) according to 00195.60(a), to be incorporated into the Work.

(3) Value of Work Accomplished - The sum of the values in (1) and (2) above will be collectively referred to in this Subsection as the "value of Work accomplished", subject to (4) below.

(4) Limitations on Value of Work Accomplished - In determining the "value of Work accomplished", the Engineer's estimate will be based on the unit prices for the various Pay Items. Any amounts not included in progress payments due to substantial mathematical unbalancing of Pay Item prices will be included in the final payment issued according to 00195.90(b).

(5) Reductions to Progress Payments - With each progress payment, the Contractor will receive a Contract payment voucher and summary setting forth the value of Work accomplished reduced by the following:

- Amounts previously paid;
- Amounts deductible or owed to the Agency for any cause specified in the Contract;
- Additional amounts retained to protect the Agency's interests according to Subsection (e) below.

(b) Retainage - The Agency reserves the right in its sole discretion to not withhold retainage from progress payments or to begin withholding retainage at any time. If the Agency withholds retainage from progress payments, the amount to be retained from progress payments will be 2.5% of the value of Work accomplished, and will be retained in one of the forms specified in Subsection (c) below. If the Agency determines that satisfactory progress is not being made on the Work, the Agency may withhold up to 5% of the value of Work accomplished from subsequent progress

payments. No retainage will be withheld from Work performed as Force Account Work, escalation/de-escalation, bonuses, or other items decided by the Agency.

As provided in 00170.65(b)(3) in addition to any retainage, a withholding of 25% of amounts earned will be withheld and released according to ORS 279C.845 when the Contractor fails to file the certified statements required in ORS 279C.845, FHWA Form 1273, and 00170.65.

(c) Forms of Retainage - If the Agency withholds retainage, forms of acceptable retainage are specified below in Subsections (1) through (3). Unless the Contractor requests and the Agency accepts a form of retainage under Subsections (2) or (3), the Agency will use the "Cash, Alternate A" in this Subsection. If the Agency incurs additional costs as a result of the Contractor's election to use a form of retainage other than Cash, Alternate A, the Agency may recover such costs from the Contractor by a reduction of the final payment.

(1) Cash, Alternate A - Retainage will be deducted from progress payments and held by the Agency until final payment is made according to 00195.90, unless otherwise specified in the Contract.

Except as otherwise provided, the Agency will deposit the cash retainage withheld in an interest-bearing escrow account as required by ORS 279C.570(2). The Contractor shall execute such documentation and instructions respecting the interest-bearing escrow account as the Agency may require to protect its interests, including but not limited to a provision that no funds may be paid from the account to anyone without the Agency's advance written authorization. Interest earned on the account shall accrue to the Contractor. Amounts retained and interest earned will be included in the final payment made according to 00195.90, unless otherwise specified in the Contract.

For a contract over $500,000, if the Contractor requests that the Agency deposit the retainage in an interest-bearing account under ORS 279C.560(5), the Agency will use the "Cash, Alternate A" in this Subsection. For a contract $500,000 or less, if the Contractor requests that the Agency deposit the retainage in an interest-bearing account under ORS 279C.560(5), the Agency will use an interest-bearing account (in a bank, savings bank, trust company, or savings association) as provided under ORS 279C.560(5).

Any retainage withheld on Work performed by a Subcontractor will be released to the Contractor according to 00195.50(d).

(2) Cash, Alternate B (Retainage Surety Bond) - Upon receipt of an approved retainage surety bond, the Agency will limit the amount of cash retainage withheld to $10,000, which will be deposited in an interest-bearing escrow account as described in (1) above. The surety bond must be in the bond form provided by the Agency. The bond must be provided by the same Surety that provides the Performance and Payment Bonds.

If the Contractor elects this form of retainage, the Agency will withhold from progress payments up to 2.5% of the value of the Work accomplished as cash retainage until the retained amount equals $10,000. After that amount is retained, no further cash retainage will be withheld until the additional required retainage that would have been withheld exceeds the face amount of the retainage surety bond provided. Thereafter, retainage will be withheld from progress payments according to these Specifications. According to 00195.50(b), if at any time the Agency determines that satisfactory progress is not being made on the Work, the Agency may withhold up to 5% of the value of the Work accomplished from subsequent progress payments.

If an acceptable retainage surety bond is provided, the Contractor shall notify all Subcontractors of the existence of the retainage surety bond and shall advise them of their rights under ORS 279C.560(7) and ORS 701.435.

Amounts retained and interest earned will be included in the final payment made according to 00195.90, unless otherwise specified in the Contract.

Any retainage withheld on Work performed by a Subcontractor shall be released to the Contractor according to 00195.50(d).

(3) Bonds, Securities, and Other Instruments - In accordance with ORS 279C.560, unless the Agency finds in writing that accepting a bond, security or other instrument poses an extraordinary risk that is not typically associated with the bond, security or other instrument, the Agency will approve the Contractor's written request to deposit bonds, securities or other instruments with the Agency or in a custodial account or other account satisfactory to the Agency with an approved bank or trust company, to be held instead of cash retainage for the benefit of the Agency. In such event, the Agency will reduce the cash retainage by an amount equal to the value of the bonds, securities and other instruments. Interest or earnings on the bonds, securities and other instruments shall accrue to the Contractor.

Bonds, securities and other instruments deposited instead of cash retainage shall be assigned to or made payable to the Agency and shall be of a kind approved by the Director of the Oregon Department of Administrative Services, including, but not limited to:

- Bills, certificates, notes or bonds of the United States;
- Other obligations of the United States or agencies of the United States;
- Obligations of a corporation wholly owned by the federal government;
- Indebtedness of the Federal National Mortgage Association;
- General obligation bonds of the State of Oregon or a political subdivision of the State of Oregon;
- Irrevocable letters of credit issued by an insured institution, as defined in ORS 706.008.

The Contractor shall execute and provide such documentation and instructions respecting the bonds, securities and other instruments as the Agency may require to protect its interests. When the Engineer determines that all requirements for the protection of the Agency's interest have been fulfilled, the bonds and securities deposited instead of cash retainage will be released to the Contractor.

(d) Release of Retainage - As the Work progresses, release of the amounts retained under (b) above will only be considered for Pay Items that have been satisfactorily completed. For purposes of this Subsection, a Pay Item will be considered satisfactorily completed only if all of the Work for the Pay Item is complete and all contractual requirements pertaining to the Pay Item and Work have been satisfied. Work not included in a Pay Item, or which constitutes part of an uncompleted Pay Item, will not be regarded as satisfactorily completed Work for the purposes of this Subsection.

Beginning with the fourth month after First Notification and every third month thereafter, the Agency will release retainage for satisfactorily completed Pay Items in the Schedule of Items, or for satisfactorily completed Pay Items added by Contract Change Order. Retainage will be released with the scheduled progress payment for the fourth month after First Notification and with the scheduled progress payment for each third month thereafter. Within 10 Calendar Days of receipt of retainage, the Contractor shall pay to each Subcontractor all such released retainage that pertains to the Work of that Subcontractor.

A determination of satisfactory completion of Pay Items or Work or release of retainage shall not be construed as acceptance or approval of the Work and shall not relieve the Contractor of responsibility for defective Materials or workmanship or for latent defects and warranty obligations.

The Contractor shall comply with all applicable legal requirements for withholding and releasing retainage and for prompt payments, including but not limited to those in ORS Chapters 279C and 701, and 49 CFR 26.29.

(e) Withholding Payments - The Engineer may withhold such amounts from progress payments or final payment as may reasonably protect the Agency's interests until the Contractor has:

- Complied with all orders and directives issued by the Engineer under or pursuant to the Contract;
- Corrected or cured its failure to comply with the Contract;
- Satisfied all legal actions filed against the Agency, the Agency's governing body and its members, and Agency employees that the Contractor is obliged to defend. (See 00170.72.); and
- Paid all liquidated and delinquent debt owed to the State or any department or agency of the State. (In addition to Agency's other rights and remedies, the Agency may also undertake collection by administrative offset, or garnishment if applicable, of all monies due to recover such debt. Offsets or garnishment may be initiated after the Contractor has been given notice if required by law.)

Notwithstanding ORS 279C.555 or ORS 279C.570 or 00195.50(d), if a Contractor is required to file statements on the prevailing rate of wages, but fails to do so, the Agency will withhold 25% of any amount earned as required in 00170.65.

(f) Prompt Payment Policy - Payments shall be made promptly according to ORS 279C.570, ORS 279C.580 and other applicable legal requirements.

00195.60 Advance Allowance for Materials on Hand:

(a) General - If the total value of Materials on hand is at least $1,000, or the total value of a single class of Materials on hand is at least $500, the Engineer may authorize an advance allowance for the Materials in the progress payments. The Agency will not make advance allowances on the Materials unless the following three conditions are satisfied:

(1) Request for Advance Allowance - If Materials on hand meet the requirement of (2) below, an advance allowance will be made if:

- A written request for advance allowance for Materials on hand has been received by the Engineer at least 5 Calendar Days before the pay period cutoff date; and
- The request is accompanied by written consent of the Contractor's Surety, if required by the Agency.

(2) Stored or Stockpiled Conditions - The Materials shall have been delivered and/or acceptably stored or stockpiled according to the Specifications and as follows:

- At the Project Site;
- On Agency-owned property;
- On property in the State of Oregon on which the property owner has authorized storage in writing. The written authorization must allow the Agency to enter upon the property and remove Materials for at least 6 months after completion of the Project. The Contractor shall furnish a copy of the written permission to the Agency; or
- On property outside the State of Oregon on which the property owner has authorized storage in writing, provided that such storage location is allowed by the Special Provisions

or authorized in writing by the Engineer. The permit must allow the Agency to enter upon the property and remove Materials for at least 6 months after completion of the Project. The Contractor shall furnish a copy of the written permission to the Agency.

To be eligible for advance allowance, the Materials shall:

- Meet Specification requirements;
- Have the required Materials conformance and quality compliance documents on file with the Engineer (see Section 00165);
- Be in a form ready for incorporation into the permanent Work; and
- Be clearly marked and identified as being specifically fabricated, or produced, and reserved for use on the Project.

(3) Responsibility for Protection - The Contractor has full control and responsibility for the protection of Materials on hand from the elements and against damage, loss, theft, or other impairment until the entire Project has been completed and accepted by the Agency.

If Materials are damaged, lost, stolen, or otherwise impaired while stored, the monetary value advanced for them, if any, will be deducted from the next progress payment.

If these conditions in 00195.60(a)(1) through 00195.60(a)(3) have been satisfied, the amount of advance allowance, less the retainage described in 00195.50, will be determined by one of the following methods as elected by the Engineer:

- Net cost to the Contractor of the Materials, f.o.b. the Project Site or other approved site; or
- Price (or portion of it attributable to the Materials), less the cost of incorporating the Materials into the Project, as estimated by the Engineer.

(b) Proof of Payment - The Contractor shall provide the Engineer with proof of payment to the materials Suppliers for purchased Materials within 30 Calendar Days of the date of the progress payment that includes the advance allowance.

If proof of payment is not provided, sums advanced will be deducted from future progress payments, and the Engineer will not approve further prepayment advance allowance requests.

(c) Terminated Contract - If the Contract is terminated, the Contractor shall provide the Agency immediate possession of all Materials for which advance allowances have been received, as provided above. If, for any reason, immediate possession of the Materials cannot be provided, the Contractor shall immediately refund to the Agency the total amount advanced for the Materials. The Agency may deduct any amount not so refunded from final payment.

00195.70 Payment under Terminated Contract - Payment for Work performed under a Contract that is terminated according to the provisions of 00180.90 will be determined under (a) or (b) of this Subsection.

(a) Termination for Default - Upon termination of the Contract for the Contractor's default, the Agency will make no further payment until the Project has been completed. The Agency will make progress payments to the party to whom the Contract is assigned, but may withhold an amount sufficient to cover anticipated Agency costs, as determined by the Engineer, to complete the Project.

Upon completion of the Project, the Engineer will determine the total amount that the defaulting Contractor would have been entitled to receive for the Work, under the terms of the Contract, had the Contractor completed the Work (the "cost of the completed Work").

If the cost of the completed Work, less the sum of all amounts previously paid to the Contractor, exceeds the expense incurred by the Agency in completing the Work, including, without limitation, expense for additional managerial and administrative services, the Agency will pay the excess to the Contractor, subject to the consent of the Contractor's Surety.

If the expense incurred by the Agency in completing the Work exceeds the Contract Amount, the Contractor or the Contractor's Surety shall pay to the Agency the amount of the excess expense.

The Engineer will determine the expense incurred by the Agency and the total amount of Agency damage resulting from the Contractor's default. That determination will be final as provided in 00150.00.

If a termination for default is determined by a court of competent jurisdiction to be unjustified, it shall be deemed a termination for public convenience, and payment to the Contractor will be made as provided in Subsection (b) below.

(b) Termination for Public Convenience:

(1) General - Full or partial termination of the Contract shall not relieve the Contractor of responsibility for completed or performed Work, or relieve the Contractor's Surety of the obligation for any just claims arising from the completed or performed Work.

(2) Mobilization - If mobilization is not a separate Pay Item, and payment is not otherwise provided for under the Contract, the Agency may pay the Contractor for mobilization expenses, including moving Equipment to and from the Project Site. If allowed, payment of mobilization expenses will be based on cost documentation submitted by the Contractor to the Engineer.

(3) All Other Work - The Agency will pay the Contractor at the unit price for the number of Pay Item units of completed, accepted Work. For units of Pay Items partially completed, payment will be as mutually agreed, or, if not agreed, as the Engineer determines to be fair and equitable. No claim for loss of anticipated profits will be allowed. The Agency will purchase Materials left on hand according to 00195.80.

00195.80 Allowance for Materials Left on Hand:

(a) Purchase of Unused Materials - If Materials are delivered to the Project Site, or otherwise acceptably stored at the order of the Engineer, but not incorporated into the Work due to complete or partial elimination of Pay Items, changes in Plans, or termination of the Contract for public convenience according to 00180.90, and it is not commercially feasible for the Contractor to return them for credit or otherwise dispose of them on the open market; the Agency will purchase them according to the formula and conditions specified in Subsection (b) below.

(b) Purchase Formula and Conditions:

(1) Formula - The Agency will apply the following formula in determining the Contractor's allowance for Materials left on hand:

Contractor's Actual Cost, plus 5% Overhead Allowance, minus Advance Allowances under 00195.60, but no markup or profit.

(2) Conditions - The Agency will not purchase the Contractor's Materials left on hand unless the Contractor satisfies the following conditions:

- Requests the Agency's purchase of unused Materials;

- Shows acquisition of the Materials according to 00160.10;
- Shows that the Materials were acquired prior to the Agency change or termination;
- Shows that the Materials meet Specifications; and
- Provides receipts, bills and other records of actual cost of Materials delivered to the designated delivery points.

00195.90 Final Payment:

(a) Final Estimate - As soon as practicable after Final Inspection of the Project, as provided in 00150.90, the Engineer will prepare a final estimate of the quantities of the Pay Items completed. With this estimate of quantities as a base, the total amount due the Contractor will be determined according to the terms of the Contract, including, without limitation, any amounts due for Extra Work performed.

(b) Final Payment - The amount of final payment will be the difference between the total amount due the Contractor and the sum of all payments previously made. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

After computation of the final amount due, and after Final Acceptance of the Project, final payment will be mailed to the Contractor's last known address as shown in the records of the Agency.

Beginning 30 Calendar Days after the date of Third Notification, interest will begin to accrue at the rate established by ORS 279C.570 on any money due and payable to the Contractor as final payment, determined as described above. No interest will be paid on money withheld due to outstanding amounts owed by the Contractor under the provisions of 00170.10.

(c) No Waiver of Right to Make Adjustment - The fact that the Agency has made any measurement, estimate, determination or certification either before or after completion of the Project, Final Acceptance, Agency assumption of possession of the Project Site, determination of satisfactory completion of Pay Items or Work or release of retainage under 00195.50(d) or payment for any part of the Work, shall not prevent either party from:

- Showing the true amount and character of the Work;
- Showing that any measurement, estimate, determination or certification is incorrect;
- Recovering from the other party damages that may have been suffered because the other party failed to comply with the Contract.

00195.95 Error in Final Quantities and Amounts:

(a) Request for Correction of Compensation - If the Contractor believes the quantities and amounts detailed in the final Contract payment voucher, prepared by the Engineer according to 00195.90, to be incorrect, the Contractor shall submit an itemized statement to the Engineer detailing all proposed corrections.

This statement must be submitted to the Engineer within 90 Calendar Days from the date the voucher was mailed to the Contractor, according to 00195.90(b). Any request for compensation not submitted and supported by an itemized statement within the 90 Calendar Day period will not be paid by the Agency. This does not limit the application of Section 00199.

(b) Acceptance or Rejection of Request:

(1) Consideration of Request - The Engineer will consider and investigate the Contractor's request for correction of compensation submitted according to 00195.95(a), and will promptly advise the Contractor of acceptance or rejection of the request in full or in part.

(2) Acceptance of Request - If the Engineer accepts the Contractor's request(s) in full or in part, the Engineer will prepare a post-final Contract payment voucher, including all accepted corrections, and will forward it to the Contractor.

(3) Rejection of Request - If the Engineer rejects the request(s) in full, the Engineer will issue a written notice of rejection and mail it to the Contractor.

(4) Contractor Objection to Revised Voucher or Notice of Rejection - If the Contractor disagrees with the revised voucher or notice of rejection, the Contractor may request review according to the procedure specified in 00199.40. If the Contractor fails to submit a request for 00199.40 review within 30 Calendar Days after the Engineer mails a post-final Contract payment voucher or notice of rejection, the Contractor waives all rights to a claim based on errors in quantities and amounts.

If the Engineer rejects the Contractor's request on the basis that the issue was not one that qualified for treatment under this Section, no review according to 00199.40 will be allowed.

Section 00196 - Payment for Extra Work

Description

00196.00 General - Only work not included in the Contract as awarded but deemed by the Engineer to be necessary to complete the Project (see 00140.60) will be paid as Extra Work. Regardless of alterations and changes, any item of Work provided for in the Contract will not constitute Extra Work. Payment for alterations and changes to Work will be made according to 00195.20.

Compensation for Extra Work will be paid only for Work authorized in writing by the Engineer and performed as specified. Work performed before issuance of the Engineer's written authorization shall be at the Contractor's risk. Extra Work will be paid as determined by the Engineer, according to 00196.10 and 00196.20.

Provisions and Requirements

00196.10 Negotiated Price - If the Engineer can reasonably determine a price estimate for Extra Work, the Engineer may then give written authorization to the Contractor to begin the Extra Work. As soon as practicable, but within 10 Calendar Days after that authorization, the Contractor shall respond in writing to the Engineer's Extra Work price estimate by submitting to the Engineer an Extra Work price quote. The price quote shall detail the following items related to the Extra Work:

- Types and amounts of Materials
- Hours of Equipment use and hours of labor
- Travel
- Overhead and profit
- Other costs associated with the proposed Extra Work

Pending approval of the price quote, the Engineer will maintain force account records of the Extra Work. As soon as practicable, but within 10 Calendar Days of receipt of a properly supported price quote, the Engineer will review the price quote and advise the Contractor if it is accepted or rejected. The Engineer will not accept a price quote that cannot be justified on a Force Account basis. If the Contractor's price is accepted, the Engineer will issue a Change Order, and the Extra Work will be paid at the accepted price.

00196.20 Force Account - If the Engineer and the Contractor cannot agree on a price for the Extra Work, the Engineer may issue an Extra Work order requiring the Extra Work to be paid as Force Account Work. Force Account Work records and payment will be made according to Section 00197.

Section 00197 - Payment for Force Account Work

Force Account Work

00197.00 Scope - The Materials, Equipment and labor rates and procedures established in this Section apply to Extra Work ordered by the Engineer to be performed as Force Account Work. With the exceptions identified in 00197.01(b), these rates and procedures also apply to other Work when according to other Sections this Section 00197 applies, including, without limitation, the following:

- 00140.70 - Cost Reduction Proposals
- 00195.20 - Changes to Plans or Character of Work
- 00195.30 - Differing Site Conditions
- 00199.30(b) - Claims Requirements

00197.01 General:

(a) Extra Work on a Force Account Basis - Before ordering Force Account Work, the Engineer will discuss the proposed work with the Contractor, and will seek the Contractor's comments and advice concerning the formulation of Force Account Work specifications. The Engineer is not bound by the Contractor's comments and advice, and has final authority to:

- Determine and direct the Materials, Equipment and labor to be used on the approved Force Account Work; and
- Determine the time of the Contractor's performance of the ordered Force Account Work.

If the Engineer orders the performance of Extra Work as Force Account Work, the Engineer will record, on a daily basis, the Materials, Equipment, labor, and Special Services used for the Force Account Work during that day. The Engineer and the Contractor shall sign the record daily to indicate agreement on the Materials, Equipment, labor, and Special Services used for the Force Account Work performed on that day.

The following shall be reflected on the daily record:

- Materials used in the Force Account Work as directed by the Engineer, except those furnished and paid under rental rates for use of Equipment;
- Equipment that the Engineer considers necessary to perform the Force Account Work. Equipment hours will be recorded to the nearest quarter hour;
- Labor costs, including that of Equipment operators and supervisors in direct charge of the specific operations while engaged in the Force Account Work;
- Special Services; and
- The Engineer's and Contractor's signatures confirming its accuracy.

(b) Other Work - When according to other Sections this Section 00197 applies, the following exceptions apply to the Work under those other Sections, except for Extra Work ordered by the Engineer to be performed as Force Account Work.

- 00197.01(a) does not apply.
- Cost Efficiency - The Agency will not be responsible for additional costs that are a direct or indirect result of the Contractor's inefficient means and methods or that reasonably could have been avoided if the Materials, Equipment, labor or services had been obtained at a more commercially reasonable cost.

- Standby Time - Equipment that is necessary for the Work but is not being operated to progress the Work will be considered to be on standby and will be limited to the standby rates and hour limitations in 00197.20(e). Equipment costs will be limited to a combination of operating time and standby time of not more than 8 hours in a 24 hour period or 40 hours in a 1 week period. The Equipment must be onsite and available for use to be eligible for standby time.

  For a period of 7 or fewer Calendar Days: If a continuous period of standby time for a piece of Equipment does not exceed 7 Calendar Days, the accumulated standby cost for that continuous period of standby time shall be limited to the standby rates and hour limitations in 00197.20(e).

  For a period of more than 7 Calendar Days: Unless the Engineer has otherwise agreed in advance in writing, if a continuous period of standby time for a piece of Equipment exceeds 7 Calendar Days, the accumulated standby cost shall be limited to:

  - For the first 7 Calendar Days, the standby rates and hour limitations in 00197.20(e), and
  - For the portion of the continuous period of standby time after the first 7 Calendar Days, the lesser of:
    - The standby rates and hour limitations in 00197.20(e); or
    - The cost for moving that piece of Equipment to and from the Project Site according to 00197.20(d).

00197.10 Materials:

(a) General - The Contractor will be paid for Materials actually used in the Force Account Work as directed by the Engineer, except for those furnished and paid for under rental rates included with the use of Equipment. Payments will be at actual cost, including transportation costs to the specified location, from the supplier to the purchaser, whether the purchaser is the Contractor, a Subcontractor, or other forces. All costs are subject to the provisions of this Subsection.

(b) Trade Discount - If a commercial trade discount is offered or available to the purchaser, it shall be credited to the Agency, even though the discount may not have actually been taken. The Agency will not take any discounts for prompt or early payment, whether or not offered or taken.

(c) Not Directly Purchased From Supplier - If Materials cannot be obtained by direct purchase from and direct billing by the supplier, the cost shall be considered to be the price billed to the purchaser less commercial trade discounts, as determined by the Engineer, but not more than the purchaser paid for the Materials. No markup other than actual handling costs will be permitted.

(d) Purchaser-Owned Source - If Materials are obtained from a supply or source wholly or partly owned by the purchaser, the cost shall not exceed the price paid by the purchaser for similar Materials furnished from that source on Pay Items, or the current wholesale price for the Materials delivered to the Project Site, whichever is lower.

00197.20 Equipment:

(a) General - Equipment approved by the Engineer to perform the Force Account Work will be eligible for payment at the established rates only during the hours it is operated or on standby if so ordered by the Engineer. Equipment hours will be recorded on the daily record to the nearest quarter hour.

Except as modified by these provisions, Equipment use approved by the Engineer will be paid at the rental rates given in the most current edition of the EquipmentWatch Cost Recovery (Blue Book)

published by EquipmentWatch, a division of Penton Business Media, Inc., and available from EquipmentWatch (phone 1-800-669-3282) (see 00110.05(e) for website).

(b) Equipment Description - On the billing form for Equipment costs, the Contractor shall submit to the Engineer sufficient information for each piece of Equipment and its attachments to enable the Engineer to determine the proper rental rate from the Blue Book.

(c) Rental Rates (without Operator):

(1) Rental Rate Formula - Rental rates for Equipment will be paid on an hourly basis for Equipment and for attachments according to the following formula:

$$\text{Hourly Rate} = \frac{\text{Monthly Base Rate x Rate Adjustment Factor}}{\text{176 hours/month}} + \text{Hourly Operating Rate}$$

Some attachments are considered "standard Equipment" and are already included in the monthly base rate for the Equipment. That information can be obtained from EquipmentWatch.

(2) Monthly Base Rate - The monthly base rate used above for the machinery and for attachments represents the major costs of Equipment ownership, such as depreciation, interest, taxes, insurance, storage, and major repairs.

(3) Rate Adjustment Factor - The rate adjustment factor used above will be determined by applying only the Model Year Adjustment to the Blue Book Rates. The Regional and User Defined Ownership/Operating Adjustments shall not apply.

(4) Hourly Operating Rate - The hourly operating rate used above for the machinery and for attachments represents the major costs of Equipment operations, such as fuel and oil, lubrications, field repairs, tires or ground engaging components, and expendable parts.

(5) Limitations - If multiple attachments are included with the rental Equipment, and are not considered "standard Equipment", only the attachment having the higher rental rate will be eligible for payment, provided the attachment has been approved by the Engineer as necessary to the Force Account Work.

Rental will not be allowed for small tools that have a daily rental rate of less than $5, or for unlisted Equipment that has a fair market value of $400 or less.

The above rates apply to approved Equipment in good working condition. Equipment not in good working condition, or larger than required to efficiently perform the work, may be rejected by the Engineer or accepted and paid for at reduced rates.

(d) Moving Equipment - If it is necessary to transport Equipment located beyond the Project Site exclusively for Force Account Work, the actual cost to transport the Equipment to, and return it from, its On-Site Work location will be allowed as an additional item of expense. However, the return cost will not exceed the original delivery cost. These costs will not be allowed for Equipment that is brought to the Project Site for Force Account Work if the Equipment is also used on Pay Item or related Work.

If transportation of such Equipment is by common carrier, payment will be made in the amount paid for the freight. No markups will be allowed on common carrier transportation costs. If the Equipment is hauled with the Contractor's own forces, transportation costs will include the rental rate of the hauling unit and the hauling unit operator's wage. If Equipment is transferred under its own power, the rental rate allowed for transportation time will be 75% of the appropriate hourly rate for the Equipment, without attachments, plus the Equipment operator's wage.

(e) Standby Time - If ordered by the Engineer, standby time will be paid at 40% of the hourly rental rate calculated according to this Subsection, excluding the hourly operating rate. Rates for standby time that are calculated at less than $1 per hour will not be paid. Payment will be limited to not more than 8 hours in a 24-hour period or 40 hours in a 1 week period.

(f) Blue Book Omissions - If a rental rate has not been established in the Blue Book, the Contractor may:

- If approved by the Engineer, use the rate of the most similar model found in the Blue Book, considering such characteristics as manufacturer, capacity, horsepower, age and fuel type;
- Request EquipmentWatch to furnish a written response for a rental rate on the Equipment, which shall be presented to the Engineer for approval; or
- Request that the Engineer establish a rental rate.

(g) Outside Rental Equipment - If Contractor-owned or Subcontractor-owned Equipment is not available, and Equipment is rented from outside sources, payment will be based on the actual paid invoice.

If the invoice specifies that rental rate does not include fuel, lubricants, field repairs, and servicing, an amount equal to the Blue Book hourly operating cost may be added for those items that were excluded.

The Agency may reduce the payment when the invoice amount plus allowance is higher than the amount authorized under (c) through (f) of this Subsection.

The provisions of 00180.20(c) apply to owner-operated Equipment.

00197.30 Labor - The Contractor will be paid for all labor engaged directly on Force Account Work, including Equipment operators and supervisors in direct charge of the specific force account operations, as follows:

(a) Wages - The actual wages paid to laborers and supervisors, if those wages are paid at rates not more than those for comparable labor currently employed on the Project, or at the recognized, current, prevailing rates in the locality of the Project.

(b) Required Contributions - The actual cost of industrial accident insurance, unemployment compensation contributions, payroll transit district taxes, and social security for old age assistance contributions incurred or required under statutory law and these Specifications. The actual cost of industrial accident insurance is the National Council on Compensation Insurance (NCCI) rate for the assigned risk pool for the appropriate work class multiplied by the experience modification factor for the Contractor.

(c) Required Benefits - The actual amount paid to, or on behalf of, workers as per diem and travel allowances, health and welfare benefits, pension fund benefits, or other benefits when such other benefits are required by a collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the Project.

00197.40 Invoices for Special Services - Invoices for Special Services that reflect current market pricing may be accepted without complete itemization of Materials, Equipment, and labor costs, if the itemization is impractical or not customary. The invoice for Special Services shall show credit for commercial trade discounts offered or available.

No percentage markup will be allowed other than that specified in 00197.80.

00197.80 Percentage Allowances - To the Contractor's actual costs incurred, as limited in this Section 00197, amounts equal to a percentage markup of such costs will be allowed and paid to the Contractor as follows:

Subsection	Percent
00197.10 Materials	17
00197.20 Equipment	17
00197.30 Labor	22
00197.40 Special Services	17

When a Subcontractor performs ordered Force Account Work, the Contractor will be allowed a supplemental markup of 8% on each Force Account Work order.

These allowances made to the Contractor will constitute complete compensation for overhead, general and administrative expense, profit, and all other Force Account Work costs that were incurred by the Contractor, or by other forces that the Contractor furnished. No other reimbursement, compensation, or payment will be made.

00197.90 Billings - Billings for Force Account Work by the Contractor shall be submitted for the Engineer's approval on forms provided by the Agency or approved by the Engineer. Billings for Materials (other than Incidental items out of the inventory of the Contractor or Subcontractors), rental Equipment from sources other than the Contractor or Subcontractors, and Special Services, shall be accompanied by copies of invoices for the goods and services. The invoices shall be fully itemized showing dates, quantities, unit prices, and complete descriptions of goods and services provided. Invoices for amounts of $10 or less per invoice are not required, unless requested by the Engineer.

Costs included on the billings shall comply with 00197.01(a) and 00197.10 through 00197.40.

When a billing for Force Account Work has been paid at the Project level, no further corrections will be made because of further review if those corrections amount to less than $10.

Section 00199 - Disagreements, Protests, and Claims

Description

00199.00 General - This Section details the process through which the parties agree to resolve any disagreement concerning additional compensation or concerning a combination of additional compensation and Contract Time. (See 00180.80 for disagreements and claims concerning additional Contract Time only, and 00195.95 for disagreements and claims concerning correction of final compensation.) The Agency will not consider direct disagreements, protests, or claims from Subcontractors, Suppliers, or any other Entity not a party to the Contract.

Provisions and Requirements

00199.10 Procedure for Resolving Disagreements - When disagreements occur concerning additional compensation or a combination of additional compensation and Contract Time, the Contractor shall first pursue resolution through the Engineer of all issues in the dispute, including, without limitation, the items to be included in the written notice in 00199.20. If the discussion fails to provide satisfactory resolution of the disagreement, the Contractor shall follow the protest procedures outlined in 00199.20. If the Engineer denies all or part of the Contractor's protest, and the Contractor desires to further pursue the issues, the Contractor shall submit a claim for processing according to 00199.30.

00199.20 Protest Procedure - If the Contractor disagrees with anything required in a Change Order or other written or oral order from the Engineer, including any direction, instruction, interpretation, or determination, or if the Contractor asserts a disagreement or dispute on any other basis, except 0195.95, that, in the Contractor's opinion, entitles or would entitle the Contractor to additional compensation or a combination of compensation and Contract Time, the Contractor shall do all of the following in order to pursue a protest and preserve its claim:

(a) Oral Notice - Give oral notice of protest to the Engineer and outline the areas of disagreement before starting or continuing the protested Work.

(b) Written Notice - File a proper written notice of protest on form 734-2887 with the Engineer within 7 Calendar Days after receiving the protested order. In the notice the Contractor shall:

- Describe the acts or omissions of the Agency or its agents that allegedly caused or may cause damage to the Contractor, citing specific facts, persons, dates and Work involved;
- Describe the nature of the damages;
- Cite the specific Contract provision(s) that support the protest;
- Include the estimated dollar cost, if any, of the protested Work, and furnish a list of estimated Materials, Equipment and labor for which the Contractor might request additional compensation; and
- If additional compensation is estimated to be due, include the estimated amount of additional time required, if any.

Failure to comply with these notice requirements renders the notice improper.

(c) Records - Keep complete records of all costs and time incurred throughout the protested Work, and allow the Engineer access to those and other supporting records. Provide daily records of protested Work, on a weekly basis, on a schedule to be set by agreement with the Engineer.

(d) Comparison of Records - Provide the Engineer adequate facilities for keeping cost and time records of the protested Work. The Contractor and the Engineer will compare records and either bring them into agreement at the end of each day, or record and attempt to explain any differences.

(e) Work to Proceed - In spite of any protest, proceed promptly with the Work ordered by the Engineer.

(f) Evaluation of Protest - The Engineer will promptly evaluate all protests, after the Contractor has fully complied with the requirements described in 00199.20(b). If the protest is denied, the Engineer will notify the Contractor in writing of the reasons for full or partial denial. If a protest is found to be valid, the Engineer will, within a reasonable time, make an equitable adjustment of the Contract. Adjustment of time will be evaluated according to 00180.80.

The Engineer has no responsibility for evaluating and may reject a protest that does not comply with 00199.20(b). If the protest is rejected, the Engineer will notify the Contractor in writing of the reasons for rejection.

(g) Protest Evaluation by Third Party Neutral - If the Engineer agrees that the Contractor has fully complied with the requirements described in 00199.20(b), and if the Engineer fully or partially denies, in writing, the Contractor's protest according to 00199.20(f), the Contractor may request that a mutually selected Third Party Neutral review the protest. Procedures for selecting, using, and paying for the cost of the Third Party Neutral will be specified by Change Order.

If the Contractor does not accept the Engineer's evaluation of the protest, or either the Contractor or Engineer disagrees with the resolution recommended by the Third Party Neutral, the Contractor may pursue a claim as described in 00199.30.

00199.30 Claims Procedure:

(a) General - If the Contractor believes that additional compensation is due, or a combination of additional compensation and Contract Time, and has pursued and exhausted all the procedures provided in 00199.10 and 00199.20 to resolve a disagreement and protest, the Contractor may file a claim.

The Agency's Contract is with the Contractor. There is no contractual relationship between the Agency and any Subcontractors, Suppliers or any Entity other than the Contractor. It is the Contractor's responsibility to fully evaluate any claim before presenting it to the Agency. In addition, when a claim includes Work done or costs incurred by any Subcontractors, Suppliers, or any Entity other than the Contractor, the Contractor remains solely responsible for presenting the claim to the Agency.

Claims that include Work done or costs incurred by any Subcontractors, Suppliers, or any Entity other than the Contractor will not be considered by the Agency unless the Contractor has:

- Completed and provided its own written evaluation of the claim;
- Verified by its own independent review and evaluation of the amount of compensation sought; and
- Certified the claim according to 00199.30(b) (Part 10).

(b) Claims Requirements - At any time during the progress of the Work, but not later than 45 Calendar Days following the date of the Second Notification, the Contractor shall submit to the Engineer in writing, claims for additional compensation or a combination of additional compensation and Contract Time additional to that specified in the Contract. For a claim not submitted within the 45-day limit, that has not met the requirements of 00199.20, or is not filed as provided in 00199.30, the Contractor waives any claim for additional compensation or for additional compensation and Contract Time, and the Agency may reject the claim.

Written claims to the Engineer or the Agency by the Contractor shall be delivered to the Agency address shown in the Special Provisions, unless a different address is agreed to by the Engineer, and shall be delivered:

- By U.S. Postal Service first class mail or priority mail (which at the sender's option may include certified or registered mail return receipt requested); or
- By overnight delivery service of a private industry courier.

Claims will be considered as having been received by the Agency:

- At the time of actual receipt or 7 Calendar Days after the postmarked date when deposited for delivery by first class or priority mail, whichever is earlier; or
- At the time of actual receipt or 3 Calendar Days after deposit with a private industry courier for overnight delivery service, whichever is earlier.

The Agency reserves the right at any time and at any step in the claim decision or review process to request additional information, records or documentation related to the claim or the Contract either directly or through agents working toward resolution of the disputed or claimed events and issues.

Claims shall be made in writing, and shall include all information, records and documentation necessary for the Agency to properly and completely evaluate the claim.

To be considered, claims for additional compensation, or for additional compensation and Contract Time, shall be completed according to 00199.30 and shall be submitted with the required information and in the format below and labeled as required below for each claimed issue:

(Part 1) Summary (label page 1.1 through page 1.X) - In the summary, include a detailed, factual statement of the claim for additional compensation and Contract Time, if any, with necessary dates and locations of Work involved in the claim and the dates of when the event arose. Also include detailed facts supporting the Contractor's position relative to the Engineer's decision (see 00199.20(f));

(Part 2) Proof of notice (label page 2.1 through page 2.X) - Submit a copy of form 734-2887, with all attachments, that was given to the Agency. Include the date when that written notice and the date when oral notice was given:

(Part 3) Copies of the Contract Specifications that support the Contractor's claim (label page 3.1 through page 3.X);

(Part 4) Theory of entitlement supporting the claim (label page 4.1 through page 4.X) - Include a narrative of how or why the specific Contract Specifications support the claim and a statement of the reasons why such Specifications support the claim;

(Part 5) Itemized list of claimed amounts (label page 5.1 through page 5.X) - Claimed damages that resulted from the event with a narrative of the theories and records and documents used to arrive at the value of the damages;

(Part 6) Additional Contract Time requests (label page 6.1 through page 6.X) - If the claim is for a combination of additional compensation and Contract Time, submit a copy of the schedule that was in effect when the event occurred and a detailed narrative which explains how the event impacted Contract Time. In addition, if an Agency-caused delay is claimed:

- Include the specific days and dates under claim;

- Provide detailed facts about the specific acts or omissions of the Agency that allegedly caused the delay, and the specific reasons why the resulting delay was unreasonable; and
- Provide a schedule evaluation that accurately describes the impacts of the claimed delay.

Also see 00180.80 for additional requirements regarding claims for Contract Time and causes that are eligible and ineligible for consideration;

(Part 7) Copies of actual expense records (label page 7.1 through page 7.X) - Include documents that contain the detailed records and which support and total to the exact amount of additional compensation sought. Include the information and calculations necessary to support that amount. That amount may be calculated on the basis of Section 00197, if applicable, or may be calculated using direct and indirect costs presented in the following categories:

- Direct Materials;
- Direct Equipment. The rate claimed for each piece of Equipment shall not exceed the actual cost. In the absence of actual Equipment costs, the Equipment rates shall not exceed 75 percent of those calculated under the provisions of 00197.20. For each piece of Equipment, the Contractor shall include a detailed description of the Equipment and attachments, specific days and dates of use or standby, and specific hours of use or standby;
- Direct labor;
- Job overhead;
- General and administrative overhead; and
- Other categories as specified by the Contractor or the Agency;

(Part 8) Supporting records and documents (label page 8.1 through page 8.X) - Include copies of, or excerpts from the following:

- Any documents that support the claim, such as manuals standard to the industry and used by the Contractor; and
- Any daily reports or diaries related to the event, photographs or media that help explain the issue or event (optional), or all other information the Contractor chooses to provide (optional);

(Part 9) Certification (label page 9.1 through 9.X) - A certified statement, signed by a person authorized to execute Change Orders, by the Contractor, Subcontractor, Supplier, or Entity, originating the claim, as to the validity of facts and costs with the following certification:

Under penalty of law for perjury or falsification, the undersigned, (Name), (Title), (Company) certifies that this claim for additional compensation for Work on the Contract is a true statement of the actual costs incurred (in the amount of $_____, exclusive of interest) and is fully documented and supported under the Contract between the parties.

Signature: _____

Date: _____, *20*___

Subscribed and sworn before me this ____ *day of* _____, *20*___

_____

Notary Public

My commission expires _____.

(Part 10) Contractor evaluation of a lower-tier claim (label page 10.1 through 10.X) - If the claim includes Work done or costs incurred by any Subcontractors, Suppliers, or any Entity other than the Contractor, the following are required:

- Data required by the other Subsections of 00199.30(b);
- Copies of the Contractor's, Subcontractor's, Supplier's and Entity's, at all tiers above the level of which the claim originates, separate evaluation of entitlement;
- Copies of the Contractor's, Subcontractor's, Supplier's and Entity's, at all tiers above the level of which the claim originates, independent verification and evaluation of the amount of damages sought; and
- A person authorized to execute Change Orders on behalf of the Contractor, Subcontractor, Supplier and Entity, at all tiers above the level of which the claim originates, must sign a statement with the following certification:

  Under penalty of law for perjury or falsification, the undersigned, (Name) (Title), (Company) certifies that this claim originating from the Subcontractor, Supplier or Entity (Company) for additional compensation for Work on the Contract is a reasonable statement, independently verified, of the costs incurred (in the amount of $_____, exclusive of interest) and is fully documented and supported under the Contract between the parties.

  Signature: _____

  Date: _____, *20*___

  Subscribed and sworn before me this ____ *day of* _____, *20*__

  _____

  Notary Public

  My commission expires _____.

If the Engineer determines that additional information, records or documentation is needed to allow proper evaluation of the claim submittal, the Engineer will request the information, records or documentation. The Contractor shall submit to the Engineer within 14 Calendar Days, or as otherwise agreed by the parties, the required additional information, records and documentation.

If the Engineer determines that the claim submittal with the additional information, records and documentation submitted is incomplete and not accepted as a claim, the Engineer will notify the Contractor in writing and the submittal will be rejected and will not be considered under 00199.40.

(c) Records Requirements - The Contractor shall comply with 00170.07.

(d) Compliance Required - Full compliance by the Contractor with the provisions of this Section is a condition precedent to the commencement of any lawsuit by the Contractor to enforce any claim.

00199.40 Claim Decision; Review; Exhaustion of Administrative Remedies - The Agency intends to resolve all claims at the lowest possible administrative level. The Engineer will also determine whether multiple claims should be advanced separately or together.

If the Engineer denies the claim for additional compensation or a combination of additional compensation and Contract Time, in full or in part, according to 00199.40(a), the Contractor may request review of the denial. The disputed claim for additional compensation or a combination of

additional compensation and Contract Time may then be resolved, in full or in part, at any of the four progressive steps of claim review procedure as specified in (b) through (e) of this Subsection.

If the Engineer has denied a claim, in full or in part, for Contract Time only according to 00180.80, or has denied a claim, in full or in part, for correction of final compensation according to 00195.95, those disputed claims may then be resolved, in full or in part, at any of the four progressive steps of claim review procedure as specified in (b) through (e) of this Subsection.

A person authorized by the Contractor to execute Change Orders on behalf of the Contractor must be present and attend all claim hearings. For all claims, all of the actions and review under each step of the review process shall occur before the review can be advanced to the next higher step.

The Engineer may determine to skip the Step 1: Region Level Review, in which case the claim or claims will advance to Step 2: Agency Level Review.

(a) Decision by the Engineer - The Engineer will, as soon as practicable, consider, investigate, and evaluate a Contractor's claim for additional compensation, or for a combination of additional compensation and Contract Time, if submitted as required by 00199.30.

Once the Engineer determines the Agency is in receipt of a properly submitted claim, the Engineer will arrange a meeting, within 21 Calendar Days or as otherwise agreed by the parties, with the Contractor in order to present the claim for formal review and discussion.

If the Engineer determines that the Contractor must furnish additional information, records or documentation to allow proper evaluation of the claim, the Engineer will schedule a second meeting, to be held within 14 Calendar Days or as otherwise agreed by the parties, at which the Contractor shall present the requested information, records and documentation.

The Engineer will provide a written decision to the Contractor within 30 Calendar Days of the last Engineer-level meeting.

If the Contractor does not accept the Engineer's decision, the Contractor may, within 10 Calendar Days of receipt of the written decision, request in writing that the Engineer arrange a review at Step 1 (see (b) below).

(b) Step 1: Region Level Review - The Contractor shall request that the Engineer arrange a meeting with the Region-level reviewer in order to present the denied or partially denied claim for formal review and discussion. The meeting will take place within 21 Calendar Days of the Agency's receipt of the request, or as otherwise agreed by the parties.

If the Region-level reviewer determines that the Contractor must furnish additional information, records or documentation to allow proper evaluation of the claim, the reviewer will schedule a second meeting, to be held within 14 Calendar Days, or as otherwise agreed by the parties, at which the Contractor shall present the requested information, records and documentation.

The Region-level reviewer will provide a written decision to the Contractor within 30 Calendar Days of the last Region-level meeting.

If the Contractor does not accept the Step 1 decision, the Contractor may, within 10 Calendar Days of receipt of the written decision, request in writing that the Engineer arrange a review at Step 2 (see (c) below).

(c) Step 2: Agency Level Review - The Contractor shall request a meeting with the Contract Administration Engineer (CAE) to present the claim for final Agency review. The presentation will

take place within 21 Calendar Days of the Agency's receipt of the Contractor's written request, or as otherwise agreed by the parties.

If the CAE determines that the Contractor must furnish additional information, records or documentation to allow proper evaluation of the claim, the CAE will schedule a second meeting to be held within 14 Calendar Days or as otherwise agreed by the parties, at which the Contractor shall present the requested information, records and documentation.

The claim is subject to 00199.60, if not all of the records requested by the CAE were furnished.

The CAE will provide a written decision to the Contractor, subject to 00199.60, if applicable, regarding the claim within 30 Calendar Days of the final Step 2 meeting.

If the Contractor does not accept the Step 2 decision, the Contractor may, within 10 Calendar Days of receipt of the written decision, request in writing through the Engineer that the claim be advanced to Step 3 or 4 (see (d) and (e) below), as applicable. For purposes of determining which process to use for claims under Step 3 or 4 concerning a combination of additional compensation and Contract Time or for Contract Time only, the value of the claim or portion of the claim for Contract Time will be assumed to be the appropriate Liquidated Damages given in 00180.50 of the Special Provisions multiplied by the number of Calendar Days in question. If applicable, advancement of the claim is subject to the provisions of 00199.60 regarding waiver and dismissal of the claim or portions of the claim.

(d) Step 3: Arbitration; Claims Review Board:

(1) Claims Less Than $50,000 - At this step, the claim will be resolved by binding arbitration before a single arbitrator according to the Construction Industry Arbitration Rules of the American Arbitration Association or such other arbitration service and rules as agreed by the parties.

Arbitration filing costs and any arbitrator's fees will be divided equally between the Agency and the Contractor.

(2) Claims of $50,000 to $500,000 - At this step, the Contractor shall present the claim to a Claims Review Board (referred to as "Board") for consideration, review and recommended resolution. The Board will be comprised of three persons. ODOT will establish and maintain, in consultation with representatives of the construction industry, a panel of more than 12 qualified individuals available to serve on Boards.

If a claim within the scope of this step is properly referred for Board consideration and review, copies of biographies of all persons on the panel will be sent to the Contractor. Within 20 Calendar Days after the biographies are mailed, the Contractor and the Engineer shall each nominate, in writing, three individuals from the panel available to serve on the Board.

Within 10 Calendar Days after receipt of the nominations, the Contractor and the Engineer shall (a) each appoint to the Board one of the three individuals by the other, and (b) inform each other of the appointment. The two appointees, now Board Members, shall select an individual from the panel to serve as the third Board Member.

If the two Board Members cannot agree on the selection of the third Board Member, the Circuit Court in the county in which the Agency's main office is located will resolve the dispute. In this event, the Engineer will act through the Agency's legal counsel to request the Circuit Court to select an individual from the panel to serve as the third Board Member. Once the three Board Members have been selected, the three Board Members will decide which of the three will be the Board Chair.

The Board may request the Engineer to designate a person not associated with the Contract to act as the recording secretary for the Board. The recording secretary is not a Board member, and will only assist the Board with administrative tasks related to its consideration and review of the referred claim.

The Agency and the Contractor will equally share the costs of the Board members. The Agency will pay the costs of the Board's recording secretary.

Members of the Board are to act impartially and independently in the consideration of facts and conditions surrounding the dispute. Board recommendations concerning the dispute are considered advisory only, shall not be binding on either party, and shall not constitute evidence in any legal proceeding for any reason.

The Board will schedule and conduct an informal hearing at which the Contractor and the Agency will each have an opportunity to present evidence and argument. The Contractor and the Agency shall each submit a brief written summary of the claim to each Board member and the other party at least 10 Calendar Days before the hearing. Unless directed otherwise by the Board Chair, the summary shall include, for each issue under dispute:

- A short statement describing the disputed issue;
- A short position statement by the party on the issue;
- A clear and concise explanation of the contractual basis for that position, including specific reference to Contract Documents;
- A clear and concise description of the costs claimed for each issue, including, without limitation, specific documents demonstrating productivity, time and costs; and
- Exhibits, including, without limitation, copies of plan sheets, extracts from the Standard Specifications and Special Provisions, correspondence, photographs, or other evidence to support the position.

The proceedings will be conducted in a manner determined by the Chair, in consultation with the other Board members. Unless directed otherwise by the Chair, the hearing will be conducted according to the following guidelines:

- The hearing will be informal;
- The witnesses will not be sworn;
- The Contractor will present its case first;
- The Agency will then present its case;
- Both parties will then have opportunity to present rebuttal;
- The Board may ask questions and, to promote open discussion of the issues, both parties may respond or emphasize issues;
- The parties' attorneys may observe the hearing and may respond to direct questions from the Board, but may not make factual presentations or legal arguments; and
- The Board will conclude the hearing when it appears to the Board Chair that each party has had sufficient opportunity to support its case and the Board has no further questions.

Within 10 Calendar Days after conclusion of the hearing, the Board will forward to the Agency's designated representative and the Contractor the Board's written recommendation for resolution of the claim. Within 10 Calendar Days of its receipt of the Board's recommendation, the Agency will provide to the Contractor the Agency's written decision regarding the claim.

If the Contractor does not accept the Agency's decision regarding the claim, the Contractor may proceed to litigation as described in Step 4 (see (e) below).

(3) Claims Over $500,000 - If the Contractor and the Engineer agree, the parties may employ the Step 3 Board review process according to 00199.40(d)(2). If not, the Contractor may proceed to Step 4 (see (e) below).

(e) Step 4: Litigation - This step applies to:

- Claims over $500,000;
- Appeals of arbitration awards issued in Step 3 at 00199.40(d)(1) above, according to ORS 36.600 through ORS 36.740; and
- Agency decisions issued under Step 3 at 00199.40(d)(2) above.

The Contractor must follow each step in order, and exhaust all available administrative remedies before resorting to litigation. Lawsuits must be properly filed in a court of competent jurisdiction within 6 months from the date of the final decision that exhausted the Contractor's available administrative remedies under this Section 00199.

The Contractor shall comply with 00170.00.

00199.50 Mediation - Notwithstanding the formal claims procedure specified above, the parties may enter into nonbinding mediation by mutual agreement at any time, in which case the parties may also agree to suspend the time requirements in Section 00199 pending the outcome of the mediation process. The rules, time and place for mediation, as well as selection of the mediator, shall be established by mutual agreement. Costs shall be divided equally between the Contractor and the Agency. Either party may terminate mediation at any time upon 5 Calendar Days' notice to the other, after which the time requirements of Section 00199 shall be automatically reinstated and shall resume from the point at which the time requirements were suspended.

00199.60 Review of Determination Regarding Records - If not all of the records requested by the CAE under 00199.40(c) Step 2 were provided, then the CAE will determine:

- If the records are of the type described in 00170.07; and
- If the records have not been maintained or the records, or access to the records, has not been provided to the Agency as required by 00170.07 and this Section; and
- If the records are material and necessary for proper evaluation of part or all of the claim; and
- The portions of the claim for which the records are material and necessary for proper evaluation.

If the CAE makes the foregoing determinations, then subject to the review process described below, all portions of the claim for which the CAE determined the records are material and necessary for proper evaluation are immediately waived and irrevocably dismissed.

Even if the records have not been maintained or the records, or access to the records, have not been provided to the Agency in a given instance, the CAE may determine that sufficient records have been provided for the Agency to properly evaluate the claim in that instance. If the CAE makes this determination, the claim or portions of the claim will not be waived or dismissed under this provision.

If the Contractor does not accept the CAE's written determination that the records are material and necessary for proper evaluation of part or all of the claim, and the portions of the claim for which the records are material and necessary, the Contractor may, within 14 Calendar Days of receipt of the CAE's determination, request, in writing, a review of such determination by the Construction Engineer (CE). If the Contractor does not request a review of the CAE's determination, the CAE's determination shall then become the Agency's final determination as of the expiration of the time limit to request review.

If the Contractor requests the review, the CE will schedule a review meeting within 14 Calendar Days, or as otherwise agreed by the parties, of when the CE receives the written review request. The Agency and the Contractor will each have an opportunity to explain their respective positions at the review meeting in a manner determined by the CE.

Within 10 Calendar Days of the review meeting, the CE will issue a written proposed finding of whether the records not maintained or not provided to the Agency, or for which access was not provided to the Agency, are material and necessary for proper evaluation of part or all of the claim. If the CE makes that finding, then the CE will also make a proposed written finding as to what portions of the claim the records are material and necessary and, therefore, waived and irrevocably dismissed.

Even if the records have not been maintained or the records, or access to the records, have not been provided to the Agency in a given instance, the CE may determine that sufficient records have been provided for the Agency to properly evaluate the claim in that instance. If the CE makes this determination, then the claim or portions of the claim will not be waived or dismissed under this provision.

The CE's proposed findings will be submitted to the Contractor and the Agency's Director. The Contractor may submit written objections concerning the proposed findings to the Director within 5 Calendar Days of receipt of such findings. If written objections are submitted, the Director may adopt or modify the proposed findings, and the Director's findings shall be the Agency's final determination. If no written objections are submitted within the 5 Calendar Day time limit, the CE's proposed findings shall then become the Agency's final determination as of the expiration of the time limit to submit written objections.

If the Agency's final determination is that the records are material and necessary for proper evaluation of part or all of the claim, then the claim or that portion of the claim for which the records are material and necessary is waived and irrevocably dismissed, unless the Contractor provides the records, or access to the records, to the CAE within 5 Calendar Days of the Agency's final determination. If the Contractor provides the records, or access to the records, within this time limit, the CAE will schedule a meeting with the Contractor within 14 Calendar Days or as otherwise agreed by the parties, to discuss the records.

The Agency's final determination that records are material and necessary for proper evaluation of part or all of the claim, and the Agency's final determination of the portions of the claim for which the records are material and necessary, shall be final and binding.

If the entire claim is waived and irrevocably dismissed pursuant to the Agency's final determination there will be no further decision by the Agency on the claim or further review of the claim under 00199.40 and the claim will not be eligible for mediation under 00199.50. If only portions of the claim are waived and irrevocably dismissed pursuant to the Agency's final determination, the CAE will provide a written decision to the Contractor regarding the remaining portions of the claim within 30 Calendar Days of the final Step 2 meeting, or the Agency's final determination regarding the records, whichever is later. There will be no further decision by the Agency on or further review under 00199.40 of the portions of the claim waived and irrevocably dismissed pursuant to Agency's final determination and those portions will not be eligible for mediation under 00199.50.

PART 00200 - TEMPORARY FEATURES AND APPURTENANCES

Section 00210 - Mobilization

Description

00210.00 Scope - This Work consists of operations and preparatory Work necessary to become ready to perform the Work or an item of Work.

Construction

00210.40 Mobilization - Mobilization includes, but is not limited to, the following:

- Moving personnel, Equipment, supplies, and Incidentals to the Project Site.
- Establishing offices, buildings, and other facilities necessary for Work on the Project.
- Performing other Work and operations or incur costs as necessary before beginning Work on the Project.
- Obtaining and maintaining access to Doc Express®, and using Doc Express® to submit documents according to 00170.08.

Measurement

00210.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00210.90 Payment - Payment for mobilization will be made at the Contract lump sum amount for the item "Mobilization".

The amounts paid for mobilization in the Contract progress payment will be based on the percent of the original Contract Amount that is earned from other Contract items, not including advances on Materials, and as follows:

- When 5 percent is earned, either 50 percent of the amount for mobilization or 5 percent of the original Contract Amount, whichever is the least.
- When 10 percent is earned, either 100 percent of mobilization or 10 percent of the original Contract Amount, whichever is the least.
- When all Work is completed, amount of mobilization exceeding 10 percent of the original Contract Amount.

This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the Contract.

When the Contract Schedule of Items does not indicate payment for mobilization, no separate or additional payment will be made for mobilization. Payment will be included in payment made for the appropriate items under which this Work is required.

No separate or additional payment will be made for any costs associated with obtaining and maintaining access to Doc Express® or the use of Doc Express®.

Section 00220 - Accommodations for Public Traffic

Description

00220.00 Scope - This Work consists of maintaining facilities to accommodate Public Traffic through and within the Project for the life of the Contract. Public Traffic includes motor vehicles, bicycles, and pedestrians.

00220.01 General:

(a) Beginning of Contractor's Responsibility - The Contractor's responsibilities for accommodating Public Traffic begin on the day any On-Site Work begins within the Project limits.

(b) Abbreviations:

PCD - Pedestrian Channelizing Device

TCD - Traffic Control Devices

TCM - Traffic Control Measures

TPAR - Temporary Pedestrian Accessible Route

(c) Definitions:

Traffic Control Devices - Signs, signals, markings, and other devices placed on, over, or adjacent to a roadway used to regulate, warn, or guide Public Traffic by authority of a public body or official having jurisdiction.

Traffic Control Measures - Elements of the TCP including, but not limited to, TCD, personnel, materials and Equipment used to control Public Traffic through a work zone.

Temporary Pedestrian Accessible Route - An area within a work zone, marked by signing, delineation and TCD, for the use of pedestrians to navigate through or around the work area. The TPAR is included as part of the traffic control plan.

Temporary Pedestrian Accessible Route Plan - A written and drawn plan within the TCP that identifies requirements for providing safe, effective and accessible routes for pedestrians through or around the work zone including TPAR details, advance public notification; and, construction and maintenance responsibilities.

Work Area - The portion of the Highway closed to Public Traffic and set aside for workers, construction Equipment, and construction materials. The work area is typically delineated by channelizing devices or separated from traffic using temporary barriers.

Work Zone - An area within Highway construction, maintenance, or Utility Work activities which extends from the first road Work, Bridge Work, or Utility Work warning sign to the last sign or the last TCD.

00220.02 Public Safety and Mobility - Provide for the safety and mobility of the public and:

(a) General Requirements:

- Be responsible for damages according to 00170.80.
- Conduct Work at all times so there is the least possible interference with or hazard to the traveling public and the affected community.

- Locate stockpile Materials and park construction Equipment and vehicles that are not in active use a minimum of 30 feet from the Traveled Way. If this is not possible, protect the stockpile Materials, Equipment, and vehicles, with barrier or as directed.
- Provide and maintain safe temporary access to business and residence driveways, temporary intersections, and temporary connections with roads, streets, and bicycle and pedestrian facilities.
- Provide approved protection and delineation between each work area and Public Traffic.
- Allow emergency vehicles immediate passage at all times.
- Use portable changeable message signs (PCMS) according to Section 00222.
- Do not impede the flow of traffic or close any lanes of traffic except as listed in 00220.40(e).
- Do not stop or hold vehicles on a Highway within the Project Site for more than 20 minutes.
- Do not block driveways for more than 2 hours unless otherwise authorized in writing.
- Do not close any lanes or pedestrian facilities until the area is signed according to the Plans and the requirements of this Section and Sections 00221 and 00222.
- Do not perform Work that restricts traffic access to and from both sides of the Traveled Way at the same time.
- Do not use temporary steel plating within the Roadway or Shoulder having a preconstruction posted speed zone greater than 35 mph.
- Do not place work zone signs or sign supports that will block existing walkways or existing bikeways, except at the closure point of a walkway or bikeway.
- Do not stop or hold traffic inside a tunnel during flagger control operations at any time.
- Delineate all business accesses with blue tubular markers on 10 foot maximum spacing. Mark the access with 36-by-24 inch "BUSINESS ACCESS" (CG20 11) signs. Locate and install these signs as directed.
- When pipe backfill cannot be achieved by the end of a work shift and temporary plating is not in place according to 00405.46(e), provide additional temporary traffic control measures, including flagging, as required by the Engineer and at no additional cost to the Agency.

(b) Temporary Pedestrian Accessible Route Plan - For the safety and accessibility of pedestrians, the temporary pedestrian accessible route plan shall provide and maintain TPAR for pedestrian pathways impacted by construction or construction staging, and the following:

- TPAR shall meet the requirements of Part 6 of the MUTCD.
- For intersection Work that impacts the accessibility of pedestrian routes through or around the work zone, limit impacts to one corner of an intersection at a time, unless otherwise shown.
- For all sidewalk or curb ramp closures, install signs and other TCD as shown, and do the following:
  - Limit pedestrian detour lengths to three sides of a city block or 1000 feet, whichever is less.
  - Close the sidewalk at a point where there is an alternate way to proceed, and provide signing and other TCD directing pedestrians to an alternate pedestrian route.
  - Place closure signing at the closure point, as shown.
  - Mount signs between the panels of a Type II barricade or on a single-post temporary sign support, as shown. Place signs facing pedestrian traffic.
- For TPAR where the existing facilities do not meet the requirements of Part 6 of the MUTCD, provide additional TCM and pedestrian detour routes that, as nearly as is practicable, meet or exceed the level of accessibility of existing facility features.

- For TPAR where the existing facilities meet the requirements of Part 6 of the MUTCD:
  - Provide additional TCM and pedestrian detour routes with an approved, non-slip, 60-inch minimum wide surface.
  - Where a 60-inch minimum width along the entire alternate pedestrian route is not possible, provide a minimum 48-inch wide route with a 60 by-60 inch passing space every 200 feet along the route.
- Protect pedestrians and delineate the pedestrian detour route by placing PCD, or other approved devices, between the pedestrian detour route and the work area. Keep PCD in place, except as required for actual Work, until the permanent pedestrian facility is completed and reopened.
- Where the TPAR moves pedestrians vertically between a sidewalk curb and the Roadway surface, and for other similar sudden changes in elevation, provide or construct a temporary curb ramp according to Section 00228 or as shown.
- When Work briefly or intermittently blocks or restricts the use of a pedestrian route, and a temporary detour route is not practicable due to the short duration of the restriction, provide a temporary means of allowing pedestrian access through or around the work area. Means of providing temporary pedestrian accessibility may include, but are not limited to:
  - Temporarily suspending the Work and making the pathway passable.
  - Use of construction staff to guide pedestrians through or around the work area.
- Keep existing pedestrian facilities open during non-work hours or continue to provide a TPAR.

(c) Bicyclists - For the safety and accessibility of bicyclists:

- Protect bicyclists and delineate temporary bicycle routes by placing bicycle channelizing devices (BCD), or other approved devices, between the temporary bicycle route and the work area, as shown or as directed. Keep BCD in place, except as required for actual Work, until the permanent bicycle facility is completed and reopened, or bicycle traffic is returned to its original facility.
- When Work blocks the use of a bicycle route, and a temporary bicycle route detour is not practicable, install “Bicycles ON ROADWAY” (CW11-1) signs in advance of the point where bicyclists must share a Traffic Lane with motor vehicle traffic. Locate the “Bicycles ON ROADWAY” signs as shown or as directed.
- Provide traversable surfaces for temporary bicycle routes free of dirt, mud, gravel or other materials that could cause a bicyclist to slip and fall.

00220.03 Work Zone Notifications - Provide the following work zone notifications:

(a) Over-Dimensional Vehicle Restrictions - When the Project restricts the width, length, height, or weight of vehicles through a work zone or detours trucks around a work zone, fill out and submit a completed copy of the "Highway Restriction Notice-Size and/or Weight" form (Form No. 734-2357), available from the ODOT Motor Carrier Transportation website, at least 35 Calendar Days before the restriction or detour takes effect.

(b) Closures - Submit to the Engineer, in writing, for approval, all proposed closure schedules, as follows:

- **Lanes** - A minimum of 7 Calendar Days before a lane closures begin.

- **Roads** - A minimum of 14 Calendar Days before closure. Notify in writing all affected emergency services, school districts, and US Postal Service a minimum of 14 Calendar Days before the closure.

- **Interchange Ramps** - A minimum of 14 Calendar Days before closure or starting Work that limits access to the interchange ramp.

- **Pedestrian Facilities** - A minimum of 14 Calendar Days before closing a sidewalk, Multi-Use Path, or other pedestrian facility. After receiving written approval, provide a minimum of 10 Calendar Days' public notification before closing a pedestrian facility by placing advance notification signing according to Section 00222 or as shown.

- **Bicycle Facilities** - A minimum of 14 Calendar Days before closing a bicycle lane. After receiving written approval, provide 48 hours' public notification before closing a bicycle lane, as directed.
- **On Street Parking** - A minimum of 14 Calendar Days before closing on-street parking. After receiving written approval, provide 48 hours' public notification before limiting the on-street parking.

Construction

00220.40 General Requirements - Provide the following for Public Traffic in all construction areas:

(a) Traffic Nuisance Abatement - If loose Rock or dust exists on Roadway surfaces and Shoulders, the Engineer may direct one or more of the following:

- Use flaggers or pilot cars and flaggers.
- Apply a fine spray of water to the surface as directed.
- Sweep paved surfaces with power brooms.

(b) Detours and Stage Construction - Construct and remove, if required, detours, stage construction Roadways, Shoulders, TPARs, and temporary Bridges, including accessory features shown or ordered.

(c) Driveways - Provide reasonable access as follows:

- Replace and maintain business accesses, driveways, approaches, crossings, and intersections as directed.
- Use reasonably well-graded Aggregate material.
- Before placing the permanent Base, do one of the following:
  - Uniformly spread the temporary Aggregate material over the Subgrade.
  - Remove and place the temporary Aggregate material in the Shoulder slope area if it meets quality requirements.
  - Dispose of the temporary Aggregate material in a manner satisfactory to the Engineer.

(d) Adjacent to Excavations - Where paved Shoulders adjacent to excavations are less than 4 feet wide, protect the traffic as follows:

- At the end of each Calendar Day, backfill Pavement edge excavations to the elevation of the existing Pavement with permanent base material or with a temporary wedge of Aggregate as shown on the Standard Drawings.
- Do not excavate along both edges of the Pavement adjacent to traffic at the same time. Before excavating at the edge of the Pavement on the opposite side of the Roadway, complete the construction to existing Pavement elevation on the side that was excavated first.

- Remove the temporary wedge of Aggregate material, if used, before placing permanent base material, and place it in the Shoulder slope area or spread it uniformly over the Subgrade.

(e) Lane Restrictions:

(1) Closed Lanes - One or more Traffic Lanes may be closed when allowed, shown, or directed during the following periods of time except as indicated in 00220.40(e)(2):

- Daily, Monday through Thursday, between 9:00 a.m. and 4:00 p.m.
- Friday, between 9:00 a.m. and 3:00 p.m.
- Nightly, Sunday night through Friday morning, between 6:00 p.m. and 7:00 a.m.

(2) Opened Lanes - Keep all Traffic Lanes and pedestrian facilities open during the following periods:

a. Holidays - Between noon on the day preceding a legal holiday or holiday weekend and midnight on a legal holiday or the last day of holiday weekend, except for Thanksgiving, when no lanes may be closed between noon on Wednesday and midnight on the following Sunday.

For the purposes of this Section, legal holidays are as follows:

- New Year's Day on January 1
- Memorial Day on the last Monday in May
- Independence Day on July 4
- Labor Day on the first Monday in September
- Thanksgiving Day on the fourth Thursday in November
- Christmas Day on December 25

When a holiday falls on Sunday, the following Monday shall be recognized as a legal holiday. When a holiday falls on Saturday, the preceding Friday shall be recognized as a legal holiday.

b. Special Events - Between noon on the Day preceding and midnight on the final Day of the special event.

Remove all barricades and objects from the Roadway during the periods in which Traffic Lanes are to remain open.

Maintenance

00220.60 Surface Maintenance Responsibilities - Provide adequately maintained accommodations at all times for Public Traffic through and within the Project Site.

(a) During Construction - The responsibility for maintaining all surface during construction is as follows:

(1) Contractor Responsibility - Do the following at no additional cost to the Agency:

- Keep surfaces being used by Public Traffic free of all dirt, mud, gravel, materials, and debris.
- Repair damage to surfaces caused by the Contractor's operations.
- Maintain all detour and stage construction Surfacing as specified or directed.

Before periods of no active Work that last longer than seven consecutive Days, do the following:

- Provide temporary pedestrian surfaces meeting the requirements of the MUTCD and Section 00228.
- Provide traversable bicycle and pedestrian routes with surfaces free of dirt, mud, gravel, and debris.

Before beginning winter shutdown, do the following:

- Provide paved Traffic Lanes at least 12 feet wide, with 2-foot wide paved Shoulders for each direction of traffic.
- Do not leave abrupt edges.
- Remove or cover temporary construction signs unless otherwise directed.
- Clean, install, and reinstall all necessary pedestrian, motor vehicle, and bicycle channelization and pavement markings, unless otherwise directed.

If this winter shutdown Work is not completed and in place, the Agency may do the Work according to 00220.60(d).

(2) Agency Responsibility - The Agency will be responsible to do the following at Agency expense:

- Maintain Existing Surfacings and Shoulders that are being used by Public Traffic at the start of the Project that have not been damaged by Contractor operations.
- Maintain surfaces of detours and intermediate stage construction during the time they are being used by Public Traffic, but only if constructed according to the Plans or as directed.
- Maintain existing surfaces and Shoulders of detours located outside the Project limits during the time they are being used by Public Traffic.
- Sand icy Pavements and remove the sand residue.
- Remove snow from Traveled Ways as required to accommodate Public Traffic.

(b) During Suspensions - During suspensions of the Work, maintain Surfacings for which the Contractor is responsible under 00220.60(a)(1), and maintain work zone traffic control according to the Specifications and the following:

(1) Suspensions Due To Contractor Fault or Neglect - If the suspension is due to any cause within the control or responsibility of the Contractor, including failure to do the following:

- Perform any provisions of the Contract.
- Correct conditions unsafe for the general public, workers or Agency employees.
- Carry out orders given by the Engineer.

Then assume sole responsibility for making provisions for traffic acceptable to the Engineer, and be responsible for the costs of maintaining surfaces under traffic and work zone traffic control during the suspension.

(2) Suspensions Due To Other Causes - If the suspension is due to unforeseen circumstances, or causes not included in 00220.60(b)(1), and if the suspension occurs within the Contract Time or adjusted Contract Time:

- Place uncompleted Traveled Ways, Shoulders, driveways, approaches, sidewalks, connections, and detours necessary for traffic in a maintainable, acceptable condition.
- Be responsible for work zone traffic control.

The Agency will then assume responsibility for maintenance of the Roadway surfaces during the suspension.

(c) Resuming Contract Work after Suspension - After any suspension do not resume Work until approved.

(d) Right of Agency To Perform Work At Contractor Expense - If the Contractor fails to provide adequate accommodations for traffic and to maintain the Traveled Ways and connections as provided in the Contract, the Engineer may proceed immediately to provide adequate accommodations and maintenance. The cost of this Work will be deducted from monies due, or that become due, to the Contractor.

00220.70 Opening Sections To Traffic - When it is in the public interest, the Engineer may order any portion of the work opened to traffic. If the portion opened to traffic has been finished in an acceptable manner, it will be designated as "accepted for traffic", and the Contractor will be relieved of maintaining it for legal, Public Traffic. If the portion of the work to be opened to traffic has not been finished in an acceptable manner, it shall be maintained under traffic by the Contractor in a condition serviceable and adequate for traffic until it is finished in an acceptable manner, except as provided in 00220.60(b).

Maintain portions of the work designated "accepted for traffic" if so ordered. Maintain portions of the work opened to traffic but not "accepted for traffic" at no additional compensation, except watering ordered to protect the work or to alleviate dust will be paid for as provided in Section 00340.

The "accepted for traffic" portions of the work will:

- Be accepted only to the extent the Contractor is relieved of maintaining these portions for legal, Public Traffic after acceptance.
- Not entitle the Contractor to reduction of retainage.
- Not relieve the Contractor's responsibility for defective materials or work.
- Not relieve the Contractor's responsibility for damages to the work from causes other than legal, Public Traffic except as provided in 00170.80.
- Not constitute a waiver of any provision of the Contract.

If the Contractor delays the completion of Shoulders, sidewalks, curb ramps, drainage Structures, or other feature of the work, the Engineer may order all or any portion of the work to be opened to traffic. In this case, the Contractor shall be responsible for maintenance as described in 00220.60(a)(1), during the period the work is opened to traffic, until Final Acceptance. Conduct the remaining operations to cause the least obstruction to traffic, and pay all additional costs caused by the presence of traffic.

Measurement

00220.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00220.90 Payment - No separate or additional payment will be made for Work performed under this Section, unless otherwise provided or Pay Items are provided under other Sections.

In addition, no payment will be made for costs incurred by the Contractor because of:

- Inconvenience, additional length of travel to conform to established traffic patterns and planned access features.
- Compliance with laws governing traffic regulations, the ADA, and load limitations.

Costs anticipated because traffic will be using portions of the work will be included in the Contract prices for the various items of Work involved.

Section 00221 - Common Provisions for Work Zone Traffic Control

Description

00221.00 Scope - In addition to the requirements of Section 00220, this Work consists of providing temporary traffic control measures and furnishing, installing, moving, operating, maintaining, inspecting, and removing traffic control devices throughout the Project area according to the Standard Drawings, the traffic control plan for the Project, the Specifications, and as directed.

00221.01 Abbreviations, Definitions, and Standards:

(a) Abbreviations:

ADT - Average Daily Traffic
PCD - Pedestrian Channelizing Devices
PCMS- Portable Changeable Message Sign
TCD - Traffic Control Devices
TCM - Traffic Control Measures
TCP - Traffic Control Plan
TCS - Traffic Control Supervisor
TPAR - Temporary Pedestrian Accessible Route
TSS - Temporary Sign Support

(b) Definitions:

Protection Vehicle - A vehicle placed in advance of short duration or mobile Work activities for the protection of workers and Equipment in the activity area. A protection vehicle is equipped with flashing warning lights, and vehicle-mounted warning signs or a changeable message sign. A protection vehicle may be fitted with a truck mounted impact attenuator.

Temporary Pedestrian Accessible Route - An area within a work zone, marked by signing, delineation and TCD, for the use of pedestrians to navigate through or around the work area. The TPAR is included as part of the traffic control plan.

Temporary Pedestrian Accessible Route Plan - A written and drawn plan within the TCP that identifies requirements for providing safe, effective and accessible routes for pedestrians through or around the work zone including TPAR details, advance public notification; and, construction and maintenance responsibilities.

Traffic Control Devices - Signs, signals, markings, and other devices placed on, over, or adjacent to a Roadway used to regulate, warn, or guide Public Traffic by authority of a public body or official having jurisdiction.

Traffic Control Measures - Elements of the TCP including, but not limited to, TCD, personnel, materials and Equipment used to control Public Traffic through a work zone.

Traffic Control Plan - A written and drawn plan for providing the safe and efficient movement of Public Traffic through or around a work zone, while providing protection for workers, incident responders, and Equipment.

Work Area - The portion of the Highway closed to Public Traffic and set aside for workers, construction Equipment, and construction Materials. The work area is typically delineated by channelizing devices or separated from traffic using temporary barriers.

Work Zone - An area within Highway construction, maintenance, or Utility Work activities which extends from the first road Work, Bridge Work, or Utility Work warning sign to the last sign or the last TCD.

(c) Standards - When designing, applying, installing, maintaining, inspecting, and removing traffic control devices, use and follow the most current versions in effect of the following:

- Oregon Department of Transportation's *Sign Policy and Guidelines for the State Highway System*
- The *Manual on Uniform Traffic Control Devices* (MUTCD)
- FHWA *Standard Highway Signs manual*
- ODOT *Oregon Temporary Traffic Control Handbook for Operations of 3 Days or Less* when directed by the Engineer only for mobile Pavement marking operations or surveying Work, available on the ODOT Traffic Control Plans Unit website (see 00110.05(e))
- ODOT *Oregon Portable Changeable Message Sign Handbook*, available on the ODOT Traffic Control Plans Unit website
- ODOT *Traffic Control Plans Design Manual*, available on the ODOT Traffic Control Plans Unit website

00221.02 General Requirements - Provide and maintain all TCM. The Engineer may verbally or in writing require immediate changes to the TCM being used on the Project. Immediately make these changes, as directed. Submit all proposed TCM revisions to the Engineer for approval.

Do not start Work on any stage of construction until the TCP has been reviewed and accepted and all TCM are in place and the TCP is operating satisfactorily. During construction, determine if TCM, in addition to those in place, are required and immediately notify the Engineer. Immediately make changes as approved or directed, but do not place or remove devices without prior approval.

Work may be suspended as specified in 00180.70 or the TCM may be performed by the Agency if the Contractor fails to correct an unsafe condition. Costs for Work performed by the Agency may be deducted from monies due the Contractor.

00221.03 Traffic Safety and Operations - Comply with the following:

- Do not use an open Traffic Lane on a freeway or multi-lane facility as an acceleration or deceleration lane for construction vehicles. Provide additional Surfacing or width within the work area or, if allowed, extend the length of a closed Traffic Lane for construction vehicle acceleration or deceleration. Do not use a flagger to allow construction vehicles to access an open Traffic Lane on a freeway or a multi-lane facility.
- When paving operations create an abrupt edge, protect traffic by installing signing according to the "2 Lane, 2 Way Roadway Overlay Area" detail shown on the Standard Drawings. Protect longitudinal and transverse Pavement joints by placing and maintaining an asphalt concrete wedge according to 00221.07(c)(1).
- During flagging operations, monitor the length of traffic queues and when extended traffic queues develop, protect traffic by providing advance flaggers and additional signing according to the "Extended Traffic Queues for Advance Flagging" detail shown on the Standard Drawings.

00221.04 Traffic Control Outside Project Site - Provide TCM outside the Project Site when required.

00221.05 Regulations and Codes - All electrical Equipment, Materials, and Work shall conform to NEC requirements and all other laws that apply.

00221.06 Traffic Control Plan - The Contractor will be allowed to use the Agency's TCP, modify the Agency's TCP, or use a different TCP. Submit the following for approval 5 Calendar Days before the preconstruction conference:

(a) Agency Traffic Control Plan - If the Agency's TCP is used without modification, a written notification indicating that the Agency's TCP will be used without modification.

(b) Contractor Modified Traffic Control Plan - If the Contractor requests to use a modified Agency TCP, or a TCP developed by the Contractor, provide stamped Working Drawings according to 00150.35 that include the proposed TCP showing all TCM and quantities of TCD, and the following:

- A TPAR plan that includes:
  - Details and features used to provide pedestrian accessibility.
  - Pedestrian staging Plans at a scale no smaller than 1 inch = 50 feet.
  - Temporary alternate facilities or detour routes for pedestrian traffic.
- Staging sequences and details for Work affecting vehicular, pedestrian, and bicycle traffic.
- Proposed order and duration of the TCM.
- A detailed temporary striping plan.

If additional modifications are made to the Contractor modified Agency TCP or the Contractor's TCP, submit stamped Working Drawings, according to 00221.06(b), at least 14 Calendar Days before beginning the construction activities that require the TCP changes.

(c) Tourist-Oriented Directional and Business Logo Signs - One copy of a sketch map of the Project showing all existing tourist-oriented directional (TOD) and business logo signs and a written narrative describing how these signs will be kept in service and protected throughout all the construction stages.

If there are no TOD or business logo signs on the Project, a written notification that no TOD or business logo signs exist within the Project limits.

00221.07 Routing Traffic Over Surfacings - Control traffic being routed over surfaces as follows:

(a) Aggregates - When directed, control traffic over Aggregate with flaggers or flaggers and pilot cars.

(b) Asphalt Treated Permeable Base - When directed, control traffic over asphalt treated permeable Base (ATPB) with flaggers or flaggers and pilot cars.

(c) Asphalt Concrete - Control traffic over asphalt concrete as follows:

(1) Paving - When the longitudinal joint is greater than 1 inch in height, install additional TCD according to 00221.03. Complete the placing of ACP and construction of paving joints according to 00744.44, 00744.45, 00745.47, and 00745.48, as applicable.

(2) Cold Plane Pavement Removal - Complete the Pavement removal according to 00620.40. When the area cannot be paved back during the same shift and the depth of Pavement removal is greater than 1 inch, install additional TCD according to 00221.03.

(d) Emulsified Asphalt Chip Seals - Control traffic over Emulsified Asphalt chip seals with flaggers and pilot cars, unless otherwise directed, until the entire surface has been swept or bladed after the Aggregate was placed as tabulated below:

ADT	Minimum Pilot Cars
Over 1500	2
1500 and Less	1

(e) Sand Seals - Control traffic with flaggers and pilot cars during application of asphalt and until it is covered with Aggregate, unless otherwise directed.

Materials

00221.10 General - Evaluate the condition of TCD using the criteria shown in the most current version in effect of the American Traffic Safety Services Association (ATSSA) publication titled *Quality Guidelines for Temporary Traffic Control Devices and Features*, available from the ATSSA website (see 00110.05(e)). Use new TCD or TCD meeting the "Acceptable" quality category of the ATSSA publication for all installations unless otherwise specified. Provide test results, quality compliance certificates, Equipment lists, and drawings when specified. Acceptance will be by the QPL, test results, quality compliance certificates, Equipment lists, drawings, and testing as necessary to assure compliance with the Specifications. After TCD have been installed and accepted on the Project, inspect and maintain the condition of the devices.

All work zone TCD shall comply with the crashworthiness requirements of the *National Cooperative Highway Research Program* (NCHRP) *Report 350* or with the AASHTO *Manual for Assessing Safety Hardware* (MASH).

00221.13 Work Zone Fencing - Use work zone fencing from the QPL.

Equipment

00221.20 Safety Apparel - Workers, except flaggers, working within Highway Right of Way and exposed to traffic or construction Equipment shall wear high visibility safety apparel that meets the Performance Class requirements of the most current version of ANSI/ISEA 107, *American National Standard for High Visibility Safety Apparel and Headwear Devices*. Wear safety apparel that at least meets the following minimum requirements:

- Daytime – Class 2 upper body garment.
- Nighttime - One of the following:
  - Class 3 upper body garment.
  - Class 2 upper body garment and Class E trousers or gaiters.
- ANSI Class 2 or Class 3 fluorescent orange red, fluorescent yellow green or a combination of the two of these colors for the apparel background material color.
- Fluorescent yellow-green, orange, yellow, or bright white hardhat or baseball-style cap. Wear hardhats when there is danger of falling or flying objects or electrical shock or burns.

Wearing high visibility safety apparel that exceeds the minimum class requirements is allowed.

Labor

00221.30 General - Observe all laws concerning safety, health, and sanitation standards according to 00170.60.

Construction

00221.40 General - Install, inspect, move, operate, maintain, and remove temporary TCD according to the Plans, Specifications, and the following:

- Install, maintain, and move all TCD by working with the direction of traffic.
- Provide additional TCM, according to 00221.02, when necessary or directed.
- Turn, cover, or remove the existing TCD as directed when they are not necessary or conflict with temporary devices. Remove and obliterate, without damaging the wearing surface, all evidence of all temporary TCD when the Contract is completed.
- Remove TCD in a sequence reverse to installation.

Temporary TCD remain the property of the Contractor.

Existing TCD shall remain in operation throughout the Contract or until replaced by new, permanent TCD as appropriate.

00221.44 Work Zone Fencing - Install work zone fencing as shown or as directed.

Maintenance

00221.60 Temporary Traffic Control Devices - Evaluate the condition of TCD and maintain them using the criteria shown in the most current version of the ATSSA publication titled *Quality Guidelines for Temporary Traffic Control Devices and Features*. Except for electrical devices, replace all TCD that, according to the ATSSA publication, are in “Marginal” or “Unacceptable” condition with equal devices that are in new or “Acceptable” condition, within a time period agreed upon by the Engineer.

Electrical devices that are in “Marginal” or “Unacceptable” condition may be repaired instead of being replaced, as long as the repairs are satisfactorily completed within a time period agreed upon by the Engineer.

TCD delivered to the Project Site found to be in “Marginal” or “Unacceptable” condition, shall be repaired or replaced at no additional cost to the Agency except as in 00221.90(b). TCD damaged by Public Traffic shall be replaced at the Contract unit price for the device.

Evaluate, maintain, repair or replace TCD, and perform other duties including the following:

- Keep TCD in proper position, clean, and legible at all times.
- Keep lights, reflectors, and flashers clean, visible, and operable during both daylight and darkness.
- Trim or remove vegetative growth or other materials so TCD can be seen by Public Traffic.
- Verify, by inspection, the effectiveness of the installations at frequent intervals, both in daylight and darkness, at actual travel speeds.
- Repair, replace, or restore damaged or destroyed TCD to maintain continuity and effectiveness.
- Maintain temporary TCD during suspensions of Work the same as if Work were in progress.

00221.61 Existing Signs and Other Existing Traffic Control Devices - Maintain existing guide signs, warning signs, regulatory signs, specific service signs (business logos), tourist-oriented directional signs (TODS), and other existing TCD, in the same manner as temporary signs and devices associated with the Project.

Measurement

00221.80 Measurement, Method "A" - Under this method, Work covered under this Section will be measured as follows:

(a) Separate Items - The quantities for work zone TCM and TCD will be measured according to 00222.80, 00223.80, 00224.80, 00225.80, 00226.80, 00227.80, and 00228.80.

(b) Temporary Protection and Direction of Traffic - No measurement of quantities will be made for this Work.

00221.88 Measurement, Method "B" - Under this method, no measurement of quantities will be made.

00221.89 Measurement, Method "C" - Under this method, no measurement of quantities will be made.

Payment

00221.90 Payment, Method "A" - Under this method, Work will be paid as follows:

(a) Pay Quantities - The accepted quantities of work zone TCM and TCD will be paid for according to 00222.90, 00223.90, 00224.90, 00225.90, 00226.90, 00227.90, and 00228.90.

(b) Temporary Protection and Direction of Traffic - Temporary protection and direction of traffic will be paid for at the Contract lump sum amount for the item "Temporary Protection and Direction of Traffic" and will be for:

- Positioning all TCD in proper locations at all times.
- Providing and furnishing electrical power.
- Cleaning up and removing devices destroyed or damaged by Public Traffic.
- Moving temporary barrier to and from Contractor's stockpile areas.
- Moving temporary impact attenuators of any type to and from Contractor's stockpile areas.
- Furnishing, placing, replacing, maintaining, moving and removing tubular and conical markers.
- Removing existing raised and recessed pavement markers.
- Furnishing, placing, replacing, maintaining, moving and removing tubular and conical markers used to delineate the Pavement edge because of edge line obliteration.
- Furnishing, installing, maintaining, moving, and removing work zone fencing.
- Moving and removing existing permanent post mounted signs and reinstalling existing permanent post mounted signs on any type of support at new locations when required by stage construction, as shown or directed.
- Providing, Surfacing, maintaining, removing, and restoring the TPAR.
- Performing routine inspections of the TCD.
- When the Schedule of Items does not include an item for a TCS, preparing and signing the daily "Traffic Control Inspection Report".

00221.98 Payment, Method "B" - Lump Sum Basis - Work zone traffic control will be paid for at the Contract lump sum amount for the item "Temporary Work Zone Traffic Control, Complete".

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing Materials and TCD, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

00221.99 Payment, Method "C" - Incidental Basis - When the Contract Schedule of Items does not indicate payment for work zone traffic control, all work zone traffic control will be considered Incidental and no separate payment will be made.

Section 00222 - Temporary Traffic Control Signs

Description

00222.00 Scope - In addition to the requirements of Section 00221, this Work consists of furnishing, installing, moving, operating, maintaining, inspecting, and removing temporary signs.

Materials

00222.10 Temporary Signs - Furnish temporary signs meeting the requirements of the "Acceptable" category shown in the ATSSA *Quality Guidelines for Temporary Traffic Control Devices and Features* handbook, available from the ATSSA website. Use materials and fabricate signs conforming to Section 00940, Section 02910 and the following:

(a) Size and Shape - Use standard size and shape signs meeting the requirements of 00221.01(c) unless otherwise specified or ordered. Double-face signs will not be allowed except for the flagger "STOP/SLOW" paddle. For diamond shaped warning signs, use 48 by 48 inch signs unless otherwise shown or specified.

(b) Type - Use ASTM Type VIII or IX sheeting from the QPL for fluorescent orange retroreflective sheeting on temporary warning signs and ASTM Type III or IV sheeting from the QPL for all other fluorescent colored retroreflective sheeting on temporary signs, unless otherwise indicated in this Section or in the TCP. Fabricate these signs on one of the following materials:

- New sheet aluminum sign blanks.
- New extruded aluminum panels.
- Used sheet aluminum sign blanks that are without bends, tears, holes, or dents and that have been cleaned to bare metal.
- 3/4 inch high-density overlay plywood.
- 3/4 inch medium-density overlay plywood.

(c) Folding or Turning Signs - Temporary signs on posts may be the folding or turning type as long as they can be locked when not in use so the sign message is not visible to any traffic.

(d) Roll-up Signs - Use roll-up signs with retroreflective roll-up sign sheeting from the QPL.

00222.11 Sign Supports:

(a) Wood Sign Posts - Use wood sign posts in the sizes and quantities as shown on the Standard Drawings and according to 02110.40, except posts may be untreated.

(b) Portable Sign Supports - Use portable sign supports from the QPL and conforming to the following:

- Free standing.
- Capable of supporting signs in vehicle-caused turbulence and in winds common to the area where they are used. If additional ballast is required to maintain the signs in an upright position, use sandbags to anchor the sign support legs. Place a sandbag filled with loose sand (approximately 25 pounds) across the bottom of each leg as needed.

(c) Temporary Barrier Sign Supports - Use concrete barrier sign supports that meet the following:

- Conform to the Standard Drawings.
- Attach securely to the top of the concrete barrier.
- Support a maximum 12 square feet of total sign area.

(d) Temporary Sign Supports - Fabricate and use TSS as shown on the Standard Drawings and according to 02110.40, except posts may be untreated.

(e) Perforated Steel Square Tube Sign Supports - Use perforated steel square tube (PSST) sign supports from the QPL and as shown on the Standard Drawings. For PSST sign supports mounted on portland cement concrete surfaces, use surface mounted post anchors according to the manufacturer's recommendations.

00222.12 Sign Covers:

(a) Temporary Signs - Use sign covers for temporary signs that meet the following requirements:

- From the QPL or made from one of the following materials:
- One-piece plywood.
- Geotextile fabric.
- Large enough to completely cover the sign and attached rider signs.
- Easy to attach to and remove from the sign without damaging the sign face.
- Black and non-reflective.
- Opaque to prevent message visibility under day and nighttime conditions.

(b) Permanent Signs - Sign covers for permanent signs shall conform to Section 00941.

00222.13 Sign Flags - Sign flags shall be:

- Fluorescent red-orange.
- Square 16 by 16 inches or larger.
- Made from an acceptable tightly woven fabric or plastic sheeting.

00222.14 Sign Flag Boards - Use sign flag boards as shown on the Standard Drawings.

00222.15 Temporary Electrical Signs - Furnish electrical signs meeting the following requirements:

(a) Sequential Arrow Signs - Use Type "C" sequential arrow signs from the QPL.

(b) Portable Changeable Message Signs - Use PCMS from the QPL.

(c) Radar Speed Trailers - Use radar speed trailers with a Type 2 panel from the QPL, Conditional List, or as approved.

Construction

00222.40 Temporary Signs - Once temporary signs have been accepted and paid for on the Project, do not remove them from the Project, until directed by the Engineer.

For all temporary warning signs use fluorescent orange retroreflective sheeting background.

Install all temporary signing according to the Plans, Section 00940, the MUTCD, the *Sign Policy and Guidelines for the State Highway System*, FHWA *Standard Highway Sign* manual and the following:

(a) Speed Signs - Use speed signs as follows:

(1) Advisory Speed Signs - Install advisory speed warning signs or riders as shown or directed.

(2) Regulatory Speed Zone Signs - Install and maintain regulatory speed zone signs as directed and according to the "Temporary Speed Zone Order" signed by the State Traffic Engineer.

When regulatory speed zone signs are used, cover conflicting existing regulatory speed zone signs with sign covers according to Section 00941. Cover or remove temporary regulatory speed zone signs and restore the original speed zone signs according to the "Temporary Speed Zone Order" and when directed.

If an existing regulatory speed zone sign displaying the original speed is 1,000 feet or less beyond the limits of the temporary speed zone, additional temporary regulatory speed zone signs displaying the original speed are not required.

(b) Roll-up Signs - Roll-up signs may be used at a single location for no more than 48 consecutive hours. Place roll-up signs within the active Work Area on portable roll-up sign supports. Remove all inappropriate roll-up signs at the end of each shift.

(c) Inconsistent Temporary Signs - Ensure that all temporary signs are properly used and consistent with the work zone. Cover all inconsistent temporary signing until the sign messages are applicable to the Work that is beginning. When signage is no longer required for staging or shift Work, remove all temporary signs, sign flag boards, supports, sign covers, and ballast associated with the staging or shift Work.

When temporary sign messages conflict with work zone conditions, traffic patterns, or other staging configurations, but signs are needed later in Project, do the following:

- Turn or cover the signs so the message is not visible to any traffic.
- Remove or cover sign flag boards.
- When covering signs and sign flag boards, use covers meeting the requirements of 00222.12.

When it is determined that only minor Work remains on the Project and the work area does not encroach on Traffic Lanes or Shoulders, do the following:

- Remove all temporary signs, including the advance construction and Project identification signs.
- Remove all sign flag boards and ballasts.
- Use roll up signs on portable sign supports for minor or short duration Work.

(d) Permanent Signing - When permanent sign messages conflict with adjacent temporary signing, work zone conditions, traffic patterns or other staging configurations, do the following:

- Turn or cover the signs so the message is not visible to any traffic.
- When covering signs, use sign covers meeting the requirements of 00222.12(b).

When work zone conditions change and permanent sign messages no longer conflict with temporary signing, uncover permanent signs. Install or uncover appropriate permanent signing as required, before changing traffic control staging.

(e) Temporary Sign Placement - Place temporary signs as shown, specified, and directed:

- Install a "TRUCKS" (W11-10) sign with an 18 inch "500 FEET" (W16-4P) plaque, approximately 500 feet before each point of access of all noncommercial stockpile sites, work zone staging area, material sources, waste areas, and plant set-up areas to a public Roadway.
- When a through road intersects the work zone, place a "ROAD WORK AHEAD" (W20-1) sign in advance of the intersection at sign spacing "A" from the "TCD Spacing Table" shown on the Standard Drawings, or as shown in the TCP. These signs do not require sign flag boards, unless otherwise directed.
- When a cold planed Pavement surface is used by traffic, install the following temporary signs:
  - "BUMP" (W8-1) sign approximately 100 feet in advance of the transverse paving edge.
  - "GROOVED PAVEMENT" (W8-15) sign with a 24 inch "Motorcycle" (W8-15P) rider in advance of the “BUMP” sign at sign spacing "A" from the "TCD Spacing Table" shown on the Standard Drawings, or as shown in the TCP.

  Face signs toward incoming traffic and install them before opening the cold planed surface area to Public Traffic. Protect exposed transverse and longitudinal cold planed Pavement edges according to 00221.07(c).

00222.41 Sign Supports:

(a) Wood Sign Posts - Except as provided in the following (b) through (f), mount all temporary signs on wood sign posts as shown.

When sign posts are installed in Rock, a shorter post may be used if the post is installed in a buried concrete footing at least 12 inches in diameter and 2 feet deep.

(b) Portable Sign Supports - Use portable sign supports as follows:

- When signs are needed at a single location for no more than 48 consecutive hours.
- Positioned so the lowest point of the sign is at least 1 foot above the Roadway surface.
- With roll-up signs.
- With ballast to prevent tipping of the signs in high wind.

Turn, cover, or remove signs at the end of each work shift when the condition is no longer in effect.

(c) Temporary Barrier Sign Supports - Mount signs on temporary barrier so the:

- Lowest point of the sign is at least 7 feet above the Roadway surface.
- Temporary sign and post are held securely to temporary barrier by an approved device.
- Sign can be turned and locked in a position parallel to the flow of traffic when not in use.

(d) Temporary Sign Supports - Use TSS as follows:

- When signs are needed at a single location for more than 48 consecutive hours.
- When not practicable to post mount due to location or when Utility conflicts exist.

- Provide reflective sheeting on TSS posts as shown in the Standard Drawings.
- Do not tip over any TSS that is exposed to traffic, unless approved by the Engineer or the TSS is protected from traffic by a barrier system.
- Position TSS as shown on the Standard Drawings or in the TCP.
- When not in use, locate TSS as far from Public Traffic as practicable and turn away from traffic, or cover the sign. Do not cover reflective sheeting on the TSS posts.

(e) Perforated Steel Square Tube Sign Supports - Perforated steel square tube sign supports may be used as a substitute for wood sign posts. Install perforated steel square tube sign supports as shown on the Standard Drawings. For PSST sign supports mounted on portland cement concrete surfaces, use surface mounted post anchors according to the manufacturer's recommendations.

(f) Existing Facility Sign Supports - When mounting temporary signs on existing facilities, install signs as shown on the Standard Drawings or other mounting methods approved by the Engineer.

00222.44 Sign Flag Boards - Install two sign flag boards, as shown or specified.

00222.45 Temporary Electrical Signs - Provide and install temporary electrical signs as follows:

(a) Sequential Arrow Signs - Use the sequential arrow signs as follows:

- To indicate a lane closure only. Use one sequential arrow sign for each lane being closed.
- Install where the sign is visible from 1/2 mile minimum.
- Mount at a height of 7 feet from bottom of sign to ground.
- Do not use on 2-Lane, 2-Way Roadway.
- For Shoulder Work use caution mode only.
- Provide a solar/battery power source.

(b) Portable Changeable Message Signs - Use PCMS according to the *Oregon Portable Changeable Message Sign Handbook* and as follows:

- Program concise accurate messages according to the *Oregon Portable Changeable Message Sign Handbook*.
- Install beyond the outside Shoulder, behind existing barrier or guardrail, as shown in the TCP, or as directed when conditions do not allow the PCMS to be located beyond the Traffic Lane.
- Install the PCMS device where it can be seen from 1/2 mile minimum. The PCMS message should be legible from 800 feet in the daytime and 600 feet at night.
- Mount so that the bottom of the sign is 7 feet above the ground.
- Program so that the entire message is displayed within 8 seconds.
- Use a maximum of two panels to display an entire message.
- Separate two PCMS used in sequence by 1,000 feet minimum.
- Messages shall not scroll horizontally or vertically across the face of the sign.
- When the PCMS is not being used to display any messages for more than 5 consecutive Calendar Days, remove the PCMS from the Roadway and locate the device at least 30 feet from the edge of the nearest Traffic Lane, place behind a barrier system, or as directed.
- Provide a solar/battery power source.
- Obtain approval from the Engineer before displaying or altering messages.

- Type B, Mini PCMS use is limited to locations where the preconstruction posted speed is 40 mph or less.

(c) Radar Speed Trailers - Use radar speed trailers according to the Plans and the following:

- Place and delineate according to the Flagger Station Lighting Delineation detail as shown on the Standard Drawings, or as directed.
- Operate radar speed modes and set speed thresholds as directed and as follows:
  - Use an over speed threshold equal to the posted speed on the radar speed trailer.
  - Use a blackout speed threshold of 85 mph, which does not allow the radar speed trailer to display a speed or message when the measured speed exceeds 85 mph.
- Program to display the over speed message as follows, or as approved by the Engineer:

  SLOW

  DOWN
- Ensure that the over speed message is displayed when the measured vehicle speeds exceed the posted speed mounted on the radar speed trailer but do not exceed the blackout speed threshold.
- Provide speed and event logging data to the Engineer at the completion of the Project, in a format compatible with Microsoft Excel.
- When not actively displaying speeds, remove from the Roadway and locate the radar speed trailer at least 30 feet from the nearest open Traffic Lane, behind a barrier system, or as directed.

(d) Temporary Power Source - Arrange for, provide, and pay for all electrical power.

Maintenance

00222.65 Portable Electrical Signs - Maintain and use the required PCMS, radar speed trailers, and sequential arrow signs according to the manufacturer's recommendations, TCP, and as required. Do not display or alter any sign message before it is approved.

While PCMS, radar speed trailers, and sequential arrow signs are in use, have repair Equipment and parts on the Project Site, as recommended by the manufacturer.

When directed, repair or replace sequential arrow signs, radar speed signs, and PCMS that are damaged or destroyed before continuing Work that requires use of the signs.

Measurement

00222.80 Measurement - The quantities of temporary signs will be measured according to the following:

(a) Area Basis - Temporary signs will be measured on the area basis, upon delivery to the Project. The quantities will be limited to those in the approved TCP including speed zone signage. The sign area will be the nominal area determined by multiplying the width times the length. No deductions will be made for corners or irregular shapes. Route markers on separate substrate riders and other signs fastened to the face of larger signs will be measured as separate signs.

Sign covers, sign flags, sign flag boards, posts and other supports will not be measured.

(b) Unit Basis - Temporary electrical signs will be measured on the unit basis, where the devices are initially installed on the Project.

The quantities for work zone traffic control measures will be limited to the following, unless otherwise specified:

- The initial installation of quantities necessary to complete the Project based on the Contract Schedule of Items.
- The initial installation of additional TCD and TCM that the Engineer and Contractor agree are necessary to ensure a safe work zone.
- Temporary signing and temporary electrical signs damaged by Public Traffic and replaced or repaired by the Contractor will not be measured.

Payment

00222.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Temporary Signs	Square Foot
(b)	Sequential Arrow Signs	Each
(c)	Portable Changeable Message Signs	Each
(d)	Radar Speed Trailer	Each

Items (b) and (c) include furnishing, mounting, operating, moving, and removing signs and supports, regardless of whether the signs are mounted on supports, trailers, vehicles, or Equipment.

Item (d) includes furnishing, operating, moving, maintaining, and removing the radar speed trailer.

No separate or additional payment will be made for sign flags, sign flag boards, posts and other supports, sign covers, or removing and replacing damaged signs.

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing the Materials and TCD, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified, except as covered in 00221.90(b).

00222.91 Payment, Lump Sum or Incidental Basis - When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment according to 00221.98 or 00221.99.

Section 00223 - Work Zone Traffic Control Labor and Vehicles

Description

00223.00 Scope - In addition to the requirements of Section 00221, this Work consists of providing flaggers, traffic control supervisors, and furnishing, operating, and maintaining associated work zone traffic control vehicles.

Equipment

00223.21 Flagger Equipment - Equip flaggers as follows:

- For daytime and nighttime flagging operations, wear high-visibility safety apparel that meets the Performance Class requirements of the most current version of ANSI/ISEA 107, *American National Standard for High Visibility Safety Apparel and Headwear Devices*. Wear safety apparel that at least meets one of the following minimum requirements:
  - Class 3 upper body garment.
  - Class 2 upper body garment and Class E trouser or gaiters.
- Safety apparel with background material colors according to 00221.20.
- A hardhat or baseball-style cap according to 00221.20.
- A minimum 18 by 18 inch "STOP/SLOW" paddle made of rigid substrate and fabricated using type ASTM Type IX or XI / ASTM Type VIII or IX sheeting, or a flagger STOP/SLOW paddle from the QPL. A 24 by 24 inch STOP/SLOW paddle is recommended for higher speed situations or where more visibility is desired.
- Portable, self-contained two-way radio and repeaters, as required, with a range suitable for communications throughout each work zone, unless otherwise directed.

00223.22 Flagger Station Lighting - Use flagger station lighting from the QPL and conforming to the following:

- Illuminates the flagger so that the flagger is visible, and is discernable as a flagger, from a distance of 1,000 feet.
- Illuminates the flagger from above at a height of 18 feet ± 3 feet.
- The light is shielded from approaching traffic.
- In addition to the products listed on the QPL, tripod mounted or cart mounted flagger station lights that were purchased on or before January 1, 2014 and that were on the QPL before January 1, 2014 may also be used. Provide proof of the original purchase date to the Engineer.

00223.23 Automated Flagger Assistance Device - Furnish an automated flagger assistance device (AFAD) from the QPL. Submit the following information for approval for the use of an AFAD to the Engineer, according to 00150.37, a minimum of 21 Calendar Days in advance of using an AFAD. The Engineer will respond within 14 Calendar Days after receipt of the submittal.

- Manufacturer's specifications and operation instructions for the AFAD.
- Dates, times, locations and durations of operation.

00223.24 Traffic Control Supervisor Equipment - Equip each TCS as follows:

- Safety apparel according to 00221.20.
- Portable, self-contained two-way radio with a range suitable for the Project Site, when necessary.

- Cellular telephone active at all times.
- A vehicle that is equipped with a roof or post mounted rotating amber light or strobe light that is visible for 360 degrees.

00223.25 Pilot Cars - Provide pilot cars with the following features:

- No smaller than a compact pickup truck.
- Four wheels.
- A "PILOT CAR FOLLOW ME" (G20-4-18) sign mounted in a conspicuous location on the rear of the vehicle.
- A roof or post mounted rotating amber light or strobe light that is visible for 360 degrees.
- A two-way radio with a range suitable for each work zone, unless otherwise directed.

00223.26 Pedestrian Transport Vehicle - Provide a pedestrian transport vehicle (PTV) with the following features:

- 26,000 lbs GVW or less
- A roof or post-mounted rotating amber light or strobe light that is visible for 360 degrees. Light must be visible and functioning at all times while operating within the Project limits.
- A two-way radio with a range suitable for each Work Zone, unless otherwise directed.
- A “CONSTRUCTION VEHICLE DO NOT FOLLOW” (CW23-14) sign mounted in a conspicuous location on the rear of the vehicle.
- A powered lift or other mechanism to safely load and unload an ADA passenger in a wheel chair, powered chair or other device.
- Accommodation for at least two ADA passengers and a maximum of 10 able-bodied pedestrians.

Labor

00223.30 Qualifications - Use flaggers, TCS, and pilot car operators that meet the following requirements:

- Have a valid driver’s license.
- Are at least 18 years old.
- Have the mental and physical ability to provide timely, clear, and positive guidance to the traveling public.
- Have a sense of responsibility for public and work crew safety.
- Have a professional appearance.
- Have a courteous but firm manner.
- Have completed an approved work zone traffic control flagging course within the past 3 years and have in their possession a current, official state Flagger Certification card from Oregon, Washington, Idaho, or Montana.

00223.31 Traffic Supervision:

(a) Traffic Control Supervisor - When the Schedule of Items includes an item for a TCS, provide a TCS who meets the requirements of 00223.30. Do not designate the Project superintendent as the TCS. The TCS shall possess a current ODOT "Oregon Certified Traffic Control Supervisor" card. A TCS with a current card from another state's transportation department, or from the American Traffic Safety Services Association, may obtain an Oregon Certified TCS card upon successful completion of ODOT's Recertification Class.

Before beginning Work on the Project, the TCS shall:

- File with the Engineer and local police, their name and a telephone number at which the TCS can be contacted at all times.
- Have the documents listed in 00221.01(c) and applicable standards and specifications available at all times.

The duties of the TCS include the following:

- Monitor work zone traffic control measures, operations, activities, and conditions, including lane closures, lane or traffic shifts, detours, flagging operations, rolling slowdowns, and temporary traffic signal Work.
- Review all applicable requirements of the Contract to ensure the convenience, safety and orderly movement of motor vehicle, bicycle, and pedestrian traffic.
- Attend meetings specifically scheduled to discuss the TCP and TCM.
- Discuss proposed TCM and coordinate implementation of the TCP with the Contractor and the Engineer.
- Make revisions to the TCP according to the following:
  - Make temporary revisions to the TCP in the event of an emergency and immediately follow-up with and report any changes to the Engineer.
  - Notify the Engineer before making any revisions to the TCP and indicate why revisions are necessary.
  - The TCS may make minor revisions to the TCP to accommodate site conditions if the original intent of the TCP is maintained and revisions have been approved by the Engineer.
  - If the Contractor requests to use a modified Agency TCP or a TCP developed by the Contractor, the TCS shall ensure stamped Working Drawings showing the revisions are submitted according to 00221.06 and 00150.35.
- Coordinate the implementation and operation of all TCM, including those of Subcontractors, Suppliers, and any adjacent construction or maintenance operation.
- Provide oversight in maintaining all TCM on the Project Site.
- Designate an area for pedestrians to wait for, load and unload the transport vehicle.
- Coordinate the Project's activities (such as ramp, road, or lane closures) with appropriate police, fire control agencies, city or county agencies, medical emergency responders, school districts, Postmaster, and public transit agencies.
- At least once per TCS construction work shift, conduct a TCD inspection according to the following:
  - Inspect following initial placement or installation of TCD.
  - Inspect devices in place for proper location, installation, operation, quality, cleanliness, and effectiveness on Public Traffic.
  - Inspect TCD effectiveness in daylight and at night.

- Inspect post-mounted signs.
- Inspect temporary illumination and flagger station lighting at night, when in place.
- Conduct additional TCD inspections for extended periods, as requested by the Engineer.
- Prepare and sign a "Traffic Control Inspection Report" form (Form No. 734-2474). Submit the report to the Engineer no later than the end of the next TCS construction work shift.

The TCS shall not act as a flagger or pilot car operator, except in the event of an emergency. The TCS may relieve the flagger or pilot car operator for a period of less than 15 minutes, not to exceed 1 hour per construction work shift.

Make arrangements so that the TCS will be available every Day, on call at all times, and available upon the Engineer's request at other than normal working hours.

The TCS shall report to the Project Site within 1 hour after being notified in the event of a Work Zone incident during non-work periods. The TCS shall have appropriate personnel, Equipment, and material available at all times to expeditiously correct any deficiency in the TCM for the Project.

Notify the Engineer of an alternate TCS who can assume the duties of the assigned TCS in the event of that person's inability to fulfill the duties of the position. The alternate TCS shall be adequately trained and certified according to 00223.30 and 00223.31. Notify the Engineer at least 12 hours before designating the TCS for the following 12 hour period. Make succeeding notifications within 24 hours every time a subsequent TCS is appointed to the Project.

(b) Traffic Control Inspection Without TCS - When the Schedule of Items does not include an item for a TCS, designate a trained person who shall be on the Project Site during working hours and on call at all other times, and who:

- Meets the requirements of 00223.30.
- Inspects and maintains TCD location, operation, quality, cleanliness, and effectiveness.
- Is equipped with a cellular telephone.
- Is equipped with a two way radio, when necessary.
- Has the authority to assign and control flagging operations.
- Has filed their name and phone number with the Engineer and local police.
- Notifies the Engineer of any corrective measures made to the TCP if the TCP is not functioning as required, or to accommodate site conditions. The designated person shall follow the TCP and shall not implement changes to the TCP before revisions are approved by the Engineer.
- Prepares and signs a daily "Traffic Control Inspection Report" (Form No. 734 2474) each working day, and submits the report to the Engineer no later than the end of the next working day.
- Shall report to the Project Site within 1 hour after being notified in the event of a Work Zone incident during non-work periods.
- Designate an area for pedestrians to wait for, load and unload the transport vehicle.

00223.32 Automated Flagger Assistance Device Operator - Use a certified flagger who has been trained in the operation of the AFAD.

The duties of the AFAD operator include the following:

- Attend the AFAD at all times during the operation of the device.
- Shall not flag traffic and operate an AFAD at the same time.

- Each AFAD shall have a separate AFAD operator.

00223.33 Pedestrian Transport Vehicle Operator - Use PTV operators that meet the requirements of 00223.30 and the following:

- Have a valid Commercial Driver's license.
- Have had adequate training, and have the mental and physical ability to load and unload pedestrians with ADA needs and bicycles.

Construction

00223.40 Flaggers - Locate flaggers far enough in advance of the work area to permit adequate time for the motorist to respond to the flagger's instructions. All flaggers, including advance flaggers, shall use a STOP/SLOW paddle. Do not use roll-up STOP/SLOW paddles for non-emergency flagging operations.

During advance flagging operations, the advance flagger shall only display the "SLOW" face of the paddle by covering the "STOP" face of the paddle with a sign cover according to 00222.12(a).

Position flaggers, as directed, at locations where traffic can enter the Highway within the limits of the work zone.

Flaggers shall direct vehicles entering the Highway to follow the pilot car line.

Direct pedestrians to wait for flagger instructions. Stop and hold motor vehicle traffic to allow pedestrians to enter the TPAR or exit the TPAR. Pedestrians must be clear of all traffic lanes before flaggers release motor vehicle traffic.

Direct pedestrians to use the pedestrian transport vehicle to pass through or around the Work Zone. Direct pedestrians to wait for the pedestrian transport vehicle in designated areas identified under 00223.31.

If a TPAR is designed and installed with a width less than 5 feet, and 5 foot by 5 foot passing spaces at 200 foot intervals are not provided, inform pedestrians of the narrowed TPAR. Before allowing pedestrians in wheelchairs or similar devices to use the TPAR, direct the flagger at the opposite end of the TPAR to stop and hold opposing pedestrian traffic until the pedestrian in the wheelchair has reached the other end of the narrowed TPAR.

Flagging stations shall be staffed continuously or until the Engineer determines flagging is no longer required.

00223.41 Flagger Station Lighting - Provide continuous flagger station lighting for nighttime flagging as follows:

- Locate the light Equipment on the same side of the Roadway as the flagger between 5 and 10 feet from the edge of the Traffic Lane, on or beyond the Roadway Shoulder, or as directed.
- Position and orient the flagger station lighting to direct the maximum amount of light toward the flagger and away from the approaching traffic in the near lane.
- Aim all of the luminaires directly at the flagger.
- Increase the output wattage or number of luminaires as the luminance from, and number of, surrounding and background lights increases. Do not provide a total output greater than 2,500 watts, unless otherwise directed.

00223.42 Traffic Control Supervisors - Use traffic control supervisors to oversee the implementation of the TCP, and the quality and placement of all temporary TCM and TCD used on the Project.

00223.43 Automated Flagger Assistance Device - Use the AFAD to control traffic through the Work Zone and as follows:

- Position the AFAD operator's control location a safe distance from traffic.
- Install and operate the AFAD according to the manufacturer's instructions and as shown in the Plans.
- Do not use the AFAD to control more than one lane of approaching traffic. If necessary, close additional traffic lanes, left turn lanes or right turn lanes approaching the AFAD to limit approaching traffic to one lane.
- Provide illumination when using an AFAD during nighttime hours. AFAD illumination shall meet the following requirements:
- Illuminates the AFAD so the AFAD is visible and discernable as an AFAD from a distance of 1,000 feet.
- Illuminates the AFAD from above at a height of 18 feet + 3 feet.
- The light is shielded from approaching traffic.
- Do not use an AFAD to replace a continuously operating temporary traffic control signal. The Engineer may order adjustments to the operation of the AFAD or substitute flagging for the AFAD based on traffic delay, field conditions, and safety concerns.
- When providing an AFAD for each direction of traffic, use AFADs of the same type and from the same manufacturer.
- When an AFAD is not in use during a work shift either turn it off or switch the yellow lens to flash mode. When the AFAD is not in use for more than one work shift, remove it and all accompanying signing from the roadway.

00223.45 Pilot Cars - Safely operate pilot cars at a prudent speed, and at a speed that does not exceed that posted on the temporary advisory speed signing.

00223.46 Pedestrian Transport Vehicle - Safely operate pedestrian transport vehicles at a prudent speed, and at a speed that does not exceed that posted on the temporary advisory speed signing. Follow the pilot car or the pilot car queue through the Work Zone. Safely pull the transport vehicle off the roadway traffic lane or into a closed traffic lane to load or unload passengers and bicycles in designated areas identified under 00223.31.

Maintenance

00223.61 Flagger Station Lighting - Maintain and use the required flagger station lighting according to the manufacturer's recommendation and as required.

When flagger station lighting is in use, have on the Project Site, the following:

- Repair Equipment and electronic components recommended by the manufacturer.
- At the beginning of each shift, have approved backup flagger station lighting available for immediate use in event of failure.
- Sufficient fuel to maintain continuous operation of the generator.

00223.63 Automated Flagger Assistance Device - When repairs or replacement of the AFAD are required, take the device out of service. Use flaggers until repairs are complete and the AFAD is re-installed and operational.

Measurement

00223.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Unit Basis - The following will be measured on the unit basis:

(1) Traffic Control Supervisor - The quantities of the TCS will be measured on the unit basis, and will be measured when a Traffic Control Inspection Report is submitted according to 00223.31 and one or more of the following occur:

- Work is performed in Roadways or Shoulders of Roadways with an ADT greater than 10,000.
- TCS performs duties described in 00223.31 as requested by the Engineer.

A maximum quantity of two TCS will be allowed for each 24 hour period. A maximum of one TCS will be allowed for a single construction work shift unless otherwise approved.

(2) Automated Flagger Assistance Device - Automated flagger assistance devices will be measured on the unit basis, where the devices are initially installed on the Project.

The automated flagger assistance device operator will be measured as a flagger according to 00223.80(b)(1).

(3) Flagger Station Lighting - Flagger station lighting will be measured on the unit basis, where the devices are initially installed on the Project. No additional measurement will be made for the backup unit in event it is used or not.

(b) Time Basis - The following will be measured on the time basis:

(1) Flaggers - Flaggers will be measured on the time basis, of the actual number of hours flagging stations are staffed.

Flagging performed by a TCS will not be measured, except as specified in 00223.31.

(2) Pilot Car - The quantity for pilot cars will be measured on the time basis, of the actual number of hours pilot cars are operated.

(3) Pedestrian Transport Vehicle - The quantity for pedestrian transport vehicles will be measured on the time basis, of the actual number of hours pedestrian transport vehicles are operated.

(4) Flagger Station Lighting - Flagger station lighting will be measured on the time basis, of the actual number of hours the flagger stations are staffed and the flagger station lighting is required. No additional measurement will be made for the backup unit in event it is used or not.

The quantities for work zone traffic control measures (TCM) will be limited to the following, unless otherwise specified:

- The initial installation of quantities necessary to complete the Project based on the Contract Schedule of Items.

- The initial installation of additional TCD and TCM that the Engineer and Contractor agree are necessary to ensure a safe work zone.
- The replacement of TCD and TCM damaged by Public Traffic and replaced by the Contractor.

Payment

00223.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Flaggers	Hour
(b)	Traffic Control Supervisor	Each
(c)	Flagger Station Lighting	Each or Hour
(d)	Pilot Cars	Hour
(e)	Pedestrian Transport Vehicle	Hour
(f)	Automated Flagger Assistance Device	Each

Item (a) includes all necessary Equipment, special apparel, flagging Equipment, and two-way radios. Workers performing flagging duties who are not properly equipped or attired will not be considered to be flaggers and will not be eligible for payment under this item. Flaggers performing Work other than flagging will not be considered flaggers and will not be eligible for payment under this item.

Item (b) includes vehicle and Equipment.

Item (c) includes furnishing, operating, moving, and removing the flagger station lighting. No separate or additional payment will be made for backup unit in event it is used or not.

Item (d) includes fully operated pilot cars, two-way radios, the "PILOT CAR FOLLOW ME" sign, and the rotating amber light or strobe light mounted on the pilot car.

Item (e) includes fully operated pedestrian transport vehicles, two-way radios, the “CONSTRUCTION VEHICLE DO NOT FOLLOW” sign, the ADA-pedestrian loading/unloading mechanism, and the rotating amber lights or strobe lights mounted on each vehicle.

Payment for item (a), item (b), item (d) and item (e) performed beyond the quantity shown in the Contract Schedule of items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the Work as determined according to Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the Work, payment for the Additional work will be made according to 00195.20.

Item (f) includes furnishing, operating, maintaining, repairing, replacing moving and removing each AFAD device, regardless of size or type. No separate or additional payment will be made for AFAD replacement, repair, or for AFAD illumination. The AFAD operator will be paid for as a flagger.

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing the Materials and TCD, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified, except as covered in 00221.90(b).

00223.91 Payment, Lump Sum or Incidental Basis - When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment according to 00221.98 or 00221.99.

Section 00224 - Temporary Traffic Channelizing Devices

Description

00224.00 Scope - In addition to requirements of Section 00221, this Work consists furnishing, installing, moving, maintaining, inspecting, and removing channelizing devices including, but not limited to, tubular markers, conical markers, surface mounted tubular markers, plastic drums, and delineators throughout the Project area as shown or specified.

Materials

00224.10 Tubular Markers - Use tubular markers from the QPL. Use blue plastic markers for temporary business accesses only. Use orange plastic markers for all other applications of Work Zone traffic control.

00224.11 Conical Markers - Use conical markers from the QPL.

00224.12 Surface Mounted Tubular Markers - Use surface mounted tubular markers from the QPL.

00224.13 Plastic Drums - Use plastic drums from the QPL.

00224.14 Delineators - Use new delineators from the QPL or salvaged reflectorized delineators (W-1) or (Y-1), as appropriate, and conforming to the requirements of Section 00840 and the following:

(a) Guardrail - At guardrail locations, use Type 4 delineators.

(b) Temporary Barrier - At temporary barrier locations, use Type 5 delineators.

00224.15 Barricades - Use barricades from the QPL and as shown on the Standard Drawings.

Construction

00224.40 Tubular and Conical Markers - Install tubular or conical markers as shown or directed.

Place tubular or conical markers no more than 10 feet apart along both sides of driveways, streets, and road connections within work areas.

Within individual runs of tubular or conical markers, use one shape for the entire run. Conical markers may be used in place of tubular markers.

00224.42 Surface Mounted Tubular Markers - Install surface mounted tubular markers as shown or directed.

Remove surface mounted tubular marker bases in a manner that leaves any remaining adhesive material with a textured surface condition similar to the texture of the surrounding top Lift wearing Course Pavement surface. Make the surface dull and non-reflective. Remove adhesive from the Pavement surface using a method that will not damage the Pavement surface.

00224.43 Plastic Drums - Install plastic drums as shown or as directed.

00224.44 Delineators - Install traffic delineators as shown or as directed. Install delineators on temporary barrier and temporary guardrail as follows:

- Space on 50 foot centers. Closer spacing may be required as directed.
- Use yellow when installed on the left side of traffic.
- Use white when installed on the right side of traffic.
- Use bi-directional markers for Median applications.
- Position to face oncoming traffic.

00224.45 Barricades - Use and place barricades as shown or as directed.

00224.46 Pavement Edge Delineation - Place tubular or conical markers to delineate the edge of Pavement immediately after construction Work removes or obscures painted edge stripes (Shoulder or fog lines). If the left Shoulder is less than 8 feet wide, Type 5 delineators may be used instead of tubular or conical markers, by installing the delineators on the barrier at 25 foot spacing before left hand edge line markings are removed or obscured.

Place tubular or conical markers to delineate the edge of Pavement immediately after construction Work or paving operations create an abrupt or sloped edge drop-off 1 inch or more in height along the right hand or left hand Shoulder.

Maintain Pavement edge delineation until temporary pavement markings can be applied according to 00225.42. Apply temporary pavement markings within 14 Calendar Days after the painted edge stripe has been removed or obscured. Locate and maintain tubular and conical markers as follows:

- Place markers between traffic and the abrupt edge.
- Space markers as shown for traffic delineators on the Standard Drawings at a maximum spacing of 200 feet.
- Patrol daily and restore them to their proper position at least once at the start of each work shift and once at the end of each work shift until the tubular or conical markers are no longer required.
- Remove markers after a new edge stripe has been painted and new delineators are in place.

Maintenance

00224.60 Temporary Traffic Delineation - Evaluate and maintain or immediately replace all unacceptable temporary tubular and conical markers, plastic drums, surface mounted tubular markers, and traffic delineators with acceptable materials.

Measurement

00224.80 Measurement - The quantities of surface mounted tubular markers, replacing surface mounted tubular markers, temporary plastic drums, temporary delineators, and temporary barricades will be measured on the unit basis.

No measurement of quantities will be made for conical markers or tubular markers.

The quantities for work zone traffic control measures will be limited to the following, unless otherwise specified:

- The initial installation of quantities necessary to complete the Project based on the Contract Schedule of Items.

- The initial installation of additional TCD and TCM that the Engineer and Contractor agree are necessary to ensure a safe work zone.
- The replacement of TCD and TCM damaged by Public Traffic and replaced by the Contractor.

Payment

00224.90 Payment - The accepted quantities of temporary traffic delineation will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Surface Mounted Tubular Markers	Each
(b)	Replace Surface Mounted Tubular Markers	Each
(c)	Temporary Plastic Drums	Each
(d)	Temporary Delineators	Each
(e)	Temporary Barricades, Type ____	Each

Item (a) includes furnishing and installing the complete assembly of each device in its initial location and for removing the device from the surface.

Item (b) includes furnishing new or refurbished devices to replace damaged or missing devices.

In item (e), the type of barricade will be inserted in the blank.

Conical markers and tubular markers will be paid for according to 00221.90(b).

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing the Materials and TCD, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified, except as covered in 00221.90(b).

TCD items included under this Section damaged by Public Traffic and replaced by the Contractor will be paid for at the Contract price for the Pay Items listed in the Contract Schedule of Items or in approved Contract Change Orders, unless otherwise specified. Payment for replacing damaged TCD will only be made when:

- The Engineer orders it.
- The replacement devices are used on the Project.
- The damaged devices are disposed of to the Engineer's satisfaction.

00224.91 Payment, Lump Sum or Incidental Basis - When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment according to 00221.98 or 00221.99.

Section 00225 - Temporary Pavement Marking

Description

00225.00 Scope - In addition to the requirements of Section 00221, this Work consists of installing, maintaining, and removing temporary pavement markings as shown or specified.

Materials

00225.10 Temporary Pavement Markers:

(a) Reflective Pavement Markers - Use new Type "1" reflective pavement markers from the QPL.

(b) Flexible Oiling Pavement Markers - Use new flexible oiling pavement markers from the QPL, approved for mixes with laydown temperatures greater than 325 °F.

(c) Flexible Overlay Pavement Markers - Use new flexible overlay pavement markers from the QPL.

00225.11 Temporary Tape - Use temporary removable, temporary non-removable, and temporary non reflective tape from the QPL.

00225.12 Painted Striping:

(a) Paint - Use striping paint from the QPL.

(b) Beads - Use glass beads from the QPL.

00225.14 Temporary Transverse Rumble Strips - Use temporary transverse rumble strips from the QPL or Conditional Use List.

Equipment

00225.20 General - Provide pavement marking Equipment according to 00850.20.

Construction

00225.40 Temporary Pavement Markers - Unless otherwise shown, to simulate skip lines or solid lines, install pavement markers as follows:

- Three single markers spaced 5 feet apart to simulate a 10 foot skip line with a gap of 30 feet to the next skip line.
- Single markers spaced 10 feet apart for solid lines.
- Double markers spaced 10 feet apart for double solid lines.

Use yellow markers for Highway centerline between adjacent Traffic Lanes travelling in opposite directions. Use white markers for lines between adjacent Traffic Lanes travelling in the same direction.

Temporary pavement markers shall remain in place until the permanent markings are complete. Replace damaged or missing markers when directed by the Engineer. On the final Pavement wearing Course and along final alignment, place permanent markings a maximum of 28 Calendar Days after placing temporary pavement markers, or as directed.

Remove temporary markers from the Pavement wearing Course within 5 Calendar Days after the placement of permanent markings. Remove temporary pavement markers without damaging the Roadway surface. Flexible pavement markers may be cut off within 1/8 inch of the Roadway surface.

(a) Reflective Pavement Markers - Install reflective pavement markers when shown according to Section 00855. Establish alignment with control points at 200 foot intervals on tangents and at 50 foot intervals on curves.

(b) Flexible Oiling Pavement Markers - Install flexible oiling pavement markers just before applying asphalt for chip seals, sand seals, and oil mats. Remove marker covers before reopening the Roadway to traffic.

If a segment of Roadway is not completed when the Roadway is reopened to traffic, install another set of markers just before the next application of asphalt.

(c) Flexible Overlay Pavement Markers - Install flexible overlay pavement markers as follows:

- On surfaces that do not require chip seals, sand seals, and oil mats.
- On underlying surfaces that temporarily carry traffic.
- When temporary striping is determined as not practicable by the Engineer.

Install the pavement markers before reopening the Roadway to traffic. Remove the markers on Pavement Base Courses before placing the next surface layer.

(d) Existing Pavement Marker Removal - Remove and dispose of existing raised or recessed pavement markers as needed for stage construction, or as directed. Remove pavement markers from permanent Pavement wearing Courses without damaging the Roadway surface, and ensure the surface texture remains similar to that of the surrounding area. Make the surface dull and non-reflective. Remove adhesive from the Pavement surface using a method that will not damage the Pavement surface.

00225.41 Temporary Tape - Replace damaged or missing tape. Remove temporary tape without damaging the Roadway surface. Install temporary tape as shown and as follows:

(a) Temporary Removable Tape - Install temporary removable tape on existing surfaces or Pavement wearing Courses as shown, or as directed. When staging across new bridge deck surfaces, use temporary removable tape. Remove the temporary removable tape before placing subsequent surfaces and after installing permanent pavement markings.

(b) Temporary Non-Removable Tape - Install non-removable tape on Base Courses as shown or as directed.

(c) Temporary Non-Reflective Tape - Install non-reflective tape over durable pavement markings to be retained as shown or directed.

00225.42 Temporary Pavement Markings - Before opening Roadways to traffic, unless otherwise specified in 00224.46, apply temporary pavement markings on Pavement base Courses, wearing Courses, and new bridge deck surfaces at locations shown, or as directed. Immediately remove all unacceptable pavement markings and replace with acceptable markings before opening Roadways to traffic, at no additional cost to the Agency.

Temporary pavement markings may be placed using paint, temporary tape, or pavement markers, as follows:

(a) Base Courses - On Pavement base Courses, use paint, temporary tape, or pavement markers for temporary pavement markings, as shown in the Plans or in the TCP.

For painted striping, apply 4-inch wide by 10-foot long stripes with 30-foot gaps for skip line striping. Apply 4-inch wide, continuous stripes for solid line striping. Apply bead binder at a thickness of 15 mils wet, equivalent to 17 gallons per mile for a 4 inch wide solid line. Apply glass beads at a rate of 5 pounds per gallon of paint.

Before opening a Traffic Lane on a base Course adjacent to temporary barrier that is located on the right-hand side of the Traffic Lane, place right-hand edge line markings using paint or a continuous removable tape, or as directed.

Before opening a Traffic Lane adjacent to temporary barrier that is located on the left hand side of the Traffic Lane, place left hand edge line markings using paint, a continuous strip of temporary removable tape, pavement markers spaced 10 feet apart, or as directed.

(b) Wearing Course - For skip line or solid line markings on the Pavement wearing Course, use paint, temporary removable tape, or pavement markers, as follows:

- For left hand solid lines and slip lines striping, use temporary removable tape or pavement markers.
- For right-hand solid edge line markings, use paint or a continuous strip of temporary removable tape.
- Where inlaid permanent pavement markings are to be placed, use paint for temporary pavement markings.
- Where durable permanent pavement markings are to be placed, apply temporary line markings using painted striping until durable permanent pavement markings can be applied according to 00225.42(d).

Before opening a Traffic Lane on a wearing Course adjacent to temporary barrier that is located on the right-hand side of the Traffic Lane, place right-hand solid edge line markings using a continuous strip of temporary removable tape, or as directed.

Before opening a Traffic Lane on a wearing Course adjacent to temporary barrier that is located on the left-hand side of the Traffic Lane, place left-hand solid edge line markings using a continuous strip of temporary removable tape, with pavement markers spaced 10 feet apart, or as directed.

(c) New Bridge Deck Surfaces - For skip line or solid line striping on new bridge deck surfaces use temporary removable tape for temporary pavement markings as shown or as directed.

(d) Durable Permanent Pavement Markings - On Pavement wearing Courses where durable permanent pavement markings are to be placed, apply temporary painted striping until durable permanent pavement markings can be applied, unless otherwise directed. Reduce the application rate of the paint to a thickness of 10 mils wet, equivalent to 12 gallons per mile for a 4 inch wide solid stripe. Apply reflective elements at a rate of 5 pounds per gallon of paint. Only one application is required.

Place temporary painted striping directly adjacent to the final location of the durable permanent pavement markings. Place the temporary painted striping so the durable permanent pavement markings can be aligned with existing striping at the end of the project limits. Removal of the temporary painted striping is not required, if aligned as described in this Subsection.

When scheduled installation of durable permanent pavement markings will exceed, or will likely exceed, 28 Calendar Days after placement of the wearing surface, furnish and place temporary

painted striping at the standard rate stated in 00225.42(a). Removal of this striping is not required if aligned as described in this Subsection.

00225.43 Pavement Legends and Bars - Before opening Roadways to traffic, unless otherwise allowed, apply temporary pavement legends and bars on Pavement base Courses at locations designated. Apply bead binder at a thickness of 15 mils wet and glass beads at a rate of 5 pounds per gallon of paint.

00225.44 Temporary Transverse Rumble Strips - Place and maintain temporary transverse rumble strips across the travel lane as shown or directed. Do not place rumble strips across surfaces used by bicycles.

00225.45 Pavement Marking Removal - Remove striping, durable markings, legends, and bars according to the following:

- Coordinate all removal Work with construction activities.
- Remove pavement markings on Pavement base Courses when a change in striping is necessary and when the Pavement will not be covered with an additional base Course.
- Remove striping and pavement markers on the wearing Course so that the permanent markings can be applied. Remove all remaining striping and pavement markers from the wearing Course after the permanent markings have been applied, as directed.
- Use vacuum shrouded Equipment or other equally effective containment procedures to contain and collect all removed pavement marking materials and spent abrasive, and dispose of according to 00290.20.
- Remove legends so that the legend outline is not recognizable on the Pavement surface.
- Unless otherwise approved, remove pavement markings during the same day the traffic shift is accomplished or new pavement markings are applied.
- Do not use paint or asphalt to cover existing stripes.
- Do not remove more than 1/8 inch of Pavement during pavement marking removal.
- Do not use grinding to remove stripes, durable markings, legends, or bars from the wearing Course or existing surfaces, unless the area will be paved over, obliterated, or the pavement markings will be replaced to match the original striping configuration.

Repair all damage resulting from pavement marking removal to the Engineer's satisfaction at no additional cost to the Agency.

Maintenance

00225.60 Temporary Traffic Pavement Markings - Temporary pavement markings shall remain in place until the permanent markings are complete. Replace missing or damaged temporary markings when directed by the Engineer. On the final Pavement wearing Course and along final alignment, place permanent markings a maximum of 28 Calendar Days after placing temporary pavement markings, or as directed.

If permanent pavement markings are not placed within 28 Calendar Days after placing temporary pavement markings, missing or damaged temporary pavement markings on wearing Course and along final alignment shall be replaced at no additional cost to the Agency, unless otherwise directed.

When removing damaged delineation from the Pavement surface, remove adhesives, hardware, damaged delineation fragments or other materials using a method that will not damage the Pavement surface. Repair any damaged surfaces to the Engineer's satisfaction at no additional cost to the Agency.

00225.64 Temporary Transverse Rumble Strips - Maintain, reposition, and replace temporary transverse rumble strips as shown or directed.

Measurement

00225.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Unit Basis - Temporary pavement legends will be measured on the unit basis, by actual count.

(b) Length Basis

(1) Temporary Tape - Temporary tape will be measured on the length basis, by measuring the actual length of the tape complete and in place. No adjustment for tape width will be made.

(2) Striping - Painted temporary striping will be measured on the length basis determined by one of the following methods:

a. Count Method - The number of 4 inch wide skip stripes will be counted and multiplied by the "standard length". For purposes of this Subsection a "standard length" for a skip stripe (10.0 feet) is defined in 00225.42(a).

b. Length Method - Measurement will be the actual length of 4 inch wide stripe complete and in place. When measuring the actual length of 4 inch wide skip stripe, the skip interval will not be included in the measurement. The length of skip stripe may be determined by dividing the total length by 4.0.

Temporary striping required for durable permanent pavement marking installation will be included in the measurement.

Temporary striping will be measured on the length basis, of lines based on a nominal width of 4 inches. If the Plans call for, or the Engineer requires, stripes other than nominal 4 inch width, the measurement will be adjusted by converting to an equivalent length of a nominal 4 inch wide stripe.

(3) Temporary Transverse Rumble Strips - Temporary transverse rumble strips will be measured on the length basis, determined by measuring the actual length of temporary transverse rumble strips complete and in place.

(4) Stripe Removal - Stripe removal for stage construction will be measured on the length basis, determined by measuring the overall length of 4 inch line removed. The quantity of stripe removal will be the computed length of lines removed based on a nominal width of 4 inches. For computation purposes, the following apply:

- The width of a line is the normal standard line width applied during original placement of solid no-passing lines, broken (skip) lines, edge lines, and any other lines normally 4 inches wide.
- The length of continuous lines is length of the line.
- The length of broken (skip) stripes is the standard length of a skip line normally painted during original placement of the lines 10.0 feet of paint per 40 feet of Roadway length. Skip stripes may be counted.

The length of standard 8-inch or 12-inch wide stripes will be adjusted by converting to equivalent length of 4-inch width line. No conversion or adjustment will be allowed for lines that are wider or longer due to improper placement or retracing deviations.

(c) Area Basis

(1) Temporary Pavement Bars - Temporary pavement bars will be measured on the area basis, for each stop bar and crosswalk bar.

(2) Legend and Bar Removal - Pavement legend removal and bar removal for stage construction will be measured on the area basis, of each legend and bar removed and will be the nominal area determined by multiplying the width times the length of the legend or bar. No deductions will be made for corners or irregular shapes.

Measurement of temporary pavement markings will include missing or damaged temporary pavement markings replaced according to 00225.60 or as directed by the Engineer.

The quantities for work zone traffic control measures will be limited to the following, unless otherwise specified:

- The initial installation of quantities necessary to complete the Project based on the Contract Schedule of Items.
- The initial installation of additional TCD and TCM that the Engineer and Contractor agree are necessary to ensure a safe work zone.
- The replacement of TCD and TCM damaged by Public Traffic and replaced by the Contractor.

Payment

00225.90 Payment - The accepted quantities of temporary traffic delineation will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Temporary Reflective Pavement Markers	Each
(b)	Temporary Flexible Pavement Markers	Each
(c)	Temporary Removable Tape	Foot
(d)	Temporary Non-Removable Tape	Foot
(e)	Temporary Non-Reflective Tape	Foot
(f)	Temporary Striping	Foot
(g)	Temporary Pavement Legends	Each
(h)	Temporary Pavement Bars	Square Foot
(i)	Stripe Removal	Foot
(j)	Legend Removal	Square Foot
(k)	Bar Removal	Square Foot
(l)	Temporary Transverse Rumble Strips	Foot

Item (a) includes temporary pavement markers having either one or two reflective faces.

Item (b) includes removing flexible pavement marker covers.

Item (i) includes removal of painted and durable stripes required for stage construction.

Item (j) includes removal of durable and non-durable legends required for stage construction.

Item (k) includes removal of durable and non-durable bars required for stage construction.

Payment for items (c), (d), (e), (f), (h), and (k) performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the Work as determined according to Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the Work, payment for the Additional Work will be made according to 00195.20.

No separate or additional payment will be made for mobilization to perform striping, stripe removal, legend removal, or for mobilization to place or remove temporary flexible pavement markers.

No separate or additional payment will be made for relocating, repositioning, or removing temporary rumble strips.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified, except as covered in 00221.90(b).

00225.91 Payment, Lump Sum or Incidental Basis - When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment according to 00221.98 or 00221.99.

Section 00226 - Temporary Roadside Barriers and Impact Attenuators

Description

00226.00 Scope - In addition to the requirements of Section 00221, this Work consists of furnishing, installing, moving, operating, maintaining, and removing guardrail, barrier, and impact attenuators for temporary traffic control, as shown and directed.

Materials

00226.10 Temporary Guardrail - Use guardrail for temporary applications meeting applicable requirements of Section 00810, except posts may be untreated. A certificate of origin according to 00165.35(d) is not required for temporary guardrail. Use guardrail terminals from the QPL and as shown on the Standard Drawings.

Salvaged guardrail materials complying with the requirements of 00810.15(b) may be used.

00226.11 Temporary Barrier and Appurtenances:

(a) Temporary Barrier - Use a temporary barrier or minimum deflection temporary barrier from the QPL or Concrete Barrier as follows:

(1) Barrier from the QPL - Use temporary barrier from the QPL.

(2) Temporary Concrete Barrier - Use concrete barrier meeting the requirements of Section 00820, and having the same Cross Section, height, and loop configuration within individual runs and the following:

- Pin-and-loop concrete barrier as shown on the Standard Drawings (three ASTM A36 loops, 32 inch height).
- Tall concrete barrier as shown on the Standard Drawings (two ASTM A36 perforated C shapes, 42 inch height).

Use concrete barrier terminals and metal guardrail transitions as shown on the Standard Drawings.

Use modified concrete barrier or modified tall concrete barrier around obstacles as shown on the Standard Drawings.

Provide concrete barrier for temporary applications that are in acceptable condition, without cracks, chips, spalls, or corroded loops or C-shape connectors.

The concrete barrier shall have functioning scuppers, unless otherwise approved.

(b) Reflective Barrier Panels - Use reflective barrier panels from the QPL.

(c) Glare Shields - Use glare shields from the QPL that are a minimum 24 inches in height.

00226.12 Temporary Impact Attenuators - Furnish temporary impact attenuators from the QPL and as shown on the Standard Drawings.

Equipment

00226.23 Truck Mounted Attenuator - Provide appropriate truck mounted attenuators (TMAs) from the QPL, based on the pre-construction posted speed, as follows:

Pre Construction Posted Speed:	TMA
< 45 mph	TL-2 Rated TMA
45 – 70 mph	TL-3 Rated TMA

The support vehicle for a TL-2 rated TMA shall have a minimum weight of 9,900 pounds. The support vehicle for a TL-3 rated TMA shall have a minimum weight of 22,000 pounds.

When a TMA is in place, set the parking brake and transmission on the support vehicle as recommended by the TMA manufacturer.

If used in a mobile operation, the TMA support vehicle shall maintain a consistent distance from the mobile operation, as shown in the TMA Support Vehicle Placement tables.

Construction

00226.40 Temporary Guardrail - Construct temporary guardrail as shown and according to Section 0810.

00226.41 Temporary Barrier and Appurtenances:

(a) Temporary Barrier - Connect all temporary barrier sections together according to the following:

- Concrete Barrier per the Standard Drawings
- Temporary Barrier per manufacturer's recommendation

When placing barrier adjacent to a Traffic Lane, maintain a minimum of 24 inches from the face of the barrier to the edge of the Traffic Lane, or as shown or directed. Flare the leading end as shown in the table below and treat ends as shown on the Plans.

Speed (mph)	Flare Rate
70	20:1
65	19:1
60	18:1
55	16:1
50	14:1
45	12:1
40	10:1
35	9:1
< 30	8:1

Secure temporary barrier to bridge decks according to the *ODOT Bridge Design Manual* or as shown.

Keep the 3 feet of space behind temporary barrier clear. Keep 1 foot of space behind minimum deflection temporary barrier, clear. Secure concrete barrier used for minimum deflection to Surfacing according to the Standard Drawings. Secure all other temporary barriers to Surfacing according to the manufacturer's recommendations.

When the clear area distance behind the barrier is less than 3 feet, use minimum deflection temporary barrier.

Place temporary barrier and minimum deflection temporary barrier on smooth, solid surfacing. Maintain smooth, solid surfacing for the clear area behind temporary barrier.

(b) Reflective Barrier Panels - Install reflective barrier panels on temporary barrier as shown or directed and as follows:

- Install a panel every 6 feet.
- Maintain a 4-foot gap between panels on each barrier section.
- Alternate silver-white and fluorescent orange color panels.
- Attach the panels to the face of the temporary barrier with a minimum of four anchors.
- Install panels so the bottom edge is 20 inches above the bottom of the temporary barrier.

(c) Glare Shields - Install glare shields as shown or as directed and according to the following:

- Install at spacing recommended by the manufacturer.
- Install all glare shield blades vertical and true to line.
- Firmly attach the base plate anchor bolts to the temporary barrier to withstand a 1,000 pound vertical pull and to prevent horizontal and rotational displacement. Maximum spacing between anchor bolts on modular units shall be 30 inches.
- Repair any damage to the temporary barrier caused by the Contractor's operations at no additional cost to the Agency.
- Modular or single element glare shields that are installed in a continuous run shall be of the same manufacture and of like appearance throughout the entire installation.

00226.42 Temporary Impact Attenuators - Assemble and install temporary impact attenuators according to the manufacturer's recommendations and as follows:

- Use attenuators designed for the preconstruction posted speed.
- Attenuators may be placed on pallets no more than 4 inches high, as approved.
- Place and fill the modules with the weight of dry sand as shown.
- Mix salt with the sand in the proportions recommended by the manufacturer, or at least 5 percent by volume when no manufacturer recommendations are given.
- Attach an object marker to the lead module as shown.
- For narrow site systems, secure the first two barrier sections by pinning or restraining as shown.
- For water-filled impact attenuators, use one of the following anti-freezing solutions to fill the impact attenuator:
  - 25% Liquid Calcium Magnesium Acetate (CMA), 75% water solution, by volume
  - 60% Liquid Potassium Acetate, 40% water solution, by volume

00226.43 Truck Mounted Attenuator - When workers or construction equipment are operating in a closed traffic lane or shoulder, are exposed to public traffic, and are not located behind a rigid, longitudinal barrier system, use a truck mounted impact attenuator (TMA). Place the TMA in advance of the exposed workers or equipment, located as shown in the TMA Support Vehicle Placement tables, or as directed. If the TMA is not available when the work requires its use, postpone the work until the TMA is available.

TMA SUPPORT VEHICLE PLACEMENT (Stationary Operations)[1]

Posted Speed:[3]	TMA Support Vehicle Weight	
	9,900 - 22,000 lb. (for TL-2 rated TMA)	**> 22,000 lb. (for TL-3 rated TMA)**
< 45 mph	100 ft.	75 ft.
45 - 55 mph	*	100 ft.
> 55 mph	*	150 ft.

TMA SUPPORT VEHICLE PLACEMENT (Mobile Operations)[2]

Posted Speed:3	TMA Support Vehicle Weight	
	9,900 - 22,000 lb. (for TL-2 rated TMA)	> 22,000 lb. (for TL-3 rated TMA)
< 45 mph	100 ft.	100 ft.
45 - 55 mph	*	150 ft.
> 55 mph	*	175 ft.

* A TL-2 TMA is not rated for these speeds. Use a TL-3 rated TMA.

[1] Distances shown are between front of the TMA support vehicle and the beginning of the area or equipment being shielded by the TMA.
[2] Distances shown for mobile operations are appropriate for support vehicle speeds up to 15.5 mph.
[3] Posted Speed refers to the pre-construction posted speed of the facility on which the TMA is being used

Maintenance

00226.60 Temporary Barrier and Guardrail - Immediately repair any temporary barrier segment or guardrail element that is damaged by the Contractor during or after placement. Repair it to the Engineer's satisfaction or replace it with an undamaged section at no additional cost to the Agency.

00226.62 Temporary Impact Attenuators - Complete repair of damaged impact attenuators, except for narrow site systems, within 24 hours of being notified of the damage. Complete repair of damaged narrow site systems within 6 hours of discovering or being notified of the damage.

When impact attenuator, truck mounted attenuator, or narrow site attenuator systems are used, have enough modules, cartridges, components, and replacement parts on hand to replace one complete installation or have on hand a complete replacement attenuator. Re-stock replacement items or complete replacement attenuators within 24 hours of use. All modules, cartridges, components, replacement parts, and replacement attenuators not used remain the property of the Contractor.

Replace damaged modules, cartridges, components, and replacement parts with modules, cartridges, components, and replacement parts of the same manufacturer and type, and with attenuation capabilities equal to the original, installed system.

00226.63 Truck Mounted Attenuators - Repair damage to support vehicles on which TMAs are mounted at no additional cost to the Agency.

Measurement

00226.80 Measurement - The quantities for work zone traffic control measures will be limited to the following, unless otherwise specified:

- The initial installation of quantities necessary to complete the Project based on the Contract Schedule of Items.

- The initial installation of additional TCD and TCM that the Engineer and Contractor agree are necessary to ensure a safe work zone.
- The replacement of TCD and TCM, except temporary signing, temporary electrical signs, and portable temporary traffic signals, damaged by Public Traffic and replaced by the Contractor. Temporary signing, temporary electrical signs, and portable temporary traffic signals damaged by Public Traffic and replaced or repaired by the Contractor will not be measured.

The quantities of Work performed under this Section will be measured as follows:

(a) Unit Basis: Temporary impact attenuators, moving temporary impact attenuators, and guardrail and concrete appurtenances will be measured on the unit basis.

Temporary impact attenuator repair will be measured on the unit basis as follows:

- For sand barrel systems, each replacement of damaged sand module (individual barrel) will be counted.
- All other systems will be the repair or complete replacement of the attenuator system.

(b) Length Basis - Items measured by the length basis will be measured as follows:

(1) Guardrail:

a. Count Method - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this Subsection, a "standard section" is defined as 12 1/2 feet of complete guardrail, without regard to the number of posts or rail elements used. Non-standard sections will be measured from center of post to center of post and added to the total calculated length of the standard sections for each run.

b. Length Method - Measurement will be from center to center of end posts, along the line and grade of each run of each type.

(2) Temporary Barrier:

a. Count Method - The laying length of a standard section, as shown on the applicable Standard Drawing, multiplied by the number of standard sections installed in each separate run. Non-standard sections, terminal sections, and transition sections will be measured and added to the total length of standard sections.

b. Length Method - Temporary barrier, minimum deflection temporary barrier, and moving temporary barrier will be measured on the length basis, measured from end to end of the barrier, including concrete barrier transitions, along the line and grade of each run. Estimated quantities of temporary barrier will be listed in the Special Provisions.

(3) Glare Shields - Glare shields and moving glare shields will be measured on the length basis, from center to center of the glare shield blades, as installed on concrete barrier for each run.

Payment

00226.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Temporary Guardrail, Type ____ Reflectorized	Foot
(b)	Temporary Guardrail Terminals, ____	Each
(c)	Temporary Guardrail Transition	Each
(d)	Temporary Bridge Connections	Each
(e)	Temporary Barrier	Foot
(f)	Minimum Deflection Temporary Barrier	Foot
(g)	Moving Temporary Barrier	Foot
(h)	Temporary Impact Attenuator, ____	Each
(i)	Moving Temporary Impact Attenuators, ____	Each
(j)	Repair Temporary Impact Attenuator, ____	Each
(k)	Temporary Glare Shields	Foot
(l)	Moving Temporary Glare Shields	Foot
(m)	Reflective Barrier Panels	Each
(n)	Temporary Guardrail End Pieces	Each
(o)	Temporary Guardrail Anchors	Each

In items (a) and (b), the type of guardrail or terminal will be inserted in the blank.

Items (c) and (d) include each device, regardless of size or type.

Items (e) and (f) include Type 5 delineators, including removing and replacing Type 5 delineators on the barriers, as necessary. This also includes furnishing, installing, connecting, securing, unsecuring, and maintaining temporary barrier, including minimum deflection temporary barrier.

Item (g) includes installing, connecting, intermediate moving or resetting, securing, unsecuring, and maintaining temporary barrier. This item also includes moving temporary barriers, regardless of size or type, from one location of actual use to another location of actual use, regardless of whether the barrier was moved to and from the Contractor's stockpile area as part of the move, and for removing and replacing Type 5 delineators on the barriers, as necessary. Moving temporary barrier to and from the Contractor's stockpile areas will be paid according to 00221.90(b).

In items (h) and (i), the type of attenuator will be inserted in the blank.

Item (i) includes each move of the device from one location of actual use to another location of actual use, regardless of whether the device was moved to and from the Contractor's stockpile area as part of the move. Moving temporary impact attenuators to and from the Contractor's stockpile areas will be paid according to 00221.90(b).

In item (j), the words "Sand Module" or the type of attenuator will be inserted in the blank.

Item (j) includes replacement of each sand module damaged by Public Traffic or includes repair or complete replacement of impact attenuators damaged by Public Traffic.

Item (l) includes moving the devices from one location on the concrete barrier to another.

Item (m) includes panels installed on the concrete barrier and replacing damaged panels.

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing the Materials and TCD, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified, except as covered in 00221.90(b).

No separate or additional payment will be made for temporary impact attenuator replacements, replacement modules, cartridges, components, anti-freezing solution, or replacement parts that are required to be on hand according to 00226.62 or for cleaning and removing debris from impacts.

No separate or additional payment will be made for moving TMAs or for repair of damage to support vehicles on which TMAs are mounted.

TCD items included under this Section damaged by Public Traffic and replaced by the Contractor will be paid for at the Contract price for the Pay Items listed in the Contract Schedule of Items or in approved Contract Change Orders, unless otherwise specified. Payment for replacing damaged TCD will only be made when:

- The Engineer orders it.
- The replacement devices are used on the Project.
- The damaged devices are disposed of to the Engineer's satisfaction.

00226.91 Payment, Lump Sum or Incidental Basis - When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be according to 00221.98 or 00221.99.

Section 00227 - Temporary Traffic Signals and Illumination

Description

00227.00 Scope - In addition to the requirements of Section 00221, this Work consists of providing, installing, maintaining, and removing temporary traffic signals and illumination, as shown or directed.

Materials

00227.10 Temporary Illumination - Furnish Materials for temporary illumination meeting the requirements of Section 00960, 00970, 02926, and the temporary illumination Plans.

00227.12 Temporary Traffic Signals - Furnish cable, guy wires, hardware, wood poles, wood pole foundations, and guy anchors that are able to support the dead load of the equipment shown and withstand a 100 mph, 3-second gust wind speed with an Importance factor (Ir) equal to 0.71 according to the 4th Edition AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

Submit stamped Working Drawings, details, and calculations for the wood pole designs to the Engineer for review according to 00150.35. Satisfy the requirements of 02120.10 and include designs for the wood poles, guy anchors, span wires, pole setting depths, and pole bearing.

Use materials for temporary traffic signals that conform to Sections 00960, 00990, 02120, and the following:

(a) General - Used materials are allowed if restored to new condition or have very minor wear that is undetectable without close inspection. Do not use permanent signal equipment as part of the temporary signal installation.

(b) Cable and Wire - Use all new cable and wire.

(c) Wood Poles - Use poles that are of acceptable condition without visible signs of deterioration or significant longitudinal splits. Poles shall have no more than 8 drilled holes for messenger and tether cable eyebolt attachments. Holes shall not be closer than 6 inches.

(d) Concrete - Use Commercial Grade Concrete according to Section 00440.

(e) Traffic Signal Control Devices - The controller program and monitor programming will be furnished by the Agency.

00227.13 Portable Traffic Signals - Use new or like-new portable traffic signals from the QPL.

00227.15 Pole Base Excavation Covers - Use pole base excavation covers meeting the following requirements:

- Utility grade plywood
- 3/4-inch minimum thickness
- New or in like new condition

Construction

00227.40 Temporary Illumination - Construct and remove temporary illumination according to the Plans and Sections 00950, 00960, 00970, and 02926.

00227.42 Temporary Traffic Signals - Construct, adjust, and remove temporary traffic signals according to the Plans, Sections 00950, 00960, 00990, and the following:

(a) Removal - Remove the temporary traffic signal when directed. Remove all wood poles and guy anchors in their entirety. Abandon vehicle detector loops in place. Contractor furnished Equipment remains the property of the Contractor.

(b) Power Service - Be responsible for Utility coordination, hook-up, and power consumption.

(c) Wood Poles - Back guy wood poles so that they are vertical with all dead loads applied. Bond all metallic conduit messenger cable, terminal cabinet, and other metallic parts within 10 feet of the ground line.

(d) Suspension of Heads - Adapt signal mounting hardware as needed for mounting on wood poles.

(e) Testing and Turn-on - Certify that all traffic signal controllers and related control Equipment for temporary signals have passed the ODOT laboratory tests. Successfully tested controllers and related control Equipment will be assigned permanent certification tags and will not require further environmental testing. Deliver controllers to the Traffic System Services Unit for functional testing.

00227.43 Portable Traffic Signals - Unless otherwise indicated in the TCP, provide and install portable temporary traffic signals as shown and according to the following:

(a) Location and Setup - Locate and set up portable temporary traffic signals according to the following:

- Locate the portable temporary traffic signal so that one vehicle signal head is directly over the Traveled Way, with a minimum vertical clearance of 17 feet.
- Provide conflict monitoring of green and yellow field indications.
- If there are indications in conflict or if there is operational failure, set the default to red flash.
- Use hard wired interconnection of the units for timing and conflict monitoring.
- Provide a method for immediate failure notification.

Do not install portable temporary traffic signals if driveways or road approaches are between the portable temporary traffic signals.

(b) Vehicle Detection - Provide vehicle detection at the stop line for each direction of traffic.

(c) Testing and Turn-on - Notify the Engineer at least 14 Calendar Days before turning on the portable temporary traffic signal. The Engineer will do the following:

- Inspect the installation and confirm the date and time the portable traffic signal is to be turned on.
- Notify the Contractor, in writing, with a list of deficiencies that need correction.
- Provide timing parameters to the Contractor for input into the portable temporary traffic signal.

Before turning on the portable temporary traffic signal, correct all deficiencies identified by the Engineer. Do not change the timing parameters without the approval of the Engineer. Use flaggers according to Section 00223 to control traffic during initial turn on of the signal. The flaggers shall remain on standby for 2 hours after the signal is turned on and operating properly.

Correct deficiencies at no additional cost to the Agency.

00227.44 Existing Traffic Signals - Adjust existing traffic signals according to the Plans and Sections 00950, 00960, and 00990.

Maintenance

00227.60 Temporary Illumination - Maintain temporary illumination and replace materials as directed.

00227.61 Existing Illumination and Sign Illumination - Maintain existing illumination and sign illumination after adjusting or working on them until accepted.

Routine maintenance of existing illumination and sign illumination will be performed by the Agency at the Agency's expense before the Contractor Works on them and after Work on them is completed and accepted.

00227.62 Temporary Traffic Signals - After successful turn-on of the temporary signal, except for equipment inside the controller cabinet, assume operation and maintenance of the temporary traffic signal until it is removed.

The operation and maintenance of the equipment inside the controller cabinet will be the responsibility of the Agency, except the Contractor shall furnish replacement parts that fail within the controller cabinet while the temporary traffic signal is in use.

After notification by the Agency, if the Contractor is not able to respond to a maintenance request for the temporary traffic signal or a request for replacement parts for the inside of the controller cabinet, Agency electricians will make repairs at the Contractor’s expense.

If the temporary traffic signal fails during operation for any reason, immediately provide flaggers to control traffic until the temporary traffic signal is operational.

00227.63 Portable Traffic Signals - After successful turn-on, perform all required maintenance during operation of the portable traffic signal. Maintain a log for each portable traffic signal that contains at least the following information:

- Dates and times when service and maintenance is performed.
- A description of Equipment that was serviced and a brief description of why the service was performed.
- All operational and Equipment failures of the unit.
- Repairs made to the unit.
- Past operational history of the unit.
- All timing parameters input into the controller.

The log shall remain with the corresponding portable traffic signal at all times.

The Agency will not replace or repair any part of portable traffic signals.

If the portable traffic signal fails during operation for any reason, immediately provide flaggers to control traffic until the portable traffic signal is operational. If the portable traffic signal fails a second time within 30 Calendar Days of the first failure, remove it from the Project and control traffic with flaggers until a replacement portable traffic signal is installed, activated, and working properly.

00227.64 Existing Traffic Signals - Maintain existing signals after adjusting or working on them until accepted.

Routine maintenance of existing signals will be performed by the Agency at the Agency's expense before the Contractor Works on them and after Work on them is completed and accepted.

Measurement

00227.80 Measurement - No measurement of quantities will be made for temporary traffic signals or temporary illumination.

Portable traffic signals will be measured on the unit basis, for each complete system. A complete system consists of two portable temporary traffic signals and hard wired interconnection between them. Portable temporary traffic signals damaged by Public Traffic and replaced or repaired by the Contractor will not be measured.

Payment

00227.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Temporary Illumination	Lump Sum
(b)	Temporary Traffic Signal	Lump Sum
(c)	Portable Traffic Signal	Each

Item (b) includes all required Materials called for by the Plans and Specifications.

Item (c) includes furnishing, operating, moving, and removing the signals and all required earthwork, bases, Surfacings, and hard wired interconnections.

No separate or additional payment will be made for:

- Removing and replacing damaged portable traffic signal
- Illumination and associated appurtenances shown on traffic signal poles.
- Furnishing, placing, maintaining, moving, and removing pole base excavation covers.
- Flagging as a result of temporary traffic signal failure or portable traffic signal failure, except when failure is due to loss of power from the power provider.

Flagging for initial turn-on and 2 hour standby time and for failure due to loss of power from the power provider will be paid for under the flagger Pay Item according to 00223.90.

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing the Materials and TCD, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified, except as covered in 00221.90(b).

Temporary illumination and temporary traffic signals damaged by Public Traffic and replaced by the Contractor will be paid for at the Contract price for the Pay Items listed in the Contract Schedule of Items or in approved Contract Change Orders, unless otherwise specified. Payment for replacing damaged TCD will only be made when:

- The Engineer orders it.
- The replacement devices are used on the Project.

- The damaged devices are disposed of to the Engineer's satisfaction.

00227.91 Payment, Lump Sum or Incidental Basis - When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment according to 00221.98 or 00221.99.

Section 00228 - Temporary Pedestrian and Bicyclist Routing

Description

00228.00 Scope - In addition to the requirements of Section 00221, this Work consists of furnishing, installing, maintaining, and removing temporary devices for accommodating pedestrians and bicyclists through a work zone.

00228.01 General - When Work briefly or intermittently blocks or restricts the use of a pedestrian route, and a temporary detour route is not practicable due to the short duration of the restriction, place one "Sidewalk Open" (CW11-3) sign in advance of the restriction and visible from the next closest alternate pedestrian pathway facing both directions of pedestrian traffic. Signs may be mounted between the panels of a Type II barricade or on a single post TSS. Do not place the sign or support such that it narrows the pedestrian pathway to a width of less than 4 feet.

Materials

00228.10 Pedestrian Channelizing Devices - Use PCD from the QPL and as shown on the Standard Drawings or in the TCP.

00228.12 Bicycle Channelizing Devices - Use bicycle channelizing devices from the QPL or Conditional Use List.

00228.13 Temporary Curb Ramps - Furnish temporary curb ramps from the QPL or the Conditional Use List; or construct temporary curb ramps on site according to the Standard Drawings. Use ACP, PCC, or other approved materials for on-site constructed temporary curb ramps.

00228.14 Temporary Walks - Use temporary walks from the QPL or use ACP, PCC, or other approved Materials for on-site constructed temporary walks.

Construction

00228.40 Pedestrian Channelizing Devices - Install PCD as shown in the Plans or in the TCP. Provide a continuous route by interconnecting all adjacent PCD. Provide a clean unobstructed path for pedestrians according to 00220.02 and MUTCD requirements.

00228.42 Bicycle Channelizing Devices - Install bicycle channelizing devices as shown. Provide a continuous route by interconnecting all adjacent BCD. Provide a clean unobstructed path according to 00220.02(c).

00228.43 Temporary Curb Ramps - Install or construct temporary curb ramps as shown in the Standard Drawings and in the Plans, and according to the manufacturer's recommendations, if applicable. Temporary curb ramp dimensions and grades shall comply with the Standard Drawings or requirements approved by the Engineer. Repair or reconstruct unacceptable temporary curb ramps before opening to pedestrian traffic.

For curb ramps that cross, or are placed adjacent to, a gutter line or other drainage Structure, provide an approved means to prevent water from accumulating at the bottom of the ramp or overflowing onto the ramp surface.

00228.44 Temporary Walks - Construct temporary walks as shown or directed. Repair or reconstruct unacceptable temporary walks before opening to pedestrian traffic.

Maintenance

00228.63 Temporary Curb Ramps and Temporary Walks - Inspect and maintain temporary curb ramps and temporary walks for:

- Any damaged curb ramp or walk surfaces.
- Ramp and walk alignment or connections to existing sidewalks or Roadway surfaces.
- Compliance with the dimensions and grades in the Standard Drawings or requirements approved by the Engineer.
- Items identified by the manufacturer's recommendations.
- Other ramp or walk quality or performance issues, as directed.
- Keep ramps and walks unobstructed. Maintain a firm, stable, and slip resistant surface free of debris.

After completion of the Work, restore the area on which the temporary curb ramp or temporary walk occupied as directed.

Measurement

00228.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Length Basis - Pedestrian channelizing devices and bicycle channelizing devices will be measured on the length basis, determined by measuring from end to end of the devices along the line and grade of each run.

(b) Unit Basis - Temporary curb ramps will be measured on the unit basis.

(c) Area Basis - Temporary walks will be measured on the area basis, limited to the neat lines as shown or directed.

Payment

00228.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Pedestrian Channelizing Devices	Foot
(b)	Bicycle Channelizing Devices	Foot
(c)	Temporary Curb Ramp, _____	Each
(d)	Temporary Walks	Square Foot

In item (c), the type of temporary curb ramp will be inserted in the blank.

Payment for item (c) and (d) will be payment in full for furnishing, installing and maintaining each temporary curb ramp or temporary walks.

Payment will be payment in full for furnishing, installing, moving, operating, maintaining, inspecting, and removing the Materials and TCD, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified, except as covered in 00221.90(b).

No separate or additional payment will be made for:

- Removing temporary curb ramps and temporary walks
- Restoring the area on which the temporary curb ramps or temporary walks occupied
- Materials
- Surfacing
- Other temporary curb ramp or temporary walk hardware

TCD items included under this Section damaged by Public Traffic and replaced by the Contractor will be paid for at the Contract price for the Pay Items listed in the Contract Schedule of Items or in approved Contract Change Orders, unless otherwise specified. Payment for replacing damaged TCD will only be made when:

- The Engineer orders it.
- The replacement devices are used on the Project.
- The damaged devices are disposed of to the Engineer's satisfaction.

00228.91 Payment, Lump Sum or Incidental Basis - When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment according to 00221.98 or 00221.99.

Section 00240 - Temporary Drainage Facilities

Description

00240.00 Scope - This Work consists of furnishing, installing, and removing temporary drainage facilities.

Construction

00240.40 Construction - Furnish and install temporary drainage facilities of sufficient capacity and strength to carry traffic over the facility, and water flow in or under the facility. Determine the actual size, strength and type of facility needed. The sizes of facilities shown on the Plans are minimum only. Submit this determination and its basis to the Engineer for review. Do not install until approved.

Remove temporary drainage facilities when they are no longer needed. The facilities remain the property of the Contractor.

Measurement

00240.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00240.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract lump sum amount for the item "Temporary Drainage Facilities".

Payment will be payment in full for furnishing, placing, maintaining, and removing temporary drainage facilities, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00253 - Temporary Work Access and Containment

Description

00253.00 Scope - This Work consists of designing, installing, maintaining, moving, and removing systems for:

- Temporary access to the work via work Bridges, platforms, scaffolding, and barges.
- Containment for all dust, debris and waste materials generated by the Work.
- Protection of work surfaces from weather.
- Heating and ventilating to maintain specified humidity, temperature, and air flow.

00253.01 General - Install all necessary work platforms and containment Structures before beginning Work in any area that requires them. Do not remove work platforms and containment Structures in an area until all Work in that area has been accepted by the Engineer.

Collect and dispose of accumulations of debris and waste before disassembling or moving a work platform or containment.

00253.02 Definitions:

Basic Wind Speed - Three-second gust speed at 33 feet above ground in open terrain with scattered obstructions not over 30 feet high.

Dead Load - Self-weight of a structure, such as a work platform, scaffolding, and containment.

Factor of Safety - Component ultimate failure load divided by the maximum working load combination applied to the component.

Fundamental Frequency - Lowest natural frequency of vibration for a structure, measured in Hz.

Live Load - The weight of personnel, equipment, materials, debris, and vehicles.

Point Load - A force applied to a structure at a single point.

Projected Area - The area of a structure exposed to the wind. For winds parallel to the roadway, the projected area of containment is the width of the containment multiplied by its height. For winds transverse to the roadway, projected area is the length of the containment multiplied by its height.

Span - A section of bridge superstructure between piers.

Wind Load - Forces imparted on a structure, such as a bridge or containment, by wind pressure and structural dynamic response to wind.

00253.03 Submittals - Submit all specified stamped drawings, specifications and design calculations for work platforms, scaffolding, work Bridges, barges, and containment, heating, and ventilating systems according to 00150.35 and at least 21 Calendar Days before the preconstruction conference.

Submit the following:

- Stamped design calculations assuring that the bridge structural members can safely resist the combined effects of dead loads, live loads, and wind loads

- Stamped Working Drawings clearly defining dimensional limits and loading limits that satisfy the conditions listed in 00253.09 for exemption from design calculations for the bridge structural members. Identify the work platform, scaffolding, and containment system dead load (in pounds per square foot) in the loading note, and identify the maximum allowable accumulations of collected debris or water (inches depth) allowed in conjunction with the number of workers allowed and the concentrated loads (in pounds) of equipment and materials to be used within the structure. Identify the maximum wind speed at which containment wall materials remains on the structure.
- Stamped work platform and scaffolding Working Drawings, specifications and design calculations
- Stamped heating and ventilating Working Drawings, specifications and design calculations. Include in the Working Drawings a view showing the size (length by width by height) and location of each containment to be used, and identifying the heating and air moving equipment (manufacturer, model, and capacity in cubic feet per minute), for each containment.
- Stamped barge plans detailing equipment layout, spuds, anchorages and equipment anchorages, and calculations including barge load capacity, balance and stability, strength of spuds and anchorages, and strength of equipment anchorage
- Specifications describing how barges are kept within safe load and balance/stability limits, and how the outfitting, operation, and maintenance of the barges comply with the operational, safety and environmental requirements according to 00290.30
- Stamped Working Drawings and calculations of the work bridges or trestles

00253.04 Design Services - Provide structural design services by a Civil or Structural Engineer licensed in the State of Oregon.

Provide heating and ventilating design services by a Mechanical Engineer licensed in the State of Oregon.

If barges will be used, provide marine design services by an engineer licensed in the State of Oregon to practice in the field of Naval Architecture and Marine Engineering or other Professional Engineer licensed in the State of Oregon with relevant naval architecture experience as accepted by the Engineer.

00253.05 Containment Requirements - Contain work debris that is generated from dry abrasive blasting and arc spray metallizing operations according to the Class 1A requirements of SSPC-Guide 6, with the following limits:

- Type A1 rigid containment material with Type C1 rigid support structure in locations adjacent to traffic.
- Type A1 rigid containment floor decking.
- Type A2 flexible containment materials are acceptable if rigid containment materials are not specified. Provide flexible containment materials that are air impenetrable and have tear strength of at least 200 pounds per foot and tensile strength of at least 300 pounds per foot.
- Type H1 instrument verification of air pressure in rigid containment, provide negative pressure at least 0.03 inch water column.
- Type H2 visual verification of air pressure in flexible containment.
- Type I1 minimum specified air movement 100 feet per minute cross draft or 80 feet per minute downdraft past work surfaces. Use portable fans as needed to provide air movement in stagnant areas.

- Type J1 exhaust air filtration with 99 percent cleaning efficiency for particulate diameters above 39 microinches and less than two grains of particulate per 1,000 cubic feet of exhaust air (or air recycled to the work area).
- Provide a muffler or pressure relief valve for air handling/cleaning system.
- Operate dust collection, air flow, and air movement Equipment during blowdown and vacuuming to prevent settling of dust on the Structure or within the containment Structure.

Contain work debris that is generated from water jet operations according to the Class 2W requirements of SSPC-Guide 6, with the following limits:

- Type A1 rigid containment material with Type C1 rigid support structure in locations adjacent to traffic.
- Type A1 rigid containment floor decking.
- Type A2 flexible containment materials are acceptable if rigid containment materials are not specified. Provide flexible containment materials that are water impenetrable and have tear strength of at least 200 pounds per foot and tensile strength of at least 300 pounds per foot.
- Ceiling not required.
- Provide adequate wall height to effectively prevent loss of contaminated water.

Contain work debris that is generated from hand tool or power tool operations according to the Class 1P requirements of SSPC-Guide 6. For hand tool cleaning or vacuum shrouded power tool cleaning, ground covers or free-hanging tarpaulins are an acceptable alternate means of containment provided the debris is captured and controlled to the same degree as Class 1P.

Immediately address any visible emissions from containment systems.

When field painting over a body of water with brushes, rollers, or daubers, contain paint drips with rigid containment floor decking or free-hanging tarpaulins, provided that the tarpaulins capture and control paint drips to the same degree as the Class 1P containment requirements of SSPC-Guide 6.

When field painting over a body of water with air spray (conventional) or airless spray, contain painting operations according to Class 1A requirements of SSPC-Guide 6.

Comply with the requirements of 00290.30.

00253.06 Barge Requirements - Provide barges meeting the following requirements:

(a) Operational Requirements:

- Provide evidence that barges have been inspected and cleaned according to Section 00290 and are in acceptable condition at the time of use on the Project.
- Anchor the barges using a minimum of two spuds or a four-point anchorage system. Provide spuds or anchorages with adequate strength to resist expected tidal and weather conditions. Provide anchorages able to adjust to the highest and lowest tidal or river elevations without imparting vertical force either upward or downward to the barges.
- Do not allow the barges to ground at any time.
- Operate the barges according to applicable maritime regulations, including removal of the barges to dock in a safe location if required to avoid extreme weather hazards.
- Have a working bilge pump and backup bilge pump on each barge at all times.
- Anchor all equipment to barge decks.
- Adjust ballast to maintain proper balance of loaded barges.

- Do not load barges beyond their safe load capacity.
- Secure hatches in the closed position except during inspections or transfer of ballast.
- Comply with all applicable U.S. Coast Guard (USCG) regulations, including, but not limited to, mariner lighting standards. Contact USCG at (206) 220-7285 for applicable regulations.

(b) Safety Requirements:

- Have a motorized boat available at all times.
- Provide a USCG approved personal flotation device for each person on board a barge.
- Provide USCG approved ring life buoys on each barge.
- Provide USCG approved “B” type fire extinguishers on each barge.
- Equip all gasoline engines with an acceptable means of backfire flame control.
- Provide adequate ventilation for fuel tanks and engine compartments for all gasoline, CNG, propane, or butane powered Equipment, adequate to remove hazardous gases from the fuel tank compartment and engine compartment.
- Use bonded fuel hoses during refueling to minimize the risk of sparking due to static electricity.

00253.07 Work Bridge Structural Design Requirements - Design work Bridges according to AASHTO *Guide Design Specifications for Bridge Temporary Works*. Provide materials for temporary work Bridges meeting the requirements of the applicable Sections of Part 00500. Comply with all requirements of applicable permitting agencies according to Section 00290.

00253.08 Work Platform and Scaffold Design Requirements:

(a) Contractor-Designed - For Contractor-designed work platforms and scaffolding, provide stamped Working Drawings and stamped calculations of the work platforms or scaffolding according to 00150.35.

Include the following information:

- All general notes for the design and construction of the platform or scaffolding
- Material list including Incidental items.
- Show layout of work access in relation to the existing Structure, drainage system and utilities.
- Detail the anchoring system that will be used to connect the temporary platform or scaffolding to the existing Structure.
- Show all structure and geometric details including, but not limited to:
  - Loading conditions.
  - Connecting devices.
  - Construction around utilities, drainage, footings, bents, or other Structures.

(b) Pre-Engineered - Pre-engineered assemblies may be utilized for all or for portions of work platforms or scaffolding. Submit manufacturer's literature indicating safe working loads. Working Drawings and calculations for pre-engineered assemblies are not required.

Materials

00253.10 Material Requirements - Provide work platforms and containment systems constructed of durable materials capable of meeting all performance requirements throughout the Project.

Previously used materials and components will not be allowed if they are bent, buckled, perforated, cut, corroded with section loss, ripped, or torn; or their usability is otherwise compromised.

Construction

00253.40 General - Install work Bridges, work platforms or scaffolding, and containment Structures so they contain all rubble and debris. Do not allow rubble or debris to fall into waterways.

Install work Bridges, work platforms or scaffolding, and containment Structures so they satisfy all the requirements of applicable permitting agencies.

00253.41 Traffic Clearance - Maintain all traffic clearances shown. Do not allow the containment system or cables, hoses, supplies, and Equipment to encroach on the indicated traffic clearances at any time. Provide a minimum of 7 feet of vertical clearance above pedestrian walkways.

00253.42 Safety Requirements - Comply with all applicable requirements of OSHA.

Follow approved procedures for evacuating and securing work platforms and containment systems if wind speeds or predicted wind speeds exceed design limits. For concrete removal and repair work, comply with all applicable requirements of OSHA Standard Number 1926.1153, Respirable Crystalline Silica, including Table 1.

Vent exhaust gases to the exterior of containment systems. Draw air for combustion from outside the containment system. Take makeup air for the containment system from a location that ensures combustion gases are not returned inside the enclosure.

Remove accumulations of debris and drift from work bridge piles and bridge piers.

00253.45 Navigation Lighting - Place flashing lights under the containment system on all four corners of each installation according to Federal regulations, marking the reduced navigational clearance. Maintain all navigation lights in operational condition at all times during the project and temporarily relocate them, if necessary, in order for them to remain visible to marine traffic.

Mark each work platform with flashing yellow lights along the outside edge at 100 foot intervals. Mark each work platform from the outer end near the navigation channel to the first set of pilings near the bank. Flashing yellow lights shall be visible to boat traffic from either side of the platform. Flashing yellow lights may be equivalent to flashing yellow lights on construction barricades.

Temporary

00253.50 Electrical Service - Install and remove any temporary electrical service needed to perform the Work of this Section using electricians meeting the requirements of 00960.30.

00253.51 Deck and Expansion Joint Sealing - In the event of water leakage through the deck or expansion joints, install temporary deck or expansion joint seals to prevent water intrusion into containment, using approved materials from the QPL.

Maintenance

00253.60 Work Bridges, Work Platforms, Barges, and Containment - Maintain work Bridges, work platforms, barges, and containment in a safe and functional condition.

Where a work Bridge or work platform is adjacent to Public Traffic, including pedestrian traffic, provide and place suitable approved barriers to prevent public access.

Finishing and Cleaning Up

00253.70 Work Bridge Removal - When temporary work Bridges are no longer needed, remove them according to Section 00310.

Satisfy all requirements of applicable permitting agencies during work Bridge or trestle removal.

Restore all areas occupied by the work Bridges or trestles to original condition.

00253.71 Work Platform and Containment Structure Removal - When attachments for work platforms and containment Structures are removed from the Bridge, restore points of attachment to original condition and perform touch up of Project Work so that the points of attachment match the surrounding surfaces.

Measurement

00253.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00253.90 Payment - The accepted quantities of work access and containment, including temporary work Bridges, barges, work platforms, scaffolding, containment Structures, and heating and ventilation will be paid for at the Contract Lump Sum amount for the item “Temporary Work Access and Containment”.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for designing, installing, maintaining, and removing work access and containment, including temporary work Bridges, barges, work platforms, scaffolding, containment Structures, heating and ventilation, or restoring the existing Structure.

No payment will be made for Materials on hand.

Payment for Work under this Section will be limited to 90 percent of the lump sum amount until satisfactory removal of the temporary work access and containment Materials and Equipment is complete.

Section 00270 - Temporary Fences

Description

00270.00 Scope - This Work consists of constructing, maintaining, and removing temporary fences, gates, and gateways as shown or directed.

Materials

00270.10 Material - Provide new Material meeting the requirements of 01050.10.

Provide temporary barrier meeting the requirements of 00226.11(a).

Construction

00270.40 Construction - Construct temporary fences, gates, and gateways according to the applicable parts of Section 01050.

00270.42 Rock Protection Fence - Construct concrete barrier according to Section 00820. Attach fence to barrier as shown.

Maintenance

00270.60 Maintenance - Maintain temporary fences and appurtenances in good condition. Keep the fences in place until they are no longer needed.

Finishing and Cleaning Up

00270.70 General - When temporary fences and appurtenances are no longer needed remove and dispose of them according to the applicable parts of Section 00310 except fence fabric, fence wire, posts, and braces may be used in permanent fence installations if the following conditions are met:

- The material was new when installed for temporary purposes.
- The material has not been used on previous projects.
- The material meets the requirements of 01050.10.
- The material is undamaged.
- The material is acceptable to the Engineer.

Measurement

00270.80 Measurement - The quantities of temporary fence will be measured on the length basis of each type of temporary fence. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates.

The quantities of temporary gates will be measured on a unit basis regardless of size or type.

The quantities of temporary rock protection fence, barrier mounted will be measured on the length basis. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run.

Payment

00270.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Temporary Type ____ Fence	Foot
(b) Temporary Gates	Each
(c) Temporary Rock Protection Fence, Barrier Mounted	Foot

In item (a) the type of fence will be inserted in the blank.

Payment will be payment in full for furnishing, placing, maintaining, and removing all Materials, including the temporary barrier, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00280 - Erosion and Sediment Control

Description

00280.00 Scope - This Work consists of controlling Soil erosion by wind, water, or other means and preventing eroded sediments and other construction-generated pollutants from moving off the Project Site, Agency controlled material sources, disposal sites, and off-site mitigation areas in order to comply with federal, State, and local laws, rules and regulations, and the Agency's National Pollutant Discharge Elimination System (NPDES) 1200 Permit or Permits applicable to the Project.

This Work also consists of providing temporary erosion and sediment control (ESC) measures and furnishing, installing, moving, operating, maintaining, inspecting, and removing ESC throughout the Project area according to the Standard Drawings, the erosion and sediment control plan (ESCP) for the Project, the Specifications, or as directed, until the site is permanently stabilized.

The Work described in the Specifications and shown on the Plans is part of the Project ESCP and represent the minimum requirements for all Project Sites and conditions.

00280.01 Abbreviations:

ESC - Erosion and Sediment Controls

ESCP - Erosion and Sediment Control Plan

ESCM - Erosion and Sediment Control Manager

00280.02 Definitions:

Effective Functioning - Preventing erosion, controlling runoff, or controlling sediment in each location where an ESC is needed so erosion-related impacts of site construction are mitigated as required.

Erosion - The wearing away of the land surface by water, wind, ice, gravity or other geological agents.

Perimeter Controls - Perimeter controls include sediment fences, ditches, filter berms in flatter areas, and other methods for preventing sediment and other construction-generated pollutants from leaving the construction site.

Permanent Stabilization - Maintenance-free measures or methods necessary to prevent erosion or sediments from leaving the Project Site.

Runoff - That portion of precipitation that flows from drainage area on the land surface, in open channels or in stormwater conveyance systems.

Sediment - Fragmented material originated from weathering and erosion of Rock and unconsolidated deposits. Sediment also includes fragmented materials from man-made materials. The material is transported by, suspended in, or deposited by water.

Temporary Stabilization - Measures or methods necessary to prevent erosion or sediments from leaving the Project Site until permanent stabilization measures are in place and established.

Wet Season Work - Wet season Work is defined as Work between October 1 and May 31.

00280.03 Standards - When designing, applying, installing maintaining, inspecting, and removing erosion and sediment control devices, use and follow the version in effect on the date the Project is advertised, of the ODOT *Erosion and Sediment Control manual*.

00280.04 Erosion and Sediment Control Plan on Agency Controlled Lands - For Work on Agency-Controlled Lands use either the Agency's ESCP, a Contractor modified version of the Agency's ESCP, or a Contractor developed ESCP. Submit the following for approval at least 10 Calendar Days before the preconstruction conference:

- When using the Agency's ESCP without modification, a written notification indicating the Agency's ESCP will be used without modification.
- When using a Contractor modified version of the Agency's ESCP or when using a Contractor developed ESCP, include the following:
  - Proposed ESCP showing all ESC Work and quantities of all Work.
  - Implementation schedules for the ESCP based on each phase of the Contractor's Work.

Do not begin any site activities that have potential to cause erosion or sediment movement until the ESCP and implementation schedules are approved by the Engineer.

Update the ESCP and schedule as needed to ensure that sediment does not leave the construction site.

Additional or revised erosion and sediment control features, not shown on the initial ESCP, may be required depending on the Contractor's methods of operation and schedule to provide effective functioning of ESC.

Ensure that the Contractor's construction ESCP and implementation schedules are prepared by an individual who meets qualifications of 00280.30. Furnish a signed copy of the ESCP with individual's name, title, state certifications, and employing firm if different than Contractor's firm.

Keep a copy of the approved ESCP with updated changes on-site during all construction activities. If there are approved changes, add them to the ESCP no later than 24 hours after implementation.

During inactive periods longer than 7 Calendar Days, keep the ESCP on-site or provide a copy to the Engineer to retain.

00280.05 Erosion and Sediment Control Plan on Non-Agency Controlled Lands - For Work on non-Agency controlled lands, in addition to the requirements of 00280.04, submit the following for review 10 days before the preconstruction conference:

- A Contractor-developed ESCP for each unique site covered under a Non-Agency NPDES 1200 Permit.
- A description of how the ESCP will be implemented and monitored on these sites.
- A complete list of other applicable permits controlling Work on these lands, whether the Agency is one of the permittees or not, and copies of the applicable permits or proof that permits are not required from all pertinent federal, State, county, city, and local agencies.
- Signed letter from the property owner that allows the Contractor access to the property. Include a statement in the letter that holds the Agency harmless for all consequences related to the Contractor's use of the property.
- Signed agreement with the property owner detailing the Contractor's operation, use of the property, and stating that Contractor will abide by permits, if any.

If the Contractor's operations require Work on non-Agency controlled lands not presented 10 days before the preconstruction conference, or if changes to the Contractor's submitted ESCP are necessary, obtain approval of a new or revised ESCP from the Engineer before beginning Work.

00280.06 Erosion and Sediment Control Manager - Designate and provide a representative as the Erosion and Sediment Control Manager (ESCM) who meets the qualifications of 00280.30.

Materials

00280.14 Erosion Prevention Materials:

(a) Plastic Sheeting - Furnish plastic sheeting slope protection, anchoring system, and toe protection meeting the following requirements:

- **Plastic Sheeting** - Minimum 6-mil thick polyethylene plastic sheeting.
- **Rock** - Class 50 riprap conforming to Section 00390.
- **Sand Bags** - Sand bags meeting the requirements of 00280.15(a). Sand bags may also be filled with sand.
- **Sediment Barrier** - Fiber rolls and compost filter sock meeting the requirements of 00280.15(a).
- **Staples** - 1/8 inch diameter steel wire staples. 2 inch "U" width with a length of 6 inches minimum.

(b) Chemical Controls:

(1) Chemical Soil Binder - Furnish a liquid stabilizer emulsion meeting the requirements of 01030.16.

(2) Chemical Dust Control - Furnish tackifier meeting the requirements of 01030.16.

(c) Non-Chemical Control - Furnish water meeting the requirements of Section 00340.

(d) Mulching and Seeding - Furnish temporary and permanent seeding, fertilizing, and mulching meeting the requirements of Section 01030.

(e) Slope and Channel Liner Matting - Furnish matting from the QPL that meets the following performance criteria categories:

- **Type A** - Slope protection mat, fully biodegradable, for Clay Soil Slopes 1V:3H or flatter.
- **Type B** - Slope protection mat, fully biodegradable, for sandy Soil Slopes 1V:3H or flatter.
- **Type C** - Slope protection mat, fully biodegradable, for Clay Soil Slopes steeper than 1V:3H.
- **Type D** - Slope protection mat, fully biodegradable, for sandy Soil Slopes steeper than 1V:3H.
- **Type E** - Flexible channel liner, fully biodegradable, for shear stress from 0 to 2 pounds per square foot.
- **Type F** - Flexible channel liner for shear stress from 2 to 4 pounds per square foot.
- **Type G** - Flexible channel liner for shear stress from 4 to 6 pounds per square foot.
- **Type H** - Flexible channel liner for shear stress from 6 to 8 pounds per square foot.

Where shown, furnish rolled slope protection matting or hydraulically applied bonded fiber matrix slope protection matting that consists of fully biodegradable long fiber strands held together by a water resistant bonding agent. Channel liner mattings, types F, G and H may be installed as permanent features and are not required to be fully biodegradable.

Furnish check slot and anchor trench material and fasteners for matting meeting the following requirements:

(1) Check Slot and Anchor Trench:

- **Class 50 Riprap** - Class 50 riprap meeting the requirements of Section 00390.

- **Soil** - Soil meeting the requirements of 00330.13.

(2) Fasteners - U-shaped wire staples or pins as follows:

- **Staples** - 1/8-inch diameter steel wire staples. 1-inch "U" width with a length of 9 inches minimum for cohesive Soils, and 1/2-inch "U" width with a length of 12 inches minimum for non-cohesive Soils.

- **Pins** - 3/16-inch diameter steel pin with a 2-inch diameter steel washer secured at the head of the pin with a length of 18 inches minimum for cohesive Soils and 24 inches minimum for non-cohesive Soils.

(f) Compost Erosion Blanket - Furnish commercially manufactured medium compost material meeting the requirements of Section 03020. Add tackifier meeting the requirements of 01030.16.

Apply tackifier at the rates shown or as recommended by the manufacturer.

(g) Straw Bales - Furnish rectangular straw bales weighing between 80 and 100 pounds, meeting the requirements of 01030.15(b).

00280.15 Runoff Control Materials:

(a) Check Dams - Furnish check dam materials meeting the following requirements:

- **Type 1: Aggregate** - Aggregate sized between 4 inches maximum and 1 inch minimum meeting the requirements of 00330.16.

- **Type 2: Fiber Rolls** - Fiber rolls or wattles that are pre-manufactured, filled with plant based, naturally occurring fiber (e.g.: straw, wood, excelsior, hemp or coconut fiber) that contains no weed seeds and that is not moldy, caked, decayed or of otherwise low quality. When straw is used, furnish straw meeting the requirements of 01030.15(b). Furnish fiber roll that is fully biodegradable with enclosing netting derived from natural fibers (e.g.: jute, sisal, hemp or coir fiber). Furnish rolls with a minimum density of 2.75 pounds per cubic foot and constructed to hold its shape to provide a diameter of between 8 and 10 inches.

- **Type 3: Biofilter Bags** - Minimum size 18 by 6 by 30-inch plastic mesh bags with 1/2-inch openings filled with approximately 45 pounds of clean, non-toxic 100 percent recycled wood product waste containing no fine materials or sediments, or as shown on the Standard Drawings for this device.

- **Type 4: Sand Bags** - Durable, weather-resistant bags woven tightly enough to prevent leakage of filler material. Fill bags with at least 75 pounds of firmly-packed fine PCC 3/8" - 0 Aggregate, or round 3/8" - 3/16" pea gravel.

- **Type 5: Prefabricated System** - Prefabricated check dam system conforming to the manufacturer's recommendations and on the QPL. Field fabricated systems are not acceptable.

- **Type 6: Compost Filter Sock** - Filter sock material, compost, and stakes meeting the requirements of 00280.15(f).

(b) Interceptor Dikes and Swales - Furnish interceptor dike and swale materials meeting the following requirements:

- **Seeding, Fertilizing and Mulching** - Permanent or temporary seeding, fertilizing and mulching meeting the requirements of Section 01030.

- **Dike Material** - Soil meeting the requirements of 00330.13.

(c) Temporary Drainage Curbs - Furnish temporary drainage curb material meeting the following requirements:

- **Type 1** - Concrete drainage curb meeting the requirements of 00480.10.

- **Type 2** - Asphalt concrete drainage curb meeting the requirements of 00480.10.

- **Type 3** - Sand bags meeting the requirements of 00280.15(a).

(d) Temporary Slope Drains - Furnish either plastic pipe and flared end sections meeting the requirements of Section 02410 or metal pipe and flared end sections meeting the requirements of Section 02420.

(e) Flow Spreader - Furnish Aggregate for flow spreaders with a maximum size between 1 inch and 4 inches meeting the requirements of 00330.16.

(f) Compost Filter Sock - Furnish filter sock material, compost, and stakes meeting the following requirements:

(1) Filter Sock Material - 5-mil thick woven tubular mesh netting with 1/8 to 3/8-inch openings, and consisting of continuous HDPE filament or polypropylene material or 100 percent biodegradable mesh netting from the QPL.

(2) Compost - Commercially manufactured coarse compost material meeting the requirements of Section 03020.

(3) Stakes - 2 by 2 inch (nominal) untreated wood stakes.

(g) Compost Filter Berm - Furnish commercially manufactured coarse compost material meeting the requirements of Section 03020.

00280.16 Sediment Control Materials:

(a) Construction Entrances - Furnish materials meeting the following requirements:

- **Aggregate** - Clean, durable, open-graded angular Aggregate sized according to the following grading requirements:

Sieve Size	Percent Passing (by weight)
6”	100
4”	60 - 90
3”	40 - 70
2”	20 - 50
1”	0 - 20
#4	0 - 2

- **Geotextile** - Subgrade geotextile meeting the requirements of Section 02320. Provide documentation according to 02320.10(c).

(b) Tire Wash Facility - Furnish tire wash facility materials meeting the following requirements:

- **Aggregate** - Aggregate meeting the requirements of 00280.16(a).

- **Geotextile** - Subgrade geotextile meeting the requirements of Section 02320. Provide documentation according to 02320.10(c).

- **Corrugated Steel Panels** - Corrugated steel panels with flexural strength adequate to bear the weight of the vehicles accessing the construction site without deformation.

(c) Sediment Fence - Furnish sediment fence materials meeting the following requirements:

- **Geotextile** - Geotextile meeting requirements of Section 02320. Provide documentation according to 02320.10(c).

- **Posts** - Untreated wood posts (wood stain is acceptable).

(d) Inlet Protection - Furnish inlet protection materials meeting the following requirements:

- **Type 2:**

  - **Wire Mesh** - 19-gauge steel-wire mesh with 3/8 by 3/8-inch openings.

  - **Geotextile** - Type 1 geotextile meeting the requirements of Section 02320. Provide documentation according to 02320.10(c).

  - **Aggregate** - Open-graded Aggregate meeting the requirements of 02630.11.

- **Type 3: Prefabricated Filter Inserts** - Prefabricated filter inserts manufactured specifically for collecting sediment in drainage inlets and from the QPL. Include handles and fasteners sufficient to keep the insert from falling into the inlet during maintenance and removal of the insert from the inlet.

- **Type 4:**

  - **Biofilter Bags** - Biofilter bags meeting the requirements of 00280.15(a).

  - **Reinforcing Steel** - Commercial grade reinforcing steel meeting the requirements of 02510.

- **Type 6: Sod** - Grass sod meeting the requirements of 01040.19(h).
- **Type 7:**
  - Filter sock material, compost, and stakes meeting the requirements of 00280.15(f).
  - Sand bags conforming to 00280.15(a).
- **Type 10: Curb Inlet Sediment Dam** - Provide one (or more) of the following curb inlet sediment barrier from products, or as approved:
  - Ertec - Curb Inlet Protection
  - ACF - Econo Curb
  - GEI Works - Taurus Curb Inlet Filter
  - GEI Works - Ultra-Curb Inlet Guard
  - Ultratech - Ultra-Curb Guard Plus

(e) Sediment Barriers - Furnish sediment barriers and sediment barrier stakes meeting the following requirements:

- **Type 2: Biofilter Bags** - Biofilter bags meeting the requirements of 00280.15(a).
- **Type 3: Fiber Rolls** - Fiber rolls or wattles meeting the requirements of 00280.15(a).
- **Type 4: Sand Bags** - Sand bags meeting the requirements of 00280.15(a).
- **Type 5: Brush Barrier** - Maximum 6-inch diameter woody debris brush or Topsoil strippings for brush barriers. Provide Type 1 sediment fence geotextile meeting the requirements of Section 02320. Provide documentation according to 02320.10(c).
- **Type 6: Aggregate Barrier** – Clean, well-graded, angular Aggregate with maximum size between 4 inches and 1 inch, meeting the requirements of 00330.16, except no more than 5 percent of the material (by weight) shall pass the No. 40 sieve.
- **Type 7: Prefabricated Barrier System** - Prefabricated barriers manufactured specifically for temporarily obstructing the flow of sediment-laden water and from the QPL.
- **Type 8: Compost Filter Sock** - Filter sock material, compost, and stakes meeting the requirements of 00280.15(f):
- **Type 9: Compost Filter Berm** - Commercially manufactured coarse compost material meeting the requirements of Section 03020.

(f) Sediment Mat - Furnish sediment mat from the QPL.

(g) Temporary Energy Dissipater - Furnish temporary energy dissipater materials meeting the following requirements:

- **Geotextile** - Type 1 riprap geotextile meeting the requirements of Section 02320. Provide documentation according to 02320.10(c).
- **Class 100 Riprap** - Class 100 riprap meeting the requirements of Section 00390.

(h) Temporary Sediment Trap - Furnish sediment trap materials meeting the following requirements:

- **Geotextile** - Type 2 drainage geotextile meeting the requirements of Section 02320. Provide documentation according to 02320.10(c).
- **Aggregate Base** - Aggregate Base meeting the requirements of Section 00640.
- **Aggregate** - Aggregate meeting the requirements of 00280.16(a).

(i) Concrete Washout - Furnish concrete washout materials meeting the following requirements:

- **Straw Bales** - Standard rectangular straw bales, with straw material meeting the requirements of 01030.15, except no certification is required.
- **Plastic Sheeting** - Minimum 10-mil thick polyethylene plastic sheeting.
- **Staples** - 1/8-inch diameter steel wire staples. 2-inch "U" width with a length of 6 inches minimum.

(j) Floating Turbidity Barrier - Furnish floating turbidity barriers shown and as directed.

(k) Flocculant - Furnish chitosan flocculant material in gel or powdered form packaged in a pervious sleeve.

Labor

00280.30 Erosion and Sediment Control Manager - If the Agency's NPDES 1200-CA Permit is applicable to the Project, designate and provide an ESCM who possesses a valid ODOT ESCM certificate or who has successfully completed an erosion control training that is acceptable to the Engineer.

The ESCM duties include:

- Manage and ensure proper implementation of the ESCP.
- Accompany the Engineer during field review of the ESCP prior to construction activities.
- Monitor rainfall on and in the vicinity of the Project Site.
- Monitor water quality in receiving streams in the vicinity of the Project Site.
- Inspect ESC on active construction sites weekly for effective functioning.
- Inspect ESC on inactive sites every 2 weeks for effective functioning.
- Inspect ESC on all active and inactive sites at least daily during rainy periods when 1/2 inch or more of rain has fallen within a 24-hour period for effective functioning.
- Ensure that ESC are regularly cleaned and maintained.
- Mobilize crews to make immediate repairs to ESC or install additional ESC during working and non-working hours when ESC is not effectively functioning.
- Record actions taken to clean up significant amounts of sediment.
- Report potential permit violations to the Agency in a timely manner.
- Regularly update the approved ESC Monitoring form.
- Update the ESCP monthly and within 24 hours after changes or major ESC modifications are implemented.

- Prepare a contingency plan in preparation for emergencies and the rainy season.
- Accompany the Engineer on inspections and, if required, on inspections by representatives of regulating agencies.

Provide the ESCM name, qualifying certifications, and 24-hour contact phone number 10 days before the preconstruction conference. If changes in the appointment of the ESCM occur during the term of the Contract, provide written notice to the Engineer within 5 Calendar Days.

If the Agency's NPDES 1200 CA-Permit is not applicable to the Project, comply with all requirements of the applicable permits.

Construction

00280.40 Installation - Install ESC as shown and according to the ESCP. Install these ESC before performing clearing, grading, or other land-altering activities. Ensure effective functioning of ESC such that sediment does not leave the Project boundaries, enter drainage systems or waterways, or violate applicable water quality standards.

Coordinate temporary ESC with permanent ESC and all related Project Work.

If ESC are not effective, modify or change ESC so they become effective.

00280.41 Work Restrictions - The following Work restrictions apply:

(a) Disturbance Limits - Delineate all construction site clearing limits with high visibility markings and do not disturb areas outside the clearing limits. Maintain the markings during Project construction.

(b) Perimeter Controls - Install all appropriate perimeter controls before beginning any ground-disturbing activities.

(c) Wet Season Work and Temporary Work Suspension - Update the ESCP and schedule for Work proposed during the wet season to ensure that all appropriate controls, including ESC during Work suspensions, are implemented and maintained. Submit the updated ESCP and schedule to the Agency and receive approval before beginning any Work during the wet season.

During the wet season, limit excavation and bare ground activities to only those required for immediate operations. Stabilize stockpiles at the end of each workday by diverting flows, placing covers, or installing sediment barriers.

(d) Disturbance Restrictions - Limit the amount of disturbed areas to that which can be effectively controlled.

00280.42 Stabilization - Stabilize Soil areas as follows:

(a) Soil Exposure Limitations:

- **Statewide (Entire Year)** - Within 7 days of exposure, stabilize all areas within 100 feet of waterways, Wetlands, or other sensitive areas using methods that do not rely solely upon germination to control erosion.

- **West of the Cascades (Entire Year)** - Stabilize all other areas within 14 days of exposure.

- **East of the Cascades (October 1 through April 30)** - Stabilize all other areas within 14 days of exposure.

- **East of the Cascades (May 1 through September 30)** - Stabilize construction areas in stages based on site conditions, weather, and as determined by the Engineer.

(b) Temporary Stabilization - Temporarily stabilize exposed Soils:

- Every 14 days or more frequently as needed or directed.
- Upon approval, active work areas scheduled for re-disturbance may be left unstabilized for 14-Day periods if erosion is not occurring or imminent.
- A minimum of 1 Day before expected rain events.
- At the end of each Day during wet periods.
- As an emergency measure when rain is falling on unprotected areas.
- When wind or vehicle traffic is visibly causing more than minor dust.
- At finish grade when working outside the permanent seeding dates.

Document all implemented ESC on the ESCP. Ensure that permanent slope stabilization is achieved before removing temporary ESC.

(c) Permanent Stabilization - Permanently stabilize exposed Soil surfaces at finished grade. Perform permanent stabilization at each completed excavation and embankment area except for areas that are scheduled to be redisturbed.

If seeded areas are not sufficiently stabilized by an established stand of vegetation according to 01030.60, or if the Soil surface is not sufficiently protected with temporary stabilization ESC by October 1 of each year, do the following:

- Use ESC necessary to redirect water flows away from disturbed areas.
- Re-grade disturbed areas to finish grade.
- Apply permanent seeding at the original specified rate.
- Apply temporary mulching or matting.

If areas for temporary stabilization are too steep or lack access for effective straw mulch application, apply, upon approval, another effective measure.

Incorporate permanent erosion control features into the Project at the earliest practicable time.

00280.43 Area Preparation - Prepare areas according to 01040.48(d) and track-walk all fill slopes at finished grade steeper than 1V:3H and flatter than 1V:1.5H so that track impressions run parallel to slope contours. Maintain at least 1 3/8-inch tall track grousers.

00280.44 Erosion Prevention - Perform erosion prevention Work as shown and according to the following:

(a) Plastic Sheeting - Place plastic sheeting on disturbed, temporary slopes or stockpiles where immediate protection is required and mulching or other methods of Soil stabilization are not feasible.

Cover exposed Soil with plastic sheeting as shown. Keep sheeting in place during rain events. Direct runoff away from areas above plastic sheeting to prevent undermining. Control runoff from plastic sheeting so water discharges without causing further pollution.

(b) Erosion and Sediment Control by Chemical Methods:

(1) Chemical Soil Binder - Hydraulically apply a liquid stabilization emulsion at the following rates unless the manufacturer recommends a different rate of application:

- **Long-Term Control of Exposed Soil Surfaces** - Apply 35 gallons per acre of emulsion. Dilute with water at the rate of one part emulsion to 20 parts water.

- **Steep Slopes with Raveling Small Rock** - Apply 45 gallons per acre of emulsion. Dilute with water at the rate of one part emulsion to 10 parts water.

(2) Chemical Dust Control - Apply tackifier for dust control for wind or equipment-caused erosion according to the following:

- **Liquid Stabilizer Emulsions** - Dilute the emulsion with water at a rate of one part emulsion to 30 parts water. Apply the diluted mixture at the rate of 865 gallons per acre unless the manufacturer recommends a different rate of application.

- **Dry Powder Tackifier** - Apply at a rate of 140 pounds per acre unless the manufacturer recommends a greater rate of application.

(c) Erosion and Sediment Control by Non-Chemical Methods - Apply water according to Section 00340.

(d) Temporary and Permanent Mulching and Seeding:

- **Mulching** - Evenly apply dry mulch and tackifier materials according to Section 01030. In areas not accessible to heavy equipment, mulch by hand or by other approved methods. Areas not prepared according to 01040.48(d) will require a greater rate of application to obtain complete coverage, which shall be at no additional cost to the Agency.

- **Seeding** - Seed according to Section 01030.

(e) Slope and Channel Liner Matting - Install matting according to the ESCP or the manufacturer's recommendations, whichever is more stringent. Install fully biodegradable matting within 25 feet of water resources.

(1) Area Preparation - Remove all materials larger than 2 inches in size. Smooth the surface and remove undulations sufficiently to allow the matting to be placed in complete contact with the Soil.

(2) Seeding - Apply seeding according to the following:

a. Seed before Matting Installation - Apply at the application rate for seed specified in Section 01030.

b. Seeding after Matting Installation - Apply at double the application rate for seed specified in Section 01030.

c. Single Application: Matting and Seed:

- **Hydraulically Applied Matting** - Apply seed at double the rate specified in Section 01030.

- **Manually Applied (Pre-seeded) Rolled Matting** - Pre-seed the matting at double the rate specified, with the seed mix specified in Section 01030.

(3) Matting Placement - Apply matting loosely so it is in complete contact with the Soil.

(4) Bonded Fiber Matrix Matting Placement - Follow the manufacturer's recommended practices to hydraulically apply bonded fiber matrix at the rates shown on the ESCP or as recommended by the manufacturer, whichever is more stringent.

(f) Compost Erosion Blanket - Blend tackifier with compost according to the manufacturer's recommendations. Apply compost and tackifier with Equipment that propels the material directly at the Soil surface and achieves direct contact with the Soil. Apply compost at a uniform depth of 2 inches to all exposed Soil surfaces.

(g) Straw Bales - Break straw bales apart and spread as mulch to a thickness of 2 inches. Tack in place according to 01030.48(b)(3).

Do not use straw bales for any other application unless approved.

00280.45 Runoff Controls - Install runoff controls according to the following:

(a) Check Dams - Construct check dams as shown or directed.

(b) Interceptor Dikes and Swales - Construct interceptor dikes and swales as shown or directed. After construction of interceptor dikes and swales, construct temporary stabilization according to 00280.42(b).

(c) Temporary Drainage Curbs - Construct temporary drainage curbs as shown or directed.

(d) Temporary Slope Drains - Construct temporary slope drains as shown or directed.

(e) Flow Spreader - Construct flow spreaders as shown or directed.

(f) Compost Filter Socks - Construct compost filter socks as shown or directed.

(g) Compost Filter Berm - Construct compost filter berms as shown or directed.

00280.46 Sediment Controls - Install sediment controls as shown and according to the following:

(a) Construction Entrances - Install construction entrances at every point of access onto paved surfaces.

(b) Tire Wash Facility - Construct tire wash facility as shown or directed.

(c) Sediment Fence - Construct sediment fence as shown or directed.

(d) Inlet Protection - Construct inlet protection as shown or directed. Install inlet protection, Type 10 - curb inlet sediment dam according to manufacturer's recommendations.

(e) Sediment Barriers - Construct sediment barriers as shown or directed.

(f) Sediment Mat - Construct sediment matting as shown or directed. Remove the mats not later than 48 hours after stream activities are complete.

(g) Temporary Energy Dissipater - Construct temporary energy dissipaters as shown or directed.

(h) Temporary Sediment Trap - Construct temporary sediment traps as shown or directed.

(i) Concrete Washout - Construct concrete washouts as shown or directed.

00280.47 Work Quality - Comply with 01030.49.

00280.48 Emergency Materials - Provide, stockpile, and protect emergency materials on-site for unknown weather or erosion conditions. A list of emergency materials will be provided in the Special Provisions. Replenish emergency materials as they are used.

The emergency materials are in addition to the other erosion control materials required to implement and maintain the ESCP.

Remove all unused emergency materials from the Project site at the completion of the Project.

Maintenance

00280.60 General - Maintain installed ESC devices in good working order and effective functioning at all times. Keep the devices in place until the Agency issues notification of acceptance of stabilization. All maintenance and repairs are at no additional cost to the Agency.

00280.61 Ineffective Controls - If an ESC device does not meet effective functioning, repair, replace, or provide additional devices. Devices repaired, replaced, or added due to improper installation, insufficient maintenance, or damage from Contractor operations will be made at no additional cost to the Agency.

00280.62 Inspection and Monitoring - Ensure that regular site inspection and monitoring are performed according to the schedule and record keeping requirements of the NPDES permit.

(a) Inspection - Perform general site inspection, complete all applicable parts of the ODOT Erosion Control Monitoring Form, and submit the form to the Agency as follows:

- Weekly for active sites.
- Every 2 weeks for inactive sites.
- Within 24 hours after 1/2 inch or more rainfall occurs including weekends and holidays.
- When directed by the Engineer.

(b) Rainfall - Furnish and install a rain gauge at the Project site. Notify the Agency if 1/2 inch or more of rainfall occurs at the Project site within a 24 hour period.

(c) Monitoring Receiving Stream - Observe and record color and turbidity or clarity within 30 feet upstream and downstream of locations where surface waters from the construction site enter the receiving stream. Describe in the report any apparent differences in color and the clarity of the discharge, and any observable difference in comparison with the receiving stream. Note whether sheen and floating matter are present or absent.

If a permit noncompliance or serious water quality issues occur verbally report to the Engineer within 24 hours and submit a written report within 5 Calendar Days.

00280.63 Sediment Removal - Remove sediment and upgrade or repair the devices as needed as soon as practicable, but not later than 2 days after the surrounding exposed ground has dried sufficiently to prevent further damage from Equipment needed for repair operations.

If rainfall continues over a 24-hour period, or other circumstances that preclude Equipment operation in the area, hand-carry and install additional ESC devices.

(a) Catch Basins - Maintain inlet protection by removing trapped sediment when storage capacity has been reduced by 50 percent. Prevent release of sediments during maintenance or removal Work.

(b) Sediment Controls - Remove sediment from sediment fences, sediment barriers, check dams, and sediment traps once it has reached one third of the exposed height of the device or storage depth.

(c) Paved Areas - Keep all paved areas clean for the duration of the Project. Use cleaning methods that do not transport sediment-laden water to receiving streams. Adjust the frequency of cleaning to ensure compliance with the ESCP.

(d) Permanent Stabilization – Maintain permanent stabilization Work by restabilizing areas disturbed by the Contractor's operations or other causes within 2 Calendar Days.

Finishing and Cleaning Up

00280.70 Removal - All temporary erosion and sediment control features that are not incorporated into the permanent Work remain the property of the Contractor. Within 30 days of the notification of acceptance of permanent stabilization, remove temporary erosion and sediment control devices and materials from the area. Dispose of accumulated sediment before removing the devices and materials according to 00280.71. Shape and permanently stabilize areas affected by the removal process. Do not remove temporary erosion and sediment control devices before permanent stabilization is accepted.

If shown or directed, compost filter material may be dispersed in place. Cut open compost filter socks and dispose of sock material according to 00290.20

00280.71 Sediment Disposal - Regrade removed sediment into slopes or remove and dispose off-site according to 00290.20.

Measurement

00280.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Lump Sum Basis - No measurement of quantities will be made for lump sum items.

(b) Unit Basis - Unit basis items will be measured on the unit basis, of each device or location where the device is constructed or placed.

(c) Length Basis - Length basis items will be measured on the length basis along the line and grade of the item or device constructed or placed.

- Flow spreaders and diversion dikes and swales will be measured along the long axis.
- Sediment barrier, when measured on the length basis, will be measured along the long axis of the barrier regardless of type.

- Temporary slope drains will be measured from the beginning of the metal end pieces to the end of the drain. Measurement will be made when each installation is at its maximum length.

(d) Area Basis - Area basis items will be measured on the area basis along the lines and grades of the surface area actually covered as shown or as required.

(e) Limitations - The quantities of emergency Materials listed in 00280.48 of the Special Provisions are included in the items listed in the Contract Schedule of Items.

Payment

00280.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Erosion Control	Lump Sum
	Erosion Prevention	
(b)	Plastic Sheeting	Square Yard
(c)	Chemical Soil Binder	Acre
(d)	Chemical Dust Control	Acre
(e)	Temporary Mulching, ____	Acre
(f)	Matting, Type ____	Square Yard
(g)	Compost Erosion Blanket	Square Yard

Item (a) includes:

- providing the Erosion and Sediment Control Manager
- developing, revising, and documenting the ESCP
- mobilization
- monitoring activities to maintain effective functioning
- furnishing, stockpiling, protecting, restocking, and removing emergency Materials
- preparing Project for a period of extended non-activity
- inspecting, maintaining, and removing erosion control devices
- restoring, mulching, tacking, and seeding all disturbed ground, Work, and storage areas not otherwise covered

When only item (a) is listed in the Contract Schedule of Items, no separate or additional payment will be made for modifications or additions to the ESCP that become necessary for permit compliance during construction.

Partial payments for item (a) will be made as follows:

- When the initial Contractor developed ESCP, narrative, and schedule are complete and accepted, and the initial erosion control devices are installed..... 25%
- When 50 percent of the Contract is complete, excluding advances on Materials 25%
- When 75 percent of the Contract is complete, excluding advances on Materials 25%
- At completion of the Work covered by this section 25%

Item (b) includes protecting exposed slopes with plastic sheets, anchoring devices, and providing toe protection.

In item (e), the word "Hydromulch", "Straw", or "Compost" will be inserted in the blank.

In items (f), the type will be inserted in the blank.

Item (f) includes preparing the slope surface and stabilizing exposed Soil with erosion matting Material and bonded fiber matrix matting application.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- constructing and removing temporary slope berms
- erosion control for Work outside the construction limits including, but not limited to, Borrow pits, haul roads, disposal sites, and Equipment storage sites

No separate or additional payment will be made for constructing laps, seams, joints, wraps, overlaps, joint overlaps, or patches unless the Engineer orders additional amounts in excess of the minimum. For laps, wraps, or overlaps that that have been ordered by the Engineer and exceed the minimum or specified length or width, payment will be made for the added lap, overlap, or wrap length or width at the Contract unit price.

Water used for non-chemical dust control will be paid according to Section 00340.

00280.91 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Runoff and Sediment Control

(a) Check Dam, Type ____ ..... Each
(b) Temporary Interceptor Dike/Swale ..... Foot
(c) Temporary Slope Drain ..... Each or Foot
(d) Flow Spreader ..... Foot
(e) Compost Filter Berm ..... Foot
(f) Construction Entrance, Type ____ ..... Each
(g) Tire Wash Facility, Type ____ ..... Each
(h) Concrete Washout Facility ..... Each
(i) Sediment Fence ..... Foot
(j) Inlet Protection, Type ____ ..... Each
(k) Sediment Barrier, Type ____ ..... Each or Foot
(l) Sediment Mat ..... Square Yard
(m) Temporary Energy Dissipater ..... Each
(n) Temporary Sediment Trap ..... Each
(o) Straw Bale ..... Each

In items (a), (f), (g), (j), and (k), the type will be inserted in the blank.

Items (a), (j), and (k) includes the biofilter bags, sand bags, and sediment fence as applicable.

Emergency Materials that are incorporated into the Project will be paid for under the appropriate items listed in the Contract Schedule of Items.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- constructing and removing temporary slope berms
- erosion control for Work outside the construction limits including, but not limited to, Borrow pits, haul roads, disposal sites, and Equipment storage sites

No separate or additional payment will be made for constructing laps, seams, joints, wraps, overlaps, joint overlaps, or patches unless the Engineer orders additional amounts in excess of the minimum. For laps, wraps, or overlaps that that have been ordered by the Engineer and exceed the minimum or specified length or width, payment will be made for the added lap, overlap, or wrap length or width at the Contract unit price.

Water used for non-chemical dust control will be paid according to Section 00340.

Section 00290 - Environmental Protection

Description

00290.00 Scope - This Section describes the Contractor's duties and obligations with respect to protection of the land, waters, air, wildlife, and other environmental resources of the State.

Comply with all applicable federal, State, and local environmental, health, safety, and other laws, acts, statutes, regulations, administrative rules, ordinances, orders, and permits, as they may be amended from time to time (referred to in this Section as "Laws"). Comply with all applicable Laws, whether or not specifically referenced in this Section or elsewhere in the Contract.

Federal, State, and local agencies known to have enacted ordinances and regulations relating to environmental pollution and the preservation of natural resources that may affect the performance of the Contract are listed in 00170.01.

If any provision of the Specifications appears to conflict with one or more Laws, the more stringent requirement shall apply, unless the Engineer directs otherwise in situations where the Specifications are more stringent.

Comply with all additional requirements or Laws imposed by any agency or governmental unit having authority to enforce the Endangered Species Act (ESA) and other Laws.

All penalties assessed against the Agency because of the Contractor's violation of Laws referenced above, or permits applicable to the Project, will be withheld from the progress or final payments according to 00195.50(e).

No condition of the Contract releases the Contractor from any responsibility or requirement under any environmental or other Law.

00290.10 Staging and Disposal Sites - Locate staging areas and disposal sites in previously improved or disturbed sites, including existing Roadways, pullouts, turnouts, parking lots, and storage yards that have been compacted, and graveled or paved, unless otherwise specified or approved, in writing, by the Engineer.

Do not stage Equipment, park Equipment or store Materials in any City, County, State, or Federal park, wayside or recreational facility.

00290.11 Water Conservation - Minimize use of water by maintaining Equipment, immediately fixing water line and container leaks, ensuring water valves are turned off promptly, and using recycled water when feasible.

00290.20 Waste, Hazardous Waste, and Hazardous Substances - Comply with all applicable federal, State, and local Laws as they pertain to the storage, handling, management, transportation, disposal, and documentation of waste, hazardous waste, and hazardous substances.

(a) Hazard Communication - Ensure the following documents are readily available on-site to employees, Subcontractors and inspectors:

- Material Safety Data Sheets (MSDS) for all hazardous substances stored or used on-site.
- Written hazard communication program, including employee training documentation.

The Oregon Occupational Safety and Health Division (OR-OSHA) provides guidance to meet these requirements in their publication *Hazard Communication: A Safe-Work-Practice Guide*.

(b) Fuel Storage - Store fuel according to the current edition of the International Fire Code and all applicable federal, State, and local Laws.

If total fuel and petroleum storage, in containers 55 gallons or larger, exceeds 1,320 gallons, comply with the applicable spill prevention control and countermeasures (SPCC) requirements of 40 CFR 112. If applicable, submit the professional engineer stamped SPCC plan, 10 days before the preconstruction conference. Comply with the plan and keep a copy on-site and readily available. The SPCC plan may be combined with the Pollution Control Plan required under 00290.30(b).

(c) Waste Management:

(1) General - Prepare a hazardous waste determination for all waste generated on-site to determine whether the waste is classified as hazardous waste, universal waste, excluded waste, waste water, or solid waste. The Agency may provide initial analytical results for some wastes such as lead-based paint and asbestos containing material. Conduct additional testing necessary for waste characterization and disposal using an Oregon Environmental Laboratory Accreditation Program (ORELAP) accredited laboratory, under chain of custody procedures.

Segregate all demolition and construction debris according to its intended end use (reuse, recycle, or dispose). If required, store in designated areas in a manner that prevents contamination to Soil and water and prevents fugitive dust emissions. Remove all waste materials recovered from the site unless otherwise approved, in writing. Retain disposal and recycling facility receipts for wastes generated on site for at least 1 year after completion of the Project. Provide copies of the receipts to the Engineer within 7 Calendar Days of the disposal or recycling.

Dispose of noxious weeds and Specified Weeds according to Section 01030.

Do not reuse demolition material, coated or treated materials, or concrete and masonry materials in waters of the State or U.S.

(2) Clean Fill - Clean fill, as defined by OAR 340-093-0030, becomes the property of the Contractor at the place of origin.

(3) Reuse, Recycle, Compost and Dispose of Materials - Waste materials become the property of the Contractor at the place of origin. Unless prohibited by Law, treat waste materials according to the following priority:

- Reuse demolition and construction debris.
- Recycle demolition and construction debris.
- Compost or mulch yard waste material from lawn and landscape maintenance.
- If it is not feasible to reuse, recycle, or compost, ("feasible" is defined as a facility that is capable of handling the material, will take the material and the cost of transportation plus the cost to reuse or recycle the material is equal to or less than the costs of disposal) dispose of waste material according to the following:

a. Burnable Materials - Dispose of burnable material, that cannot be reused or recycled, according to 00290.30(c)(3).

b. Woody Matter - Woody matter may be burned according to 00290.30(c)(3) or may be chipped to a size of no more than 3 inches in any direction then uniformly spread over selected landscape areas, as directed, in loose layers not more than 3 inches thick. Burying wood, stumps, or other woody material is not allowed.

c. Preserved and Coated Wood - Dispose of chemically preserved wood, pressure treated wood, and wood coated with latex paint that does not contain lead according to the following:

- Reuse whole.
- Provide to others to reuse.
- Burn as fuel at an energy recovery facility with a DEQ or LRAPA stationary source permit.
- Deliver to a DEQ permitted municipal solid waste landfill or a DEQ permitted construction and demolition landfill.

Dispose of wood coated with lead-containing paint at a DEQ permitted municipal solid waste landfill or a DEQ permitted construction and demolition landfill.

Test wood as required by the receiving facility.

d. Concrete and Masonry - Concrete and masonry that are not recycled and do not contain hazardous substances may be reused to fill basements or be buried in embankments on-site, provided that the materials are broken into pieces not exceeding 15 inches in any dimension, and placed so that:

- No part of any piece is within 2 feet of the top, side or end surface of the basement, embankment, or other Structure.
- The fill or embankment is constructed and compacted according to 00330.42 and 00330.43.

If the Engineer provides written approval, concrete may be reused as Aggregate if it meets the requirements of Section 02610 through Section 02690.

e. Disposal on Agency-Owned Lands - Do not dispose of waste materials on Agency-owned or Agency-Controlled Lands, except when shown, specified, or allowed in writing to be used as fill. If allowed, place waste materials only at specified locations, as directed.

f. Off-Site Disposal - Dispose of waste at an energy recovery facility with a DEQ or LRAPA Stationary Source Permit, at a permitted landfill, or at other waste disposal facilities as required depending on the type of waste.

Subject to local zoning codes and the requirements of 00280.05, materials that meet the definition of clean fill may be placed on other properties in a manner consistent with environmental requirements, and with the written permission of the property owner. Furnish the Engineer a copy of the signed agreement with the owner before placing the clean fill material. Do not place the clean fill material at locations that are visible from a public Highway, road, or street unless the site is zoned and licensed for landfill.

(d) Hazardous Waste Management - Determine the generator category for the Project, based on the amount and type of hazardous waste generated. Use the following definitions. If they differ from current Laws, use the current Laws.

- **Conditionally Exempt Generator** - A conditionally exempt generator (CEG) generates 220 pounds or less of hazardous waste per month or 2.2 pounds or less of acutely hazardous waste per month and accumulates up to 2,200 pounds of hazardous waste or 2.2 pounds of acutely hazardous waste on-site.

- **Small Quantity Generator** - A small quantity generator (SQG) generates 220 to 2,200 pounds of hazardous waste per month, can accumulate up to 13,200 pounds of hazardous waste on-site (or more with a permit), and ships hazardous waste off-site within 180 days of generation.

- **Large Quantity Generator** - A large quantity generator (LQG) generates more than 2,200 pounds of hazardous waste per month or more than 2.2 pounds of acutely hazardous waste per month, and has no accumulation limit, but ships all hazardous waste off-site within 90 days of generation.

In addition to current Laws, comply with the following:

- If the Project generator category is SQG or LQG, or if it requires a hazardous waste identification number, obtain a Resource Conservation and Recovery Act (RCRA) site identification number from the DEQ. Pay all fees and complete the RCRA application form as follows:
  - List the Contractor as the Site Contact, the Site Operator, the Hazardous Waste Form Contact, and the Hazardous Waste Fee Contact.
  - List ODOT as the Site Location, the Land Owner, and the Legal Owner.
  - Fill in the Comments section with the following statement:

    "[Contractor name] is responsible for the following: All hazardous waste management on-site for the duration of this construction Project, for delivery of the waste to a permitted recycling or disposal facility, and for all forms and fees associated with the hazardous waste management including cancellation of the RCRA site identification number at the end of the Project. ODOT is the owner of the waste and maintains long-term responsibility for the waste as required by RCRA, excluding all wastes generated solely from materials brought to the site by the Contractor, which remain the property of the Contractor."
  - The Contractor may sign hazardous waste manifests for the off-site shipment of hazardous wastes as the "offeror" rather than as the "generator".
- Maintain all required waste management records, including monthly hazardous waste generation records, manifests, recycling and disposal receipts, test results, and annual DEQ reports. Submit monthly records to the Engineer by the fifteenth Day of the following month and submit DEQ reports to the Engineer concurrently with DEQ. Keep copies for at least 3 years following completion of the Project and resolution of any regulatory violations or citations.
- If the quantity of hazardous waste projected to be generated meets the requirements for a LQG, prepare a full Hazardous Waste Contingency Plan according to 40 CFR 265 Subpart D. Maintain a copy of the Contingency Plan on-site at all times during construction activities, readily available to employees and inspectors.
- If the quantity of hazardous waste projected to be generated meets the requirements for an SQG, prepare a modified Hazardous Waste Contingency Plan according to 40 CFR 262.34(d)(5) and 40 CFR 265 Subpart C. Maintain a copy of the modified Contingency Plan on-site at all times during construction activities, readily available to employees and inspectors.
- If the quantity of hazardous waste projected to be generated meets the requirements for a CEG, follow the contingency planning and storage requirements of the SQG unless the only potentially hazardous waste is aerosol cans smaller than 20 ounces. Limit storage to 180 days and 2,200 pounds. Prepare a modified Hazardous Waste Contingency Plan and keep a copy on-site with emergency response procedures and contact information.

- If the Project is an SQG or LQG, retain a Certified Hazardous Materials Manager (CHMM) in good standing and with experience managing the hazardous wastes associated with the Project to oversee waste management at the site.
- All employees involved in the handling and management of CEG hazardous waste shall comply with the federal and State Laws for hazardous waste management. All employees involved in the handling of SQG and LQG hazardous waste shall be trained according to federal and State Laws. For LQG hazardous waste projects, keep employee training records on-site and readily available.
- If the quantity of hazardous waste generated in a month changes the generator category, immediately implement the requirements for the new category and comply with them for the remainder of the year. Complete the new documentation and training requirements within 30 Calendar Days of the change.
- Ensure hazardous waste containers are clearly and visibly labeled with the contents and accumulation start date, compatible with the contents and in good condition. Store them in a designated weather-protected area that is secured from public access, has secondary containment adequate to contain a release, and has sufficient aisle space to safely maneuver containers and respond to spills (minimum 30 inches).
- If hazardous waste will be treated on-site, obtain approval from DEQ and the Engineer for each specific treatment or recycling process, treat wastes within accumulation tanks or closed containers that meet RCRA requirements, conduct treatment within the storage time for the applicable generator category, maintain current copies of all required notifications and waste analysis plans readily available on-site and request DEQ technical assistance prior to starting any on-site recycling or treatment.

(e) Hazardous Substance Transportation - Comply with the following requirements for transportation of hazardous substances and hazardous waste:

- Train all employees involved in transportation and shipping as required by US DOT.
- Use drivers who have a commercial drivers license with a hazardous materials endorsement when required.
- Ship hazardous wastes from SQG and LQG projects using a DEQ-registered hazardous waste transporter under a hazardous waste manifest.
- Ensure shipments are appropriately packaged and labeled, and vehicles are appropriately placarded.
- Submit copies of the completed manifests and documentation to the Engineer and retain copies for at least 1 year.

(f) Unexpected Contamination - If, during construction, unanticipated hazardous substances are discovered that threaten the health and safety of workers, the public, or the environment, do the following:

- Immediately remove all affected employees and secure the area to prevent access.
- Notify the Engineer immediately and provide written notification within 24 hours, setting forth a description of the hazardous substances encountered.

The Engineer will attempt to resolve the unanticipated situation expeditiously according to 00140.40. Delays to Work due to the discovery of unexpected contamination shall be considered for exclusion from Contract Time according to 00180.50(e).

(g) Spills and Releases - Obtain a response agreement with a professional on-call spill response team. The professional on-call spill response team, identified in the pollution control plan (PCP), agrees to be available and respond to spills that cannot be cleaned up with on-site resources. A

professional spill response team is a company or section of a company specifically dedicated to hazardous materials emergency spill response, insured, and bonded for hazardous materials cleanup, and employing experienced personnel certified according to 29 CFR 1910.120.

In the event of a spill or release of a hazardous substance or hazardous waste or the release of any other material that has the potential to harm human health or the environment, do the following:

- Immediately commence response actions to protect human health and the environment. Follow the PCP, SPCC Plan and Contingency Plan, as appropriate. If any of the provisions in these plans conflict, implement the actions providing the greatest protection of public health and safety and the environment.
- If the spill cannot be safely contained and cleaned up with on-site resources, activate the professional on-call spill response team.
- Immediately notify the Engineer.
- If the quantity released exceeds the State or federal reportable quantities, or if the release impacts or threatens to impact any surface water body, immediately notify DEQ by the Oregon Emergency Response System (OERS) at 1-800-452-0311 and the EPA and U.S. Coast Guard through the National Response Center (NRC) at 1-800-424-8802 (federal reportable quantities or spills impacting or potentially impacting water only). If the quantity released is unknown, proceed with OERS and NRC notifications. Reportable quantities are listed at 40 CFR 302.4 and OAR 340-142-0040 to OAR 340-142-0050.
- Conduct cleanup of the released material according to all applicable Laws and DEQ requirements. Clean up to background levels unless otherwise agreed to by the Agency in writing.
- Provide a written report to the Engineer, using the DEQ Spill/Release Report form, within 10 Calendar Days of completing spill response, but no more than 30 Calendar Days after the initial event. If the spill was reported to DEQ, submit the report to DEQ concurrently. Include a description of how future releases will be prevented.

00290.29 Health and Safety - Comply with all applicable health and safety Laws as they pertain to the hazardous substances and wastes used, stored and generated on-site. If any of these requirements are in conflict, the more stringent requirements apply.

00290.30 Pollution Control - Prevent, control, and abate pollution of the environment. Comply with new or amended environmental pollution Laws, not contemplated at the time of Bid preparation, according to 00140.50 and ORS 279C.525.

(a) Pollution Control Measures - Comply with the following requirements:

(1) General:

- Allow no pollutant of any kind (e.g., petroleum products or fresh "green" concrete) to come in contact with an active flowing stream or waters of the State and U.S.
- Comply with the erosion prevention and sediment control requirements of Section 00280 and all applicable DEQ NPDES 1200 Permit requirements.
- Do not cause turbidity to waters of the State and U.S. outside of regulated levels.

(2) Materials and Waste Management:

- Store construction Equipment, materials and debris in a manner that prevents contamination of water and Soil and prevents fugitive dust.

- Store hazardous substances in the original containers or labeled compatible containers according to State Fire Marshal's regulations, International Fire Code and product MSDS.
- Locate areas for storing fuels and other potentially hazardous materials at least 150 feet away from any waters of the State and U.S. or storm inlet, unless otherwise approved by the Engineer.
- Dispose of material waste according to 00290.20.
- Do not use treated timbers within any waters of the State and U.S.

(3) Equipment Fueling, Repair and Maintenance:

- Promptly correct or repair operational procedures, leaks, or Equipment problems that may cause pollution at the Project Site. If Soils or other media become contaminated as a result of operational procedures or Equipment problems, remove and dispose of them according to applicable Laws and 00290.20(g).
- Locate areas for parking, refueling and servicing mobile Equipment and vehicles at least 150 feet away from any waters of the State and U.S. or storm inlet, unless otherwise approved by the Engineer.
- For large Equipment that is not easily moved, prevent fuel and operating fluids from reaching any waters of the State and U.S. or storm inlet by, at a minimum, using spill containment systems designed to completely contain potential spills during all refueling and Equipment repair operations.

(4) Equipment Cleaning and Washouts:

- Inspect and clean all Equipment prior to operating it within 150 feet of any waters of the State and U.S. or storm inlet. Check for fluid leaks and remove all external oil, grease, weed seed, and dirt.
- Do not discharge untreated wash and rinse water into any waters of the State and U.S. or storm inlet.
- Establish wash areas that contain all fluids and debris, at least 150 feet from any waters of the State and U.S. or storm inlet, such that untreated waste water does not impact those systems.
- Clean concrete Equipment in washout areas that contain all fluids and debris. Recycle washout materials into fresh mixes or dispose of according to applicable permits.

(5) Off Site Tracking:

- Limit water leakage from trucks carrying saturated Soils to less than 1 gallon per hour before allowing them to leave the Project Site.
- Remove all loose dirt and debris from trucks prior to leaving the Project Site.

(6) Other Spill Prevention and Response Measures:

- Inspect heavy Equipment, storage containers, staging areas and other potential sources of hazardous substances daily to identify and prevent potential releases.
- If flooding of the Project site is expected to occur within 24 hours, evacuate areas used for staging, access roads, or storage and remove materials, Equipment, and fuel.
- Immediately contain and repair leaking Equipment or containers and clean up any releases according to 00290.20(g).
- Maintain hazardous material containment kits and spill containment kits on-site to facilitate the cleanup of hazardous material spills on dry land and/or waters of the State and U.S.

(b) Pollution Control Plan - Develop a PCP using ODOT Form 734-2445 and submit it for approval at least 10 Calendar Days before the preconstruction conference. Maintain a copy of the PCP on-site at all times during construction activities, readily available to employees and Inspectors. Ensure that all employees comply with the provisions of the PCP.

Include the following information in the PCP:

- Identify a professional on-call spill response team.
- Identify all Contractor activities, hazardous substances used and wastes generated.
- Describe how hazardous substances and wastes will be stored, used, contained, monitored, disposed of and documented. Include pollution prevention, spill response, waste reduction, dust prevention, off site tracking prevention, washout facility design, vehicle and Equipment fueling and maintenance procedures, employee training and emergency contact information.
- Include the waste determination results from 00290.20(c)(1). Provide reuse, recycle, and disposal options and the reasons for selecting those alternatives.
- Include or refer to the SPCC plan and the hazardous waste contingency plan, if required.
- Include scaled site plans showing locations for hazardous substance storage, spill response Equipment, communications Equipment and fire suppression Equipment.

(c) Air Pollution Control Measures - Comply with ORS Chapter 468, ORS Chapter 468A, OAR 340-014, OAR 340-200 through OAR 340-268, and all other applicable Laws.

(1) Vehicle and Equipment Idling - Establish truck staging areas for diesel-powered vehicles located where truck emissions have a minimum impact on sensitive populations, such as residences, schools, hospitals and nursing homes.

Limit idling of trucks and other diesel powered Equipment to 5 minutes, when the Equipment is not in use or in motion, except as follows:

- When traffic conditions or mechanical difficulties, over which the operator has no control, force the Equipment to remain motionless.
- When operating the Equipment's heating, cooling or auxiliary systems is necessary to accomplish the Equipment's intended use.
- To bring the Equipment to the manufacturer's recommended operating temperature.
- When the outdoor temperature is below 20 °F.
- When needed to repair Equipment.
- Under other circumstances specifically authorized by the Engineer.

(2) Dust Control and Permitting - Prevent airborne dust and fugitive dust emissions from construction activities including Rock, concrete, and asphalt crushing operations, and obtain permits according to 00160.70. Do not use oil, waste, waste water, or other illegal materials as dust suppressants.

(3) Burn Restrictions - Burn wastes only if open burning is allowed by State, LRAPA, and local burning Laws. Obtain and comply with all required permits including DEQ permits required by OAR 340-264-0010 through OAR 340-264-0020, LRAPA permits, and local fire district permits. Provide copies of all permits to the Engineer prior to burning. Do not conduct burning within riparian areas. Conduct burning at locations where existing Structures will not be damaged and where smoke will not impact traffic. Do not burn the following materials on-site:

- Rubber products
- Tires
- Plastic
- Wet garbage
- Petroleum and petroleum treated materials
- Asphalt or industrial waste
- Any material that creates dense or noxious odors
- Painted materials
- Asbestos, mercury or PCB-containing materials or equipment
- Hazardous wastes
- Scrap wiring or electrical equipment
- Painted or treated wood

Buildings intended for demolition may be burned by the local fire department for training purposes provided that all hazardous substances have been removed from the building before burning. Contact the local fire department for applicable restrictions.

00290.32 Noise Control - Comply with ORS Chapter 467, OAR 340-035, all other applicable Laws, and the following construction noise abatement measures:

- Do not perform construction within 1,000 feet of an occupied dwelling on Sundays or legal holidays, or between the hours of 10:00 p.m. and 6:00 a.m. on other days, without the approval of the Engineer.
- Use Equipment with sound control devices no less effective than those provided on the original Equipment. Equipment with un-muffled exhausts is prohibited.
- Use Equipment complying with pertinent equipment noise standards of the EPA.
- Do not drive piling or perform blasting operations within 3,000 feet of an occupied dwelling on Sundays or legal holidays, or between the hours of 8:00 p.m. and 8:00 a.m. on other days, without the approval of the Engineer.
- Mitigate the noise from Rock crushing or screening operations performed within 3,000 feet of all occupied dwellings by placing material stockpiles between the operation and the affected dwellings, or by other means approved by the Engineer.

If a specific noise impact complaint occurs during the construction of the Project, one or more of the following noise mitigation measures may be required, at no additional cost to the Agency, as directed by the Engineer:

- Locate stationary construction Equipment as far from nearby noise sensitive properties as feasible.
- Shut off idling Equipment.
- Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
- Notify nearby residents whenever extremely noisy Work will be occurring.
- Install temporary or portable acoustic barriers around stationary construction noise sources.
- Operate electric-powered Equipment using line voltage power or solar power.

00290.34 Protection of Fish and Fish Habitat - Comply with the Laws of the Oregon Department of Fish and Wildlife, National Marine Fisheries Service, and U.S. Fish and Wildlife Service, and the rules and practices developed through the Oregon Plan for Salmon and Watersheds. Conduct operations to avoid any hazards to the safety and propagation of fish and shellfish in waters of the State and U.S.

(a) Regulated Work Areas - Perform Work within regulated work areas only within the regulated in-water work periods. Do not allow Equipment to enter any waters of the State or U.S. or the regulated work area except as allowed in permits issued for the Project.

The regulated work area, if any, will be identified in the Special Provisions.

(b) Prohibited Operations - Except where allowed by the Contract or by permit, do not:

- Blast underwater
- Use water jetting
- Release petroleum products or chemicals in the water
- Disturb spawning beds
- Obstruct stream channels
- Cause silting or sedimentation of waters of the State or waters of the U.S.
- Use treated timbers within the regulated work area
- Impede adult and juvenile fish passage, including intermittent streams
- Allow equipment to enter or work in or on the water.

00290.36 Protection of Wildlife and Wildlife Habitat - Comply with the Laws of the Oregon Department of Fish and Wildlife and U.S. Fish and Wildlife Service. Conduct operations to avoid any hazards to the safety and propagation of wildlife.

(a) Migratory Birds - Comply with the Migratory Bird Treaty Act (16 U.S.C. 703-712) which protects most species of birds in Oregon and prohibits the removal of nests containing eggs or dependent young (i.e., active nest) without a permit. Migratory birds include most birds in Oregon; the few exceptions include rock pigeons, house sparrows, and European starlings.

Except where allowed by the Contract and by permit, do not disturb an active migratory bird nest, do not inhibit the ability of adult birds to care for eggs or dependent young, and do not impact the supporting structure on which an active nest is built.

If active migratory bird nests are encountered stop all actions that may disrupt the nest and its occupants (including visual and auditory impacts) and contact the Engineer. Do not resume Work that may disrupt nesting until approved by the Engineer.

(b) Bats - If bats are encountered, stop all actions in the area and contact the Engineer. Do not disturb bat colonies. In the event that a bat colony is encountered during construction, the Engineer may suspend Work according to 00180.70. Do not resume Work until approved by the Engineer.

Protect bats by doing the following:

- Prevent destruction of bat colonies as shown.
- If bats gain access to excluded areas, stop actions in the area and contact the Engineer. Do not resume Work until approved by the Engineer.

00290.38 Protection of Plants - Plant habitats to be protected will be shown with the plant habitat boundaries flagged by the Engineer. Avoid destruction of plant habitats by ensuring construction personnel, Equipment, and associated pollutants, including sediment, chemical contaminants, discharge water, non-native grass and weed seed, do not enter the habitat.

00290.40 Protection of Forests - Obtain necessary permits according to ORS 477.625 and ORS 527.670, and comply with the Laws of any authority having jurisdiction for protection of forests.

00290.41 Protection of Waters of the U.S. or State - Comply with and require that all the Contractor's employees, agents, and Subcontractors on the Project Site comply with the following:

- Clean Water Act Section 404 (33 U.S.C. 1344); Federal Rivers and Harbors Act of 1899, Section 10 (33 U.S.C. 403 et seq.).
- ORS 196.800 to ORS 196.990 (Oregon Removal-Fill law).
- ORS 390.805 to ORS 390.925 (Oregon Removal and Filling in Scenic Waterways law).
- All other applicable Laws governing preservation of Wetland resources.

Willful violation of permit conditions and applicable laws exposes the offending Contractor and other violators to criminal and civil sanctions. Civil sanctions include, but are not limited to, the offender's sole liability for all costs associated with site restoration, maintenance and additional mitigation Work required by federal or State authorities.

(a) Identifying Waters of the U.S. or State, Including Wetlands - Wetlands known to be on the Project Site will be shown and identified either as "permanently filled or excavated" or as "temporarily impacted". Wetlands to be protected will be shown as "no work zones".

(b) Disturbing Waters of the U.S. or State, Including Wetlands - If Wetlands are shown, meet with the Agency Wetland Specialist, the Engineer, and Inspector on-site prior to moving Equipment onto the site or beginning any Work, to ensure that all parties understand the locations of Wetlands and the measures that shall be taken to protect them.

Ensure protection of no work zones as follows:

- Fence off no work zones using work zone fencing from section 00221.13 of the QPL.
- Except as authorized by the Engineer for the purpose of installing or maintaining approved Wetland protective measures, keep all persons, Equipment and materials off no work zones.
- The Engineer has the authority to bar from the Project any person entering a protected site other than for the purpose of installing or maintaining protective measures.

Install all site protection for Wetlands required by the Plans and Special Provisions prior to staging Equipment or starting Work near the sites.

The Engineer may suspend Work until the Contractor, Engineer, Agency Wetland Specialist, and other required federal and State personnel, if any, meet to determine damage to the site and the nature and scope of necessary site restoration and maintenance. The Engineer may require the Contractor to submit a written plan for protection of other sites for the duration of the Project before Work resumes.

00290.50 Protection of Cultural Resources - Comply with all Laws governing preservation of cultural resources. Cultural resources may include, but are not limited to, dwellings, Bridges, trails, fossils, and artifacts.

If cultural resources are encountered on the Project area or in material sources, and their disposition is not addressed in the Special Provisions, do the following:

- Immediately discontinue operations or move to another area of the Project Site or material source.
- Protect the cultural resource from disturbance or damage.
- Notify the Engineer.

The Engineer will do the following:

- Arrange immediate investigations.
- Arrange for disposition of the cultural resources. The Engineer may direct the Contractor to perform salvage operations according to 00140.30 or 00140.60.
- Notify the Contractor when to begin or resume construction operations in the affected area.

00290.51 Protection of Sensitive Cultural Sites - Comply with and require that all the Contractor's employees, agents, and Subcontractors on the Project Site comply with all Laws applicable to the preservation and protection of sensitive cultural sites. The existence of any sensitive cultural sites affecting the Project, and the mandatory preservation and protection measures applicable to the sites, are determined according to the Laws including, but not limited to, the following:

- National Historic Preservation Act (NHPA) of 1966, Section 106, codified in 36 CFR Part 800 (Protection of Historic Properties).
- ORS 97.740 to ORS 97.760, ORS 97.990(5), and ORS 97.990(6) (Indian Graves and Protected Objects).
- ORS 358.905 to ORS 358.955 (Archaeological Objects and Sites).
- ORS 390.235 to ORS 390.240 (Archaeological Sites and Historical Material).

Ensure protection for sensitive cultural sites according to the following:

- Except as authorized by the Engineer for the purpose of installing or maintaining approved sensitive cultural site protective measures, keep all persons, Equipment, and materials off known sensitive cultural sites.
- Install all sensitive cultural site protection required by the Plans and Special Provisions prior to staging Equipment or starting Work near the sites.
- Instruct all Contractor and Subcontractor personnel to regard the locations of these sites and their contents as confidential.

The Engineer has the authority to bar from the Project any person entering a protected site other than for the purpose of installing or maintaining protective measures.

If sensitive cultural sites are known to be on the Project, additional information will be provided in the Special Provisions.

(a) Disturbing Known Sensitive Cultural Sites - Willful violation of Laws exposes the offending Contractor and other violators to criminal and civil sanctions. Civil sanctions include, but are not limited to, the offender's sole liability for all costs associated with monitoring, recovery, site restoration or other archaeological Work required by Tribal, federal, and State authorities. Costs can exceed $100,000.

The Engineer may suspend Work until the Contractor and the Engineer meet to determine damage to the site and the nature and scope of necessary site restoration and maintenance. The Engineer

may require the Contractor to submit a written plan for protection of other sites for the duration of the Project before Work resumes.

(b) Disturbing Unknown Sensitive Cultural Sites - If the Contractor finds a previously undiscovered sensitive cultural site, immediately cease all activities at that site, follow procedures listed in 00290.50, and notify the Engineer. If the Contractor inadvertently disturbs unknown sensitive cultural sites, but immediately ceases all activities and follows the procedures listed in 00290.50, the Agency, to the extent permitted by Article XI, section 7 of the Oregon Constitution and by the Oregon Tort Claims Act, will indemnify, within the limits of the Tort Claims Act, the Contractor for costs associated with monitoring, recovery, site restoration or other required archaeological Work, provided neither the Agency nor the State shall be required to indemnify the Contractor for such costs resulting from, arising out of or relating to the willful misconduct, negligence or other wrongful acts attributable to the Contractor or other persons on the Project site.

Delays to Work due to new cultural resource finds will be considered for exclusion from Contract Time according to 00180.50(e).

Work required for monitoring and site restoration for newly discovered sensitive cultural sites encountered by the Contractor will be paid for according to 00195.20.

Measurement

00290.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00290.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract lump sum amount for the item "Pollution Control Plan".

Partial payments will be made as follows:

- When the initial PCP is approved 20%
- When 30 percent of the Contract is complete, excluding advances on Materials 20%
- When 60 percent of the Contract is complete, excluding advances on Materials 20%
- When 90 percent of the Contract is complete, excluding advances on Materials 20%
- At completion of the Contract and all waste is removed from the Project site and all reports, receipts, and documents have been submitted 20%

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Payment includes, but is not limited to, the following:

- Contractor's Pollution Control Plan
- Spill Prevention Control and Countermeasures plan
- Hazardous Waste Contingency plan
- hazardous waste determination
- determination of generator category
- the Certified Hazardous Materials Manager
- the Professional on-call Spill Response Team

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PART 00300 - ROADWORK

Section 00305 - Construction Survey Work

Description

00305.00 Scope - Provide construction survey work according to the current edition on the date of Advertisement, of the ODOT *Construction Surveying Manual for Contractors* (see 00110.05(e)).

00305.05 3D Engineered Models - If the Contractor elects to use the 3D Engineered Models to control the work, provide unstamped 3D Construction Models according to 00150.35 which include the following:

- A detailed outline and list of the pay items and Work that will be controlled by the 3D Construction Models.
- A narrative outlining any differences between the Agency prepared 3D Engineered Models and the 3D Construction Models.
- A copy of the 3D Construction Models that will be used by the Contractor's equipment for machine guidance or verification that include and represent the Agency prepared 3D Engineered Models with changes identified in the narrative. Provide files in LandXML format or as directed.

Measurement

00305.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00305.90 Payment - The accepted quantities of Work will be paid for at the Contract lump sum amount for the item "Construction Survey Work".

Payment will be payment in full for furnishing all Material, Equipment, labor, and Incidentals necessary to complete the work as specified.

No separate or additional payment will be made for any temporary protection and direction of traffic measures including flaggers and signing necessary for the performance of the construction survey work.

No separate or additional payment will be made for preparing surveying documents including but not limited to office time, preparing and checking survey notes, and all other related preparation work.

Costs incurred caused by survey errors will be at no additional cost to the Agency. Repair any damage to the Work caused by Contractor's survey errors at no additional cost to the Agency. The Engineer may make an equitable adjustment, which may decrease the Contract Amount, if the required survey work is not performed.

Section 00310 - Removal of Structures and Obstructions

Description

00310.00 Scope - This Work consists of removing and disposing of man-made materials and cleaning up areas they occupy. See Section 00501 for removal of Bridges.

00310.01 Areas of Work - Perform removal Work in the same areas as specified in 00320.01.

If a building to be removed lies partly within the Right-of-Way, remove the entire building unless otherwise shown or directed.

00310.02 Exclusions - Removal Work does not include removal or disposal of materials that are:

- Designated to remain.
- Included in earthwork as given in 00330.41.
- Specifically indicated by the Specifications, Plans, or Special Provisions to be removed Incidental to other items of Work under the Contract.
- Owned or controlled by third parties.

Construction

00310.40 Restrictions on Removal Work:

(a) Guardrail, Median Rail, and Concrete Barrier - In those areas where guardrail, median rail, or concrete barrier are to be removed and replaced with new or salvaged rail or barrier, do one of the following:

- Install the new or salvaged units the same working shift the existing unit is removed.
- Protect the area with temporary barrier with appropriate end treatment satisfactory to the Engineer, until the new or salvaged unit is installed.

(b) Milepost Markers - Throughout construction, protect and maintain all milepost markers affected by the Work at locations visible to the traveling public. This may require removing and relocating the milepost markers to maintain visibility throughout construction. When construction is completed, reinstall the milepost markers in their original locations in a manner satisfactory to the Engineer, unless new milepost markers are to be installed according to Section 00840.

00310.41 Removal Work:

(a) General - Where an abutting Structure or part of a Structure is to be left in place, make clean, smooth, vertical cuts with a saw or other approved cutting device. Avoid operations that may damage any portion of the remaining Structure.

(b) Guardrail Posts - Remove posts completely and backfill holes with selected granular backfill material meeting the requirements of 00330.14.

(c) Drainage Structures - Remove drainage Structures, such as box culverts, down to a depth 2 feet below ground, slope or waterway bed. Remove culverts, sewers, siphons, and other conduits according to 00330.41(a)(7).

(d) Materials Within Construction Areas:

(1) General - Remove materials within construction areas entirely or break down the materials to an elevation at least 2 feet below Subgrade or slope surface as allowed below.

(2) Bituminous Treated Surfaces - Scarify and break up existing bituminous treated surface when it lies under Subgrade and is not salvaged. Incorporate the scarified material into the embankment. Pieces of existing Pavement shall not exceed 15 inches in any dimension.

(3) Concrete Floors, Slabs and Walls - Before placing material in basements or over concrete slabs, remove or break through the floors, slabs, and walls so no fragments of the floors, slabs, and walls have a dimension in excess of 15 inches and there is no protruding reinforcement.

(e) Materials Outside of Construction Areas - Remove materials that lie outside of construction areas to an elevation at least 2 feet below the surface elevation to which the affected area is to be finished.

00310.42 Salvaging Drainage Structure Fittings - Metal grates, frames, rings, covers, and other metal fixtures or fittings for drainage Structures may be salvaged and used on new Structures if the Engineer determines they are reusable.

00310.43 Disposal of Material - Dispose of materials according to 00290.20(c).

00310.44 Earthwork in Connection with Removal - Excavation required to perform removal of Structures and obstructions will be considered Incidental to the removal Work, unless it is within the measurement limits for an excavation Contract Pay Item.

Backfill holes according to 00330.45. The backfill will be measured for payment according to 00330.82, when there is an embankment measure basis Pay Item for earthwork and that material is used for backfilling, otherwise no separate payment will be made for this Work.

Maintenance

00310.60 Repair of Damages - Repair promptly any breakage or damage to materials or items not intended to be removed. Complete replacement of the affected materials may be required if the Engineer determines it is necessary. Make all repairs and replacements at no additional cost to the Agency.

Measurement

00310.80 Measurement - The quantities of removal Work performed under this Section will be measured according to the following:

- **Lump Sum Basis** - Under this method, no measurement of quantities will be made.

- **Separate Item Basis** - Under this method, the quantities of Work performed on a separate item basis will be measured as follows:

  - **Length and Area** - The length or area of the Structure or item actually removed, will be measured along the line and grade of the Structure or item for each continuous Structure or item removed. Measurement will be on the length or area basis, limited to the Neat Lines shown or directed. The length of asphalt Pavement cutting will be the length of the actual cut based on a depth of 6 inches. If the depth is greater than 6 inches, the length will be adjusted by converting to an equivalent number of feet on a proportionate-length basis.

- **Each** - Items will be measured on the unit basis by count of units removed.

No measurement for removal of concrete barrier will be made for barrier that is measured and paid as “Remove and Reinstall Concrete Barrier” under Section 00820.

Payment

00310.90 Payment - The accepted quantities of Work done under this Section will be paid for at the lump sum basis or separate item basis according to 00310.91 or 00310.92, as applicable.

Payment will be payment in full for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for barriers used for temporary protection where guardrail, median rail, or concrete barriers have been removed.

No separate or additional payment will be made for protecting and maintaining milepost markers and reinstalling them at their original location.

When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

00310.91 Lump Sum Basis - The accepted quantities of removal Work done on a lump sum basis will be paid at the Contract lump sum amount for the following items:

	Pay Item	Unit of Measurement
(a)	Removal of Structures and Obstructions	Lump Sum
(b)	Removal of ____	Lump Sum

Item (a) includes all removal Work done on a lump sum basis, except as covered under Pay Items given in the form of (b).

In item (b), the specific kind or description of removal Work will be inserted in the blank.

Payment for removal of concrete barrier does not include payment for concrete barrier that is removed and reinstalled according to Section 00820.

00310.92 Separate Item Basis - The accepted quantities of removal Work done on a separate item basis will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Removal of Pipes	Foot
(b)	Removal of Curbs	Foot
(c)	Removal of Walks and Driveways	Square Yard
(d)	Removal of Surfacings	Square Yard
(e)	Removal of Inlets	Each
(f)	Removal of Manholes	Each
(g)	Asphalt Pavement Saw Cutting	Foot
(h)	Removal of Concrete Barrier	Foot

Item (d) includes the removal of all Surfacings, except for walks and driveways, as defined in 00110.20 under "Existing Surfacings".

Item (g) applies to asphalt Pavement saw cutting when shown.

Payment for removal of concrete barrier does not include payment for concrete barrier that is removed and reinstalled according to Section 00820.

Section 00320 - Clearing and Grubbing

Description

00320.00 Scope - This Work consists of removing and disposing of vegetation and buried matter within a specified area, or as directed. The Work also includes preserving vegetation and objects designated to remain in place and cleanup of the work area.

00320.01 Areas of Work - The areas to be cleared and grubbed are shown on the Plans, or if not shown on the Plans, the clearing lines are 10 feet outside the following:

- Top of side slopes of ditches and channel changes.
- Top of cut slope.
- Top of cutbank rounding if rounded.
- Toe of fill slope.
- Outside edge of Structure.
- Other work areas shown on the Plans, such as material sources, Borrow areas and road connections.
- Tree, plant, or natural areas to be preserved.

00320.02 Definitions:

(a) Clearing - Clearing consists of:

- Preserving trees and other vegetation designated to remain in place.
- Salvaging marketable timber, when required by the Special Provisions.
- Cutting and removing vegetation, such as weeds, grasses, crops, brush, and trees.
- Removing downed timber and other vegetative debris.

(b) Grubbing - Grubbing consists of removing:

- Brush stems remaining above the ground surface after the clearing Work.
- Tree stumps.
- Roots and other vegetation found below ground surface.
- Partially buried natural objects.

(c) Clear Zone - See 00110.20. For purposes of this Section, the minimum Clear Zone line is 30 feet from the edge of the Traveled Way.

Construction

00320.40 Clearing Operations:

(a) Clearing Trees and Other Vegetation - Remove and dispose of noxious weeds and Specified Weeds according to Section 01030 prior to beginning clearing of trees and other vegetation.

Cut trees and brush so they fall into the areas specified to be cleared.

Cut off tree stumps, not required to be grubbed under 00320.41, as follows:

- Flush with the ground surface if within the Clear Zone.

- No higher than 4 inches above the ground surface if between the Clear Zone and the clearing line.

Remove all evidence of clearing matter and debris. This Work includes removal of:

- Sod, weeds and dead vegetation.
- Downed timber, brush and other vegetation.
- Sticks and branches with diameters greater than 1/2 inch.
- Dead trees, downed timber, stumps, and specified trimmings from areas where live trees and other vegetation are designated to remain.

(b) Preserving Vegetation and Other Natural Materials:

(1) Within the Work Areas - Avoid injuring vegetation or other natural materials designated to be saved. Preservation of this vegetation includes protection and special care.

(2) Outside the Work Areas - Avoid injuring vegetation or other natural materials. Confine operations that may injure vegetation or other natural materials to the work area, or to areas that have already been cleared.

(3) Vegetation and Materials to be Saved - The Engineer will designate no work zones and identify and mark trees, existing landscaping, vegetation, or other natural materials to be saved, as shown. Provide and place work zone fencing, from section 00221.13 of the QPL, around designated no work zones and critical root zones of marked trees, as directed. Do not begin construction activity or move Equipment into existing landscaped or vegetated areas until the work zone fencing is in place to designate and protect no work and critical root zones.

Do not work within the no work zones or critical root zone of marked trees unless written approval is obtained from the Engineer. Be responsible for all damage to and removal of trees, landscaping, vegetation or other natural materials designated to be saved. Damage will be determined by a specialist selected by the Engineer.

(4) Salvaging Vegetation and Natural Materials - As shown or directed, salvage and stockpile plants, rocks, down timber, and other natural materials for use in site restoration. Do not salvage material dominated by weedy species, as directed. If shown, salvage conifer trees that are greater than 18 inch diameter at breast height (DBH) with root wad intact. Store salvaged material in a clean and dry place until site restoration, or as directed.

(c) Tree and Vegetation Trimming - Trim trees according to good tree surgery practices, as directed, and according to the following:

- Do not leave unsound branches of trees in place.
- Trim branches over Roadways and Bridges to provide at least 20 feet of clearance above the Roadway surface.
- Trim branches over walks to provide at least 8 feet of clearance above the walk surface.
- Trim branches obstructing sight distance at intersections or impairing visibility of signs.

Keep Equipment and materials off the critical root zone as directed.

Remove hazardous, dead, and damaged trees outside the clearing limit as directed.

00320.41 Grubbing Operations - Within excavation limits, remove tree stumps, roots, and other vegetation to a depth of at least 6 inches below excavation Subgrade or sloped surfaces.

Within embankment limits, remove tree stumps, roots, and other vegetation.

00320.42 Disposal of Matter - Dispose of all matter and debris according to 00290.20.

00320.43 Backfilling Holes - Except in areas to be excavated, backfill holes remaining after grubbing operations with clean fill (see 00290.20(c)(2)) according to 00330.45.

Measurement

00320.80 Measurement - The quantities of clearing and grubbing Work performed under this Section will be measured according to the following:

- **Lump Sum Basis** - Under this method, no measurement will be made.
- **Area Basis** - Under this method, measurement will be the ground surface, limited to the areas shown or directed.

Payment

00320.90 Payment - The accepted quantities of clearing, grubbing, disposal, and cleanup Work will be paid for at the Contract lump sum amount or the Contract unit price, per acre, for the item "Clearing and Grubbing".

Payment will be payment in full for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for work zone fencing.

When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00330 - Earthwork

Description

00330.00 Scope - This Work consists of excavation, ditching, backfilling, embankment construction, grading, leveling, borrow, and other earth-moving Work required in the construction of the Project, excepting such Work specifically included and provided for as:

- A Pay Item elsewhere in the Contract Specifications.
- Incidental Work in the detailed Specifications for other Contract Pay Items.

The term "earthwork" will be used as a general term to designate the Work included within the scope of this Section.

00330.01 Lines, Grades, and Cross Sections - All earthwork shall conform to the lines, grades and Cross Sections established.

Roadbed Cross Sections shall be subject to variation from the Typical Sections shown on the Plans, if directed, to:

- Provide superelevation on curves.
- Take care of special conditions at intersections and elsewhere.
- Balance earthwork quantities.

00330.02 Definitions:

Abandoned Pipes and Miscellaneous Matter - Sewers, pipes, conduits, logs, timbers, concrete and other Structures, materials, objects, and matter encountered in the Work, excepting only items identified for removal or preservation.

General Excavation - All excavation covered by this Section, except foundation, toe trench, and Borrow excavation.

Overbreak - Material beyond and outside of the slope limits established by the Engineer, that becomes displaced or loosened during excavation and is excavated.

Selected Materials - Those materials with pertinent characteristics that are preserved and sorted as directed from specified excavations and handled for specific uses.

Stone Embankment Material - Rock used in specific embankment applications, including Buttresses, inlays, shear keys, and erosion control applications.

00330.03 Basis of Performance:

(a) General - Except as provided in 00330.00, all earthwork shall be performed on either the excavation basis or the embankment basis. The basis of performance for each earthwork Pay Item will be specified in the Special Provisions and the Contract Schedule of Items.

(b) Excavation Basis - Earthwork performed under this provision, including excavation, haul, and embankment construction, unless otherwise specified, will be paid for by excavation measurement. (See 00330.80 and 00330.81.)

(c) Embankment Basis - Earthwork performed under this provision, including excavation, haul and embankment construction, unless otherwise specified, will be paid for by embankment measurement. (See 00330.80 and 00330.82.)

00330.04 Sources of Borrow:

(a) Agency-Furnished Borrow - Use materials obtained from Agency-furnished sources lying outside of, separated from and independent of planned Roadbed excavations, or other required excavations within the Project limits, only when called for by the Contract or when specifically directed. (See 00330.41(d).)

(b) Contractor-Furnished Borrow - Unless otherwise specified or directed, all Borrow shall be furnished by the Contractor. Sources shall lie wholly outside of and beyond the limits of Agency-Controlled Lands. Acquire at Contractor's own expense. The provisions of 00160.60 and 00160.80 shall apply.

Materials

00330.10 Selected Materials - When the Contract contains a Pay Item "Extra for Selected ____ Material", furnish the material from required excavations. The Specifications for the selected materials will be in the Special Provisions, if different than specified in these Specifications. If other provisions of this Section call for selecting or sorting material for various parts of the Work, select and sort the materials to meet the directed requirements.

00330.11 Selected Topsoil - Furnish Topsoil selected for use according to 00330.10 and meeting the requirements of 01040.14.

00330.12 Borrow Material - Furnish Borrow Materials for general embankment construction with Soil that is free of Unsuitable Materials or other characteristics detrimental to the construction of firm, dense and sound embankments. Furnish Borrow Materials for other uses meeting the specified requirements for the use intended.

00330.13 Selected General Backfill - Furnish soil selected as directed from specified excavations, and containing no particle with any dimension greater than 3 inches, or other Unsuitable Material.

00330.14 Selected Granular Backfill - Furnish durable sand, gravel or combinations of these, selected as directed from specified excavations, and containing no particle with any dimension greater than 3 inches or other Unsuitable Material. Reclaimed glass meeting the requirements of Section 02695 may be substituted for selected granular backfill.

00330.15 Selected Stone Backfill - Furnish a combination of durable sand, gravel and cobbles, selected as directed from specified excavations, and containing no particle with any dimension greater than 6 inches, and no Unsuitable Material. Reclaimed glass meeting the requirements of Section 02695 may be substituted for selected stone backfill.

00330.16 Stone Embankment Material:

(a) Requirements - Furnish an unweathered, hard, angular, durable, free-draining material, visibly well-graded from coarse to fine with the maximum size between 15 inches and 3 inches. Rock fragments larger than 15 inches but not larger than 36 inches may be included if placed as directed in 00330.42(c)(2).

If the 1" - 0 portion exceeds 10 percent of the total volume by the Engineer's visual examination, the 1" - 0 material will be randomly sampled for testing. The wet sieve test, according to

AASHTO T 11, will be performed on the sampled material. The amount of material passing the No. 200 sieve shall not exceed 5.0 percent by weight.

(b) Control Sample - Provide, at a location acceptable to the Engineer, in close proximity to the Project, at least a 5-cubic yard sample of stone embankment meeting the gradation specified. This sample will be used as a frequent reference for judging the gradation of the material supplied.

(c) Sampling and Testing Assistance - If the Engineer visually determines the material furnished justifies sampling and testing, dump and check the gradation of two random loads of stone embankment material. Provide a sorting site, mechanical Equipment and labor to assist in checking gradation at no additional cost to the Agency.

00330.17 Quality Control - Provide quality control according to Section 00165.

Equipment

00330.20 Tamping Foot Rollers - If specified, use tamping-foot rollers with a weight of at least 15 tons, with each tamping-foot protruding from the drum at least 4 inches.

00330.21 Vibratory Rollers - If specified, use vibratory rollers having a smooth drum, exerting a dynamic force of at least 30,000 pounds per impact and operating at a frequency of at least 1,000 vibrations per minute. Limit roller speed to no more than 1 1/2 mph.

Labor

00330.30 Quality Control Personnel - Provide technicians having CEBT and CDT technical certifications.

Construction

00330.40 General:

(a) Quantities - Quantities and locations of earthwork materials indicated on the Plans are approximate only. Make sure there is enough suitable material available to complete embankments and other required fillings before disposing of any excavated materials. Make up any shortage of materials caused by premature disposal at no additional cost to the Agency.

The Agency makes no guarantee or representation by implication or otherwise, that any material available on the Project site is suitable for incorporation into any portion of the Project. No material will be considered unsuitable on the sole basis that special or additional processing or handling is required to make it suitable for incorporation into the Project.

(b) Preservation of Existing Surfacings - In addition to the cautions in Section 00150 and Section 00170, protect Existing Surfacings of all types that are to remain in place from being damaged or fouled with undesirable material. Repair or replace damaged or fouled surfaces as directed and at no additional cost to the Agency.

(c) Avoidance and Correction of Detrimental Operations - Perform all operations involved in excavating, hauling and placing of earthwork materials so no damage or detriment to the completed or partially completed Work results. At all times provide sufficient drainage of completed or partially completed earthwork to prevent damage or loss due to rainfall, surface water or any other cause. In all cases, take proper precautions to ensure that embankment construction and filling do not move, endanger or cause undue strain or stress to any Structure or adjacent ground. Temporary and final embankment slopes within any Cross Section shall not be constructed steeper than the Slope staked for that Cross Section.

Recondition or remove unstable materials resulting from improper operations, inadequate drainage or over-watering, and restore or replace with stable material at no additional cost to the Agency.

00330.41 Excavations - Perform excavation of earthwork as shown, as directed and according to the following:

(a) General:

(1) Selection and Sorting of Excavated Materials - All materials available from excavations, including Borrow Materials, are subject to selection and separate handling for their best utilization in various parts of the Work. Select the types of materials to be used according to 00330.42, 00330.44, 00330.45, 00330.47, the Special Provisions, and as directed. Select and sort excavated materials, as necessary, to meet Contract requirements.

(2) Selected Topsoil - Stockpile and place selected Topsoil according to 01040.43.

(3) Unsuitable Materials - Unsuitable Materials encountered in required excavations shall be classed as waste material and disposed of according to 00330.41(a)(5).

(4) Excess Materials - If the quantities of excavated materials are greater than required to construct embankments and to do all filling and backfilling, the remaining materials shall be classed as waste materials and be disposed of according to 00330.41(a)(5).

(5) Waste Materials - Unless otherwise specifically allowed and subject to the requirements of 00280.05, dispose of materials, classed as waste materials in 00330.41(a)(3) and 00330.41(a)(4), outside and beyond the limits of the Project and Agency-controlled property and according to 00290.20. Do not dispose of materials on Wetlands, either public or private, or within 300 feet of rivers or streams.

(6) Excavation of Existing Surfaces - Unless otherwise specified, earthwork includes excavating, hauling and depositing of Existing Surfacings that are within the limits of the excavation Work.

If an abutting Roadway or Structure, or part of a Roadway or Structure, is to be left in place, make cuts according to 00310.41(a).

(7) Abandoned Pipes and Miscellaneous Matter - Remove and dispose of abandoned pipes and miscellaneous matter encountered in the Work as a part of the earthwork, unless otherwise specified.

Remove ends of remaining abandoned pipe or portions of other miscellaneous matter remaining exposed in slopes or at Subgrade after excavation Work to at least 2 feet back of the finished slope or below Subgrade.

Place a watertight cap or plug in the inlet ends of remaining abandoned pipes. Leave outlet ends open. Place free-draining cover material and/or take other measures as directed to allow for free passage of drainage at remaining outlet ends. Shape and finish the affected area so no evidence of their existence is apparent upon completion of the Work.

(8) Ditches, Channel Changes, Approaches, Connections, Etc. - Perform excavations to construct ditches, channel changes, approach Roadways, road connections, and other items, as required.

(9) Excavation Below Grade:

a. Rock - If directed, excavate Rock found in Roadbed excavation to a depth of 12 inches below Subgrade or as directed. Backfill to Subgrade elevation with selected granular backfill material as directed.

b. Selected Material - Where the Plans indicate the placement of a selected material below Subgrade in excavation areas, excavate to the depth necessary to place the material to its specified compacted thickness.

c. Unstable Subgrade Material - Where unstable material is encountered below Subgrade in Roadbed excavations, excavate such material below Subgrade as directed. Dispose of these unstable materials according to 00330.41(a)(5). Backfill with selected general backfill or selected granular backfill material to provide a firm Roadbed as directed. A geotextile may be required before backfilling.

(10) Protection of Excavation Side Slopes - Use methods in making Roadbed excavations that will not shatter or loosen excavation slopes, avoid overbreaks, and leave slopes accurately and smoothly trimmed. As far as practicable, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line. Overbreak is Incidental to the Work except in cases where the Engineer determines that such overbreak was unavoidable.

After the main excavation in Rock or rocky cuts is completed, thoroughly test the slopes with bars or by other approved means and remove all loose, detached, broken, or otherwise unstable material. Remove jutting points and bring the entire cut slope area to a safe, trim, neat and stable condition. Dispose of the materials removed under this provision in the same manner as other excavated material. Remove all exposed roots, debris and all stones more than 3 inches in size that are loose or could become loose.

(11) Rounding of Cutbanks - As part of the earthwork, blend the tops of cutbanks with the adjacent ground by rounding as called for by the Plans. Rounding will not be required when Rock requiring blasting to excavate extends to the top of cutbanks, and makes rounding impracticable.

(12) Outside Earthwork Limits - Outside earthwork limits but within the Clear Zone, (see 00320.02(c)), remove partially buried natural objects, such as boulders, which the Engineer determines would be dangerous to an errant vehicle. Place them within embankments as specified or dispose of them as directed.

(b) Foundation Excavation - Excavate Unsuitable Materials in embankment foundations and elsewhere as designated. This Work will be classed as "Foundation Excavation". Dispose of these materials according to 00330.41(a)(5) and replace with selected general backfill, selected granular backfill or other suitable materials as directed.

(c) Toe Trench Excavation - Excavate trenches at the toe of slopes that are to be protected with stone embankment, riprap or other protective material, as shown or directed, to provide a suitable foundation. Maintain the toe trenches until the geotextile or filter blanket, if any, and stone embankment, riprap or other protective materials are placed.

(d) Borrow Excavation - Whenever the Specifications or Contract Plans call for an Agency-furnished Borrow source for earthwork materials, the material excavated from such source and used in the Work as earthwork materials will be classed as "Borrow Excavation". Excavate and use these materials according to the Contract provisions, or as directed.

(e) Blasting - Avoid the use of explosives as far as practicable. If blasting is necessary and is not included in the Contact Schedule of Items, perform blasting according to following:

(1) General - Use blasting methods that do not shatter or loosen backslopes, that produce smooth and uniform excavation slopes at the specified Slope angles, and that satisfactorily loosen the Rock for excavation. Do not use tunnel blasting methods.

(2) Methods - Follow the requirements of 00335.40(b) through 00335.40(h) and 00335.43.

00330.42 Embankment, Fills, and Backfills - Consider the nature, characteristics, and qualities of the materials to be selected before performing embankment, fill, and backfill Work. Select and use excavated materials in various parts of the Work according to 00330.41(a). Use all materials originating from required excavations, as far as practicable, in the formation of embankments and Subgrade, and for bedding, backfilling and other purposes shown on the Plans, as directed, and according to the following:

(a) Embankment Foundation Preparation - In addition to the excavation and replacement of Unsuitable Materials as provided in 00330.41(b), and before constructing embankments, prepare the areas on which embankments are to be constructed as follows:

(1) Unstable Areas - Where the embankment foundation will not support hauling or compaction Equipment and only if directed, place an initial layer of selected materials. Place the initial layer by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the Equipment and not greater than 3 feet, unless otherwise authorized. Do not place the initial layer higher than 3 feet below Subgrade. Commence consolidation of the initial layer by routing construction Equipment uniformly over the entire layer. The initial layer shall meet the compaction requirements of 00330.43 except for layer thickness. Subsequent layers shall meet all requirements of 00330.43.

(2) Ends of Abandoned Pipe - Place a watertight cap or plug in the inlet ends of remaining abandoned pipes. Place a screen over the outlet ends of remaining abandoned pipes, and if directed, place free-draining cover material and/or take other measures as directed to allow for free passage of drainage.

(3) Drainage - Provide drainage and drainage Structures as called for by the Plans or as directed.

(4) Backfilling Inside Roadbed Limits - Break up concrete or asphalt floors, slabs, or walls, as specified in 00310.41(d), before backfilling or placing embankment. Backfill basements, trenches and holes within embankment limits with selected stone backfill material. Backfill material placed in basements may include pieces of broken concrete and masonry not exceeding 15 inches in any dimension provided they are placed and compacted according to 00330.42(c). The broken concrete and masonry shall not have protruding reinforcement.

(5) Existing Surfacings - Scarify and break up Existing Surfacings according to 00310.41(d) before placing embankment material.

(6) Roughen Ground Surface - Break up, roughen or scarify the ground surface if the Slope is 1V:5H, or less, to positively bond embankment materials with the existing ground with benching allowed as a supplement.

(7) Foundation Benching - If existing ground surfaces or existing embankment surfaces are steeper than 1V:5H, bench the existing ground or embankment.

Make the bottom bench at least 10 feet wide. Each succeeding bench shall penetrate the slope at least 3 feet horizontally beyond the vertical side of the previous bench, and be wide enough to operate placing and compaction Equipment. Each bench and embankment layer surface shall be brought to a Slope flatter than 1V:10H. The benching, placing and compaction operation shall be performed simultaneously from the bottom up.

Place and compact the bench excavation material combined with new embankment material in layers to the thickness and compaction required in 00330.43.

(8) Compact Existing Ground - After roughening the existing ground surface and/or benching, compact the top 1 foot of existing ground and embankment in place to the density specified and with compaction Equipment specified, according to 00330.43.

(b) Excess Moisture - Do not place material in final position in embankments or as backfill until excess moisture has been removed to within minus 4 percent to plus 2 percent of optimum moisture as required in 00330.43. Remove excess moisture by manipulation, aeration, drainage, rehandling or other means, at no additional cost to the Agency.

(c) Embankment Construction:

(1) General - Except as provided in 00330.42(a)(1), do not construct embankments or fillings when the embankment material, the foundation or the embankment on which it would be placed is frozen, not stable or not compacted, unless otherwise directed.

Make Roadbed embankment slopes as smooth, safe, and sightly as practicable with the materials used to construct the embankments.

Route hauling Equipment over the full width of embankments. Traveling over the same areas repeatedly will not be allowed unless approved by the Engineer as unavoidable.

Place embankments and all fillings in nearly horizontal layers not more than 8 inches thick, except as provided in 00330.42(c)(2). Compact each layer separately and to the density required in 00330.43.

Place slope berms, if required, according to 00280.

(2) Rock in Embankment Construction:

a. General - Retrieve Cobbles and Boulders that fall or roll outside embankment limits and place them within embankments as specified, or dispose of them as directed.

b. Limited Quantities of Rock - If embankment materials contain up to 50 percent Rock, sort the materials until they can either be placed in 8 inches layers, or meet the requirements of and be placed according to 00330.42(c)(2)(c).

c. Oversize Durable Rock Fragments - Placing isolated individual Durable Rock fragments having dimensions greater than the specified layer thickness will be allowed if:

- Clearance between adjacent fragments provides adequate space for placement and compaction Equipment between Rock fragments to place materials in horizontal layers as specified and for compaction according to 00330.43.
- No part of the fragment comes within 36 inches of Subgrade.

d. Durable Rock - If embankment materials contain more than 50 percent Durable Rock, distribute and manipulate the Rock so that the voids between the larger pieces are filled with

smaller pieces forming a dense and compact mass. Durable Rock is defined in 00110.20. In the absence of two-cycle slake durability test results, the Rock durability will be visually evaluated.

When such embankments cannot be placed in 8-inch horizontal layers, place the embankment in nearly horizontal layers of the thickness directed, but not more than 15 inches.

If the visible quantity of Silt and Clay materials passing the No. 200 screen is less than 20 percent by volume, as determined by the Engineer, the maximum Rock fragment size and layer thickness may be increased to 36 inches, but the layer thickness shall not exceed the average maximum size of the Rock fragments.

e. Nondurable Rock - In the absence of two-cycle slake durability test results, the Engineer will visually evaluate if the Rock is potentially degradable. If embankment materials contain more than 50 percent Nondurable Rock, as defined in 00110.20, process the material as follows:

- Pulverize Nondurable Rock to 12" - 0 size and place in nearly horizontal layers not more than 12 inches thick.
- Water to promote slaking and breakdown of the nondurable material according to Section 00340.
- The moisture content of the material at the time of compaction shall be within the requirements of 00330.43.
- Compact the material to density/deflection requirements specified in 00330.43 with a tamping-foot roller that meets the requirements of 00330.20. Each embankment layer shall receive a minimum of three Coverages with the tamping-foot roller. Operate the roller at a uniform speed not exceeding 3 mph. No additional compensation will be made for additional roller Coverages to meet the requirements of 00330.43.

(3) Embankment Slope Protection - Construct outer portions of embankments exposed to erosion by stream flow or other erosive action with Rock fragments, or other desirable materials, if directed, and such are available in the excavations. Also, if directed, place similar material as a protective layer on the outside of the regular embankment slopes as embankment widening. Placement shall closely follow construction of the embankment when directed. Protective materials placed as embankment widening need not be compacted but shall present a reasonably smooth surface, resistant to washout or slippage.

(4) Embankments for Approaches, Connections, Etc. - Construct embankments as required and as directed to provide a complete Project. Construct according to 00330.42(c) and 00330.42(d).

(5) Embankment Construction Around Minor Structures - Backfill prior excavations in the vicinity of curbs, walks, driveways, inlets, manholes and other such minor Structures with selected general backfill, or selected granular backfill material as directed with no particles larger than 1 inch and that is compatible with the adjacent material, unless otherwise specified. The material shall have a moisture content as specified in 00330.43, be placed in layers according to 00330.42(c)(1), and be compacted according to 00330.43.

(6) Embankment Construction at Pipes - Before installing any pipes with 72-inch or smaller, inside nominal diameter that will protrude above the existing ground surface:

- Provide temporary drainage at no additional cost to the Agency, unless provided for in Section 00240.

- Construct specification embankments at least five pipe diameters each direction from the pipe centerline and to a height equal to the following:
  - 12 inches minimum above the outside top-of-pipe elevation.
  - A higher height if shown or directed.
- Then trench, bed, and install the pipe, and backfill around all pipes according to 00445.45.

(7) Embankment Construction at Bridge Ends - At the ends of Bridges and for a distance of at least 100 feet from the Bridge, place and compact the embankments before beginning Bridge construction, unless otherwise directed. Unless the embankment is constructed according to 00330.42(c)(8), provide and place selected stone backfill material, meeting the requirements of 00330.15 when such is available from excavations, in all embankments within 100 feet of Bridges, or as directed.

(8) Engineered Fills - In areas designated on the Plans as "Engineered Fills", place selected stone backfill material in maximum 8-inch Lifts from the existing ground up to the base of granular structure backfill. Compact to 95 percent maximum density according to 00330.43.

If the existing ground line is within the limits of the granular structure backfill, subexcavate the area beneath the footing in order to place the full depth of granular structure backfill shown or specified.

Place the granular structure backfill, meeting the requirements of 00510.13, in maximum 6-inch Lifts and compact to 100 percent maximum density from the top of the selected stone backfill to the footing elevation shown. The thickness and extent of these materials shall be according to the details shown, or as directed.

The foundation compaction requirements in 00330.43 shall be subject to the higher requirements of this provision. Compact according to the percentages required above.

(d) Stone Embankment - If the Contract Plans or Specifications require embankments, or parts of embankments, to be constructed of stone embankment material, furnish and place the stone embankment material according to this provision and as directed. Furnish materials from Contractor-provided sources that conform to the requirements of 00330.16, unless otherwise specified.

Construct these embankments according to the other provisions of 00330.42, unless otherwise specified or directed, and as follows:

- Material placed in the upper 1 foot of embankments or within 1 foot of a culvert or other Structure, shall not be more than 3 inches in size.
- If placement in water is allowed, construct the first layer of embankment to an elevation 2 feet above water. Continue thereafter as specified or directed.
- Some Rock fragments larger than 15 inches, but not larger than 36 inches, may be placed provided they are placed and compacted according to 00330.42(c)(2)(c).

00330.43 Earthwork Compaction Requirements:

(a) General - Compact natural ground, embankment foundations, foundations for Structures, each layer of embankment, fills, and backfills, the upper 1 foot of Roadbeds in cuts and other earthwork that is to support any part of the Roadbed prism according to this Subsection.

Unless otherwise specified, compact in place the entire surface of each layer of all specified materials with a minimum of three Coverages, using Equipment made specifically for compaction.

Select compaction Equipment based on the type of material being compacted and the layer thickness. Normal compaction Equipment consists of sheepsfoot rollers, tamping-foot rollers, grid rollers, pneumatic-tired rollers, and vibratory rollers. Routing of hauling and grading Equipment will not be accepted as adequate to achieve compaction, except as provided in 00330.42(a)(1).

In the immediate vicinity of minor Structures as provided in 00330.42(c)(5), in holes, around and under isolated individual Rock fragments, and elsewhere where embankment and filling materials can or cannot be reached by normal compaction Equipment, compact with machine-operated pneumatic or mechanical tampers, or by hand methods if allowed, as required to ensure intimate contact between the backfill material and the Structure or fragment and provide thorough compaction.

(b) Moisture-Density Testable Materials:

(1) Test in-place materials for compaction according to the MFTP.

(2) In-place materials shall meet the following moisture content, density, and deflection requirements, each of which has equal weight and each of which shall be satisfied:

a. Moisture Content - Moisture content at the time of compacting the materials shall be prepared to within minus 4 percent to plus 2 percent of optimum moisture content. Material that does not contain sufficient moisture to obtain proper compaction shall be wetted and thoroughly mixed as directed. Material containing an excess of moisture shall be dried by manipulation, aeration, drainage or other means before being compacted.

b. Density - After compaction of each layer the density shall be at least:

- 95 percent of maximum density in Roadbed cuts, to a depth of 1 foot below established Subgrade elevation.
- 95 percent of maximum density in embankments, fills, backfills, and specified portions of existing ground.

c. Deflection Requirement - In addition to moisture-density testing, conduct at least one deflection test according to ODOT TM 158 for each 3 feet, or portion of 3 feet, of embankment placed. If the layer being tested exhibits any yielding, deflection, reaction or pumping, rework the area to provide acceptable test results prior to placement of any additional material.

Conduct deflection tests, witnessed by the Engineer, on the finish grade of all Subgrades. During placement of Subbase, base Aggregates, or ACP, if deflection is observed, remove the ACP, Base, and Subbase Aggregates and correct the deflecting areas at no additional cost to the Agency.

Provide a signed test report to the Engineer at the end of each shift after completing the required testing. At no additional cost to the Agency, remove and replace embankment constructed thicker than 3 feet that was not deflection tested.

(c) Non-Moisture-Density Testable Materials - When material is not moisture-density testable because Rock fragments in the material prevent moisture-density testing, place and compact the material as follows:

- Place non-moisture density testable material in nearly horizontal layers with thickness not exceeding 12 inches.
- Water or aerate the material to ensure each layer can be compacted to form a dense mass, free of pumping.

- Compact each layer uniformly with a minimum of four full Coverages using a smooth drum vibratory roller.
- Conduct at least one deflection test according to ODOT TM 158 for each layer of embankment placed. If the layer being tested exhibits any yielding, deflection, reaction or pumping, rework the area to provide acceptable test results prior to placement of any additional material.

(d) Small, Irregular Fill Areas - The density requirements of 00330.43 do not apply to irregular fill areas that have a total volume of no more than 150 cubic yards outside of the travel lanes. Construct these areas according to the following:

- Place embankment material in nearly horizontal layers with thickness not exceeding 8 inches.
- Water or aerate the material to ensure each layer does not deflect under the action of the roller used for compaction.
- Compact each layer using a roller appropriate to the material being placed and as directed. Use a smooth-drum vibratory roller for sands and gravels; use a sheepsfoot or tamping-foot roller for Silts and Clays. The Engineer will determine the classification of the embankment Soil.
- Compact each layer uniformly with a minimum of five full Coverages of the specified roller.
- In areas not accessible to rollers, use compaction Equipment suitable for the area and compact each layer with sufficient Coverages to produce a firm unyielding surface.

00330.44 Buttress, Inlay, or Shear Key - Remove the designated materials and construct the Buttress, inlay or shear key as follows:

(a) Preparation - Do not start excavation for each segment until a stockpile of stone embankment material is immediately available at or near the site. Locate the stockpile at a site approved by the Engineer. The size of the stockpile shall be sufficient to fill one excavated segment.

(b) Sequence of Construction - Excavate the area according to 00330.40 and 00330.41 to provide a backslope to the lines, Slopes and details shown, or as directed. Excavate and backfill in segments to minimize aggravating stability conditions. Each segment shall not exceed 75 feet in length as measured across the top of each open excavation segment, unless otherwise specified or directed.

(c) Unsuitable Materials - Sort and dispose of Unsuitable Materials as waste material according to 00330.41(a)(5).

(d) Foundation - Excavate to a depth of at least 5 feet into firm, stable, undisturbed materials as shown or as directed. Remove soft or loose materials. The Engineer will verify sufficient excavation into firm, stable, undisturbed materials in each segment before allowing the backfill. Where shown or directed, place riprap geotextile against the excavated backslope. Remove water from the excavation before placing stone embankment material.

(e) Drainage - Provide drainage as shown or as directed.

(f) Placement of Stone Embankment - After excavation of each segment according to 00330.44(b) and 00330.44(d), place the stone embankment material to fill the excavated segment before excavating the next segment. Backfill all segments on the same Day they are excavated. Place and manipulate the stone embankment material in the Buttress, inlay or shear key to provide a dense and well-filled mass to the lines, Slopes and Cross Sections shown, or as directed.

00330.45 Filling of Holes - Backfill holes outside the limits of required excavation or embankment construction that result from grubbing and removal Work, basements, trenches and other such holes as directed. Smooth and shape to blend with the surrounding area. If the basis of performance is the excavation basis, no separate payment for this Work will be made. If the basis of performance is the embankment basis, payment for this Work will be made according to 00330.94.

00330.46 Watering of Materials - Water materials as directed to provide compaction and required density to embankments and backfills and to alleviate dust nuisance according to Section 00340.

00330.47 Specified Selected Courses or Layers of Materials - In addition to the requirements of 00330.42, select, sort, and place Courses or layers of materials if included in the Contract Schedule of Items. Select and sort the materials obtained from required excavations and place in locations and thicknesses specified, or as directed.

Place and construct selected Courses or layers to conform to the requirements of 00330.42 and 00330.43, unless otherwise specified.

The Work covered by this provision may include, but is not limited to:

- Selected Embankment Material
- Selected Subgrade Material
- Selected Stone Embankment Material
- Selected Topsoil

00330.49 Construction Slide Removal and Repair - Remove construction slide materials and repair construction slide damages to the Work according to Specifications, or as directed, and as follows:

(a) Definition - For the purposes of this provision:

(1) Slide - A slide is a lateral movement of earth materials.

(2) Construction Slide - A slide outside the designated limits of excavations, or below the foundation within designed limits of embankments or within embankments, which occurs after excavation or embankment construction starts and before Final Acceptance of the Contract.

(3) Slide Materials - Materials displaced as the result of a slide.

(b) Remove Construction Slide Materials - Within the limits of established or reestablished lines, grades and Slopes, do the following:

- Excavate and remove construction slide materials.
- Sort and dispose of Unsuitable Materials.
- Use excavated slide materials, to the extent practicable, in embankments, fills, backfills, and widenings, and for flattening slopes within the Project limits.
- Dispose of excess material according to 00330.41(a)(4).

(c) Construction Slide Repair - Reconstruct or restore Subgrade and slopes to the established or reestablished lines, grades and Slopes. Reconstruct or repair damaged Structures or facilities within construction slide areas.

(d) Responsibility for Construction Slide Removal and Repair:

(1) Contractor Responsibility - Perform construction slide removal and repair Work at no additional cost to the Agency when caused by any of the following:

- Embankment foundation conditions or pre-existing subsurface conditions that were reasonably anticipated in the Contract.
- Contractor's method and manner of operations.
- Contractor's failure to perform or to protect the Work according to Plans and Specifications.

(2) Agency Responsibility - Slide removal and repair Work will be paid for according to 00330.90 when all of the following apply:

- Caused by embankment foundation conditions or pre-existing subsurface conditions that were not reasonably anticipated in the Contract.
- Not caused by Contractor's method and manner of operation.
- Not caused by Contractor's failure to perform or to protect the Work according to Plans and Specifications.

Finishing and Cleaning Up

00330.70 General - Immediately before completing the earthwork:

- Blend the tops of cutbanks with the adjacent terrain.
- Trim and finish all Roadbeds, ditches, waterway channels, and other excavations and embankments to the lines, grades, and Cross Sections established.
- Clean up debris and foreign matter of all kinds on the entire Right-of-Way area. Dispose of materials as directed.
- Finish the Subgrade to be within a tolerance of plus or minus 0.06 foot from the established line, grade, and Cross Section and to be free of ruts, depressions and irregularities.
- In planting and seeding areas, remove all rocks, Boulders, and vegetative matter.
- Remove all litter, debris and obstructions.

Measurement

00330.80 Measurement - The quantities of earthwork will be measured according to one or more of the following:

- Volume basis, based on the Agency's digital terrain model (DTM) calculated by Triangular Volume, Average End Area Volume, or by other methods of equivalent accuracy.
- Volume basis, computed by the average end area method from Cross Section measurements, or by other methods of equivalent accuracy. When specified, corrections for curvature will be made.

Measurement will only be for those items listed in 00330.93 and 00330.94 that are actually included as an item in the Contract Schedule of Items.

Structure excavation will be measured according to 00510.80(b).

Materials sub-excavated from beneath footings as required by 00330.42(c)(8) will be measured according to 00510.80(b).

Granular structure backfill will be measured according to 00510.80(d).

Watering of materials required by 00330.46 will be measured according to 00340.80.

00330.81 Excavation Basis Measurement - When measurement of earthwork is on the excavation basis, the materials will be measured in their original positions before excavation. Measurement will be limited to the lines, grades, and Slopes as established.

The quantities of excavation measured for payment will include the volumes of:

- Abandoned pipe and miscellaneous matter within excavation limits.
- Materials removed below Subgrade in Roadbed excavations according to 00330.41(a)(9) and 00330.91(d).
- Overbreak determined to be unavoidable according to 00330.41(a)(10).

The following earthwork items will be measured on the excavation basis:

- Borrow Excavation
- Ditch Excavation
- Foundation Excavation
- General Excavation
- Toe Trench Excavation

Embankments required or necessary to perform earthwork on the excavation basis will not be measured separately.

00330.82 Embankment Basis Measurement - When measurement of earthwork is on the embankment basis, the materials will be measured in their final embankment position. Measurement will be limited to the lines, grades, and Slopes of the original ground contours established before the Contractor begins any Work on the Project.

The quantities of embankment measured for payment will include the volumes of materials used to backfill excavations below Subgrade and holes when shown or directed.

The quantities of embankment measured for payment will not include the volumes of:

- Any additional quantities required due to subsidence, settlement of the ground or Base, settlement within embankments, or to shrinkage, settlement, washout, slippage, or loss regardless of cause, subject to 00170.80 or 00170.82.
- Any additional quantities required due to compaction efforts that are required in 00330.43.
- Any additional quantities required due to clearing and grubbing operations.
- Slide materials paid for according to 00195.20.
- Any materials for which payment is made for completed embankments or backfills under other Contract provisions.

The following earthwork items will be measured on the embankment basis:

- Embankment In Place
- Stone Embankment
- Extra For Selected ____ Material

Excavations, including cutbank rounding, overbreak whether avoidable or not, and foundation benching, required or necessary to perform earthwork on the embankment basis, and retrieval or removal of Cobbles and Boulders according to 00330.42(c)(2)(a) will not be measured separately.

When an excavation basis item is included in the Contract Schedule of Items and selected materials are obtained from the excavation for use as "Extra for Selected ____ Material", measurement will be made for both items.

Payment

00330.90 Payment - The accepted quantities of earthwork performed under this Section will be paid for at the Contract unit price, per unit of measurement, for each item that appears in the Contract Schedule of Items.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Structure excavation will be paid for according to 00510.90(b).

Materials sub-excavated from beneath footings as required by 00330.42(c)(8) will be paid for according to 00510.90(b).

Granular structure backfill will be paid for according to 00510.90(d).

Watering of materials required by 00330.46 will be paid for according to 00340.90.

Slide removal and repair Work determined under 00330.49(d)(2) to be Agency responsibility will be paid for according to 00195.20.

No separate or additional payment will be made for Work that is required to be done under these Specifications that does not appear as a separately listed item in the Contract Schedule of Items.

No separate or additional payment will be made for blasting done according 00330.41(e) unless a blasting item is listed in the Contract Schedule of Items.

00330.91 Kinds of Pay Excavation - The kinds of pay excavation on the Project will be indicated by the items listed in the Contract Schedule of Items and are defined as follows:

(a) Ditch Excavation:

- Limited to the lines, grades, and Cross Sections shown or established with bottom widths of 8 feet and less that lie outside of and separate from Roadbed Cross Sections.
- Includes canals, channels, and inlet, outlet, diversion, drain, and other open ditches to carry water.

(b) Foundation Excavation:

- Limited to the lines, grades, and Cross Sections shown or established.
- To remove soft materials for preparation and stabilization of areas below embankments.

(c) Toe Trench Excavation:

- At the toe of riprap slopes as shown and elsewhere as directed to provide a suitable foundation toe trench on which to place riprap geotextile or filter blanket, and riprap Material.

(d) General Excavation:

- Other than ditch, trench, structure, foundation, toe trench, and Borrow excavation.
- Includes cut ditches, Borrow ditches, and Roadside ditches in the roadway section as staked or established, or shown as being a part of the typical roadway Cross Sections.
- Includes other ditches with bottom widths greater than 8 feet.
- Includes Unsuitable Material excavated below Subgrade in Roadbed excavations according to 00330.41(a)(9), when determined that such excavation is neither more nor less difficult to remove than the material above Subgrade in the whole of the cut. When determined that such excavation is either more or less difficult to remove than the material above Subgrade in the whole of the cut, payment will be according to 00195.20.

(e) Borrow Excavation:

- Obtained from specifically designated and authorized sources lying outside of, separated from, independent of, and beyond the roadway Cross Sections, unless otherwise directed.

00330.92 Kinds of Incidental Earthwork - No separate or additional payment will be made for the following:

- Removal of overburden from pits and quarries.
- Excavation of Rock and other Material for use in Surfacings or Structures.
- Excavation for haul roads.
- Other excavation (Borrow excavation excepted) that is not directly a part of the finished Work.
- Blending tops of cutbanks with adjacent ground according to 00330.41(a)(11).
- Overbreak, except on excavation basis earthwork and the Engineer determines that overbreak was unavoidable.
- Foundation benching performed according to 00330.42(a)(7).
- Rock excavated below the excavation plane established by 00330.41(a)(9) and the specified backfill required to fill up to the excavation plane, to the satisfaction of the Engineer.
- Smoothing and maintaining foundations, Roadbeds, and haul roads.
- Material handled, removed, placed, or used contrary to Specifications or directions.
- Rehandling and reshaping of materials previously excavated, except where called for in the Specifications, Plans, or Contract Change Orders.
- Excavation for forms to construct curbs, gutters, walks and other similar Structures unless specified.
- The volume of any free water or liquid.
- Hauling, moving, or transporting earthwork materials.
- Removal of excess moisture according to 00330.42(b).
- Retrieval or removal of Cobbles and Boulders according to 00330.42(c)(2)(a).
- Constructing outer portions of embankment with suitable Material for slope stabilization.

- Additional quantities of materials required due to clearing and grubbing operations and compaction requirements within embankment limits.

00330.93 Excavation Basis Payment - When listed in the Contract Schedule of Items, the following items will be paid for on the excavation basis:

	Pay Item	Unit of Measurement
(a)	Ditch Excavation	Cubic Yard
(b)	Foundation Excavation	Cubic Yard
(c)	Toe Trench Excavation	Cubic Yard
(d)	General Excavation	Cubic Yard
(e)	Borrow Excavation	Cubic Yard

These items include excavating, selecting, handling, hauling, placing, and compacting the materials as specified.

00330.94 Embankment Basis Payment - When listed in the Contract Schedule of Items, the following items will be paid for on the embankment basis:

	Pay Item	Unit of Measurement
(a)	Embankment In Place	Cubic Yard
(b)	Stone Embankment	Cubic Yard
(c)	Extra For Selected ____ Material	Cubic Yard

Item (a) includes excavating, selecting, handling, hauling, placing, and compacting of the Materials as specified and all other costs incurred in furnishing required embankment Materials.

Item (b) includes furnishing, selecting, handling, hauling, placing, and compacting the material as specified.

In item (c), the type of Material will be inserted in the blank.

Item (c) includes preserving, sorting, stockpiling, and handling of the specified selected Materials as described in 00330.41(a)(1) and 00330.41(a)(2), selected and placed according to 00330.42, 00330.47, and the Special Provisions.

Unless a specific Pay Item in the form of item (c) appears in the Contract Schedule of Items, no separate or additional payment will be made for preserving, sorting and handling selected Materials. However, earthwork materials obtained from excavations and incorporated into specified embankments will be paid for at the applicable item, if listed in the Contract Schedule of Items.

Excavation of unstable material that is below Subgrade in Roadbed excavation areas, according to 00330.41(a)(9), will be paid for according to 00195.20.

Section 00331 - Subgrade Stabilization

Description

00331.00 Scope - This Work consists of excavating and disposing of unstable materials in excavation areas only and placing Subgrade geosynthetic, stone embankment, and Aggregate backfill to the lines and grades as shown or directed.

Materials

00331.10 Materials - Furnish Materials meeting the following requirements:

Aggregate Base 02630
Aggregate Subbase..... 00641.10(b)
Stone Embankment.....00330.16
Subgrade Geotextile.....02320
Subgrade Reinforcement Geogrid.....02320
Water.....00340

00331.16 Acceptance of Backfill - The backfill Material will be accepted based on visual inspection. The Engineer may perform tests if deemed necessary.

Equipment

00331.20 General - Provide all Equipment necessary to perform the Work according to Sections 00330, 00340, 00350, and 00641.

Construction

00331.40 Excavation - Excavate unstable material to the lines and grades as shown or directed. Dispose of the excavated material according to 00330.41(a)(5).

00331.41 Geosynthetic:

(a) Geotextile - Place geotextile as shown.

(b) Subgrade Reinforcement Geogrid:

(1) Placement - Prepare the surface receiving geogrid to a smooth, uncompacted condition to the depth shown and as follows:

- Orient the geogrid rolls parallel to the roadway centerline.
- Unroll the geogrid in the same direction as Aggregate Base placement. If the geogrid shifts or becomes misaligned, realign it and anchor it according to the manufacturer's recommendations.

(2) Overlaps - Overlap the geogrid a minimum of 24 inches. Overlap the geogrid in the same direction as Aggregate Base placement with the preceding layer lapped on top of the following layer.

(3) Protection of Geogrid - Drive rubber tired Equipment on the geogrid at no more than 5 mph. Drive tracked Equipment on the geogrid only after placing a minimum of 6 inches of Aggregate Base on top of the geogrid. Do not turn or make sudden stops or starts on the geogrid or the Aggregate Base.

During installation cover the geogrid with the Aggregate Base as soon as possible. Do not leave uncovered for more than 5 Calendar Days.

(4) Repair - Repair or replace damaged or torn geogrid according to manufacturer's recommendations at no cost to the Agency.

00331.42 Backfill - Place the backfill material to lines and grades as shown or directed, to provide a homogeneous mixture. Compact the backfill until there is no reaction or yielding under the compactor.

Measurement

00331.80 Measurement - The quantities of Subgrade stabilization will be measured on the area basis of Subgrade surface area stabilized to the full depth as shown. The surface area will be determined by horizontal measurements. In areas where directed to stabilize to a depth other than shown, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

Payment

00331.90 Payment - The accepted quantities of Subgrade stabilization will be paid for at the Contract unit price, per square yard, for the item "____ Inch Subgrade Stabilization".

The depth of stabilization will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for excavation, geosynthetic, stone embankment or Aggregate backfill Material, or water.

Section 00335 - Blasting Methods and Protection of Excavation Backslopes

Description

00335.00 Scope - This Work consists of excavating in Rock using controlled blasting methods to achieve smooth, uniform and unfractured backslopes, and produce a free surface or shear plane in the Rock along the specified excavation backslope, and production blasting to facilitate excavation.

00335.01 Definitions:

Buffer Row - In multiple-row blasts in which perimeter control blasting techniques are used, the first row of production holes immediately adjacent to and drilled along a plane parallel to the perimeter control blast line. The buffer row is located between the production holes and the perimeter controlled blast line.

Perimeter Controlled Blasting - The use of explosives and blasting accessories in carefully spaced and aligned drill holes. Perimeter controlled blasting techniques include presplitting and trim (cushion) blasting.

Presplitting - A perimeter control blasting method in which the perimeter row of blast holes are drilled along the plane of the specified final excavation backslope and that utilizes reduced drill hole spacing and reduced diameter explosives decoupled from the drill hole wall, and whose initiation precedes the initiation of the adjacent production holes by a minimum of 25 milliseconds.

Production Blasting - Fragmentation blasting in the main excavation area, usually using more widely spaced drill holes than controlled blast holes

Trim (Cushion) Blasting - A perimeter control blasting method in which the initiation of the perimeter row of blast holes drilled along the plane of the specified final excavation backslope follows the initiation of the adjacent production holes within 25 to 75 milliseconds, if production holes are being employed in the blast.

Materials

00335.10 Materials - Furnish all explosives and blasting caps that are no more than 1 year old. Each blasting cap period shall come from one lot number.

Construction

00335.40 Blasting Methods:

(a) General - Use methods in making excavations that do not shatter or loosen the backslopes and that produce smooth and uniform excavation slopes at the specified Slope angles. These include:

- **Perimeter Controlled Blasting** - Use on the entire length of cut section in Rock or cemented materials that have backslopes of 1V:0.75H or steeper, even if the main excavation can be ripped.

- **Production Blasting** - Blasting in the mass of Rock to be excavated shall be designed to control flyrock, minimize ground vibration and air blast, and result in loosened and fragmented in-place Rock of a size that can be removed, transported, or crushed to produce specified products. Lay out production blast holes in a consistent pattern that does not affect the perimeter control blast holes. Where production blast holes are made adjacent to Highways with specified closure restrictions, the volume of material blasted shall not exceed the

Contractor's ability to remove the blasted material from the adjacent Highway within the specified closure time.

(b) Safety and Flyrock Control - Use techniques that effectively limit and control flyrock. Clear the site of all boulders or other material as directed prior to beginning blasting Work. Following every blast, observe the entire blast area for a minimum of 5 minutes before reentering or commencing Work in the area.

Be responsible for the storage, transportation, and handling of explosives, their use, and the results of all blasting operations according to 00170.94.

Cover all blast areas that are within 200 feet of residences, facilities or above-ground utilities using appropriate blast containment mats or an approved equivalent method.

Discontinue blasting operations, as directed, if it is apparent that the methods employed are not producing acceptable results or the safety of the public, the Contractor's employees or adjacent property is being jeopardized.

(c) Preblast Survey - Offer, in writing, to perform a preblast survey for owners and occupants of all buildings, Structures, and utilities within the distance of the blast specified in 00335.40(e). If the offer is accepted, use an Agency-approved survey form, signed and completed by an independent third party, and submitted to the Engineer and Contractor at least 72 hours before blasting begins. Deliver a copy of the survey form and copies of any photos taken to the owners and occupants.

(d) Blasting Plan - Provide a separate blasting plan for each cut that requires blasting, prepared by a person qualified and experienced in blasting Work. Each plan shall cover individual major Rock cut areas or Rock production from a material source. Similar minor Rock cut areas of less than 50 cubic yards, as well as utility and culvert trenches, may be covered as a group in one generalized blasting plan.

Submit the blasting plans for the Engineer's review at least 21 Calendar Days before beginning drilling for excavations or when any perimeter controlled blasting is required.

The blasting plans will be reviewed for conformance with the Specifications and any concerns will be discussed with the Contractor. Submit any proposed changes to the blasting plans in writing to the Engineer for review before implementation. Submittal of blasting plans is for quality control and record-keeping purposes.

Review of blasting plans by the Engineer does not relieve the Contractor of full responsibility for the accuracy and adequacy of the plans and the resulting safety when implemented in the field.

Each blasting plan shall contain the full details of the drilling and blasting patterns, vibration, flyrock, and noise reduction methods, blast area security measures and traffic control that the Contractor proposes to use, and the following information:

- Station limits of proposed shot.
- Removal of overburden.
- Plan and Cross Section diagrams of proposed drill pattern for controlled and production blast holes including buffer rows, free face, burden, blast hole spacing, blast hole diameters, blast hole angles, lift height and sub drill depth. Accurately draw to scale and show each cut area to be blasted.
- Loading diagram showing the type, amount and specific gravity of explosives, primers, and initiators, and location depth, and type of stemming.

- Initiation sequence of production and controlled blast holes including delay times and delay system.
- Manufacturer's product data sheets for all explosives, primers and initiators to be used in the Work.

(e) Blasting Notification - Notify all owners and occupants of buildings, Structures, and utilities that are within the following distances of the blasting areas:

- 300 feet for shots using less than 50 pounds of explosives per time delay of 15 milliseconds.
- 600 feet for shots using between 50 and 250 pounds of explosives per time delay of 15 milliseconds.
- 1,250 feet for shots using more than 250 pounds of explosives per time delay of 15 milliseconds.

Provide notification, in writing, once, at least 48 hours before blasting begins, and again on the Day the blasting operations occur.

Do not begin detonation of the blast until the Agency representative is ready to videotape the blast, or until the Engineer is prepared to witness the blast.

(f) Blasting Test Sections - Demonstrate the adequacy of each proposed blasting plan by means of test shots in each cut or excavation before beginning full-scale blasting. Do not proceed with remaining drilling and blasting until acceptable test blast results have been demonstrated to the satisfaction of the Engineer.

In areas where perimeter controlled blasting techniques are being employed, drill and blast short representative test sections not exceeding 100 feet in length. Excavate a section not less than 20 feet wide exposing the full height of the lift for examination. In areas where no perimeter controlled blasting techniques are being employed, determine effectiveness of the test section based on the material placement, cut slope stability, fragmentation and control of ground vibration, air blast and flyrock.

Do not drill ahead of the test blast area, except as provided in 00335.41(a)(6), until the test section has been evaluated. The Contractor may be directed to use test section lengths less than 100 feet.

If the results of the test shots are unacceptable revise the methods, techniques and procedures, at no additional cost to the Agency, so that the results achieved will be acceptable. No further drilling and blasting will be allowed until the revised methods are reviewed according to 00335.40(d) and verified by additional test shots.

If, during the progress of the Work, the methods of drilling and blasting do not produce acceptable results within the tolerances specified, drill, blast and excavate additional test sections until a technique is determined that will produce acceptable results.

(g) Blasting According to Plan - After the Engineer has reviewed the blasting plan and determined that test sections have demonstrated acceptable results, perform all perimeter controlled and production blasting according to the plan that produced acceptable results. Notify the Engineer when any changes in conditions or results are observed. On the Day of each blasting occurrence and before detonation of the blast, the supervisor or blasting specialist in charge shall certify, in writing, that the shots being carried out are consistent with the reviewed blasting plan.

(h) Blasting Report - Submit a blasting report detailing the blast outcome within 48 hours of making each blast. Include in the report the following:

- Drill logs and notes regarding conditions encountered in the drill holes, including a description of encountered subsurface conditions such as open joints, soft or fractured Rock zones, groundwater conditions, hole alignment, and drilling problems.
- Any variations from the submitted Blasting Plan, including any changes to explosives type or amount, loading dimensions, hole spacing, and initiation sequence and delay times.
- All blast monitoring documentation.
- A copy of the color video recording of the blast area(s), with sound, high definition (at least 1080p resolution, 24 fps), in a format commonly used for viewing with a computer or DVD player. The video recording must show an unobstructed view of the blast area, framed to show both above and below the blast area. Begin recording at least 10 seconds before the blast, and continue recording until there is no visible dust.
- A comment section that includes the Contractor's evaluation of the blast performance, any unusual conditions or situations during the blast, and any misfires.
- Details of all damage incurred and details of all neighbors' complaints or comments.

(i) Suspension of Blasting - If damage to existing facilities or adjacent property occurs due to blasting, immediately suspend blasting and report damage to the Engineer. Discontinue blasting operations if the methods of drilling and blasting do not produce acceptable results within the tolerances specified.

Before resuming blasting operations, revise the Blasting Plan and take other appropriate measures as necessary to correct the unacceptable blasting results. Submit the revised Blasting Plan to the Engineer. Do not resume blasting until authorized by the Engineer.

00335.41 Controlled Blasting Methods:

(a) Presplitting:

(1) Attach mechanical devices to all drilling Equipment used to drill the presplit holes to determine, within an accuracy of 1 degree, the angle at which the drill steel enters the Rock.

(2) Drill presplit holes with a minimum diameter of 2 1/2 inches and a maximum diameter of 3 inches.

(3) Start presplit drill holes along the presplit line within 3 inches of the dimensions shown on the blasting plan. Holes located beyond this tolerance will be rejected. Completely fill the rejected holes with stemming material at no additional cost to the Agency. Drill new presplit holes with the proper spacing. Rejected holes will not be measured for payment.

(4) Control the drilling operations to ensure that presplit hole alignment does not vary from the plane of the planned slope by more than 9 inches either parallel or normal to the slope. Presplit holes exceeding these limits will not be paid for unless, in the Engineer's opinion, satisfactory slopes are being obtained.

(5) The length of presplit holes for any individual lift shall not exceed 30 feet unless the Contractor can demonstrate to the Engineer's satisfaction that hole alignment can be maintained within the above tolerances. Upon satisfactory demonstration, and with written permission of the Engineer, the length of holes may be increased to a maximum of 60 feet. If more than 5 percent of the presplit holes are misaligned in any one lift, reduce the height of the lifts until the 9-inch alignment tolerance is met.

(6) Drill presplit holes a minimum of 30 feet longitudinally beyond the limits of the production holes to be detonated or to the end of the cut. Unless otherwise allowed by the Engineer in writing, remove all overburden, including any loose or decomposed Rock, before drilling the presplitting holes.

(7) When the cut height will require more than one lift, a maximum offset of 18 inches between lifts will be allowed to allow for drill Equipment clearance. Adjust the Slope angle of lower lifts to compensate for drill offsets and any drift that may have occurred in upper lifts.

(8) Use only explosives manufactured specifically made for presplitting in the presplit holes. The maximum diameter of explosives used in presplit holes shall not be greater than half the diameter of the presplit hole. Bulk ammonium nitrate and fuel oil (ANFO) will not be allowed in the presplit holes.

(9) Determine that the presplit hole is free of obstructions for its entire depth before placing charges. Exercise all necessary precautions so the placing of the charges will not cause caving of material from the walls of the holes.

(10) Detonation of explosives in each hole in a presplit shot may be delayed, providing the hole-to-hole delay is no more than 25 milliseconds.

(11) Drill the presplit holes with a minimum spacing of 10 times the presplit hole diameter, and a maximum spacing of 14 times the presplit hole diameter.

(b) Trim (Cushion) Blasting - When the horizontal distance from the new proposed slope face to the existing Rock face is less than 15 feet, the Contractor may trim blast instead of presplitting. The requirements in 00335.41(a) for presplitting also apply to trim blasting, by changing the words "presplit" and "presplitting" to "trim blasting". If trim blasting burdens are less than 6 feet or zones of weakness in the Rock are observed, submit a hole loading diagram that reflects the site conditions.

(c) Buffer Row - Locate the buffer hole line a minimum of 3 feet away from the perimeter control blast line, or 1 foot for every inch of buffer hole diameter, whichever is greater. Space buffer row holes 3 to 5 feet center-to-center. The explosive load in buffer holes shall not exceed 50 percent of the full explosive load that could be placed in a 3-inch production hole. Initiation of the buffer holes shall be on a delayed sequence toward a free face.

00335.42 Production Blasting - Do not drill any row of production blast holes closer than 6 feet to the perimeter controlled blast line. Where necessary to minimize damage to the Rock backslope, a row of buffer holes may be drilled between the perimeter controlled blast line and the production blast holes. Except for the bottom lift, do not extend production holes below the bottom of the controlled blast holes. Do not exceed 6-inch diameter for production holes. Detonate production holes on a delay sequence documented in the blasting plan.

00335.43 Scaling - Remove all loose, hanging, or potentially dangerous Rock on the excavated surface by scaling during the completion of the excavation of each lift or test section. Do not begin drilling the next lift until this Work has been completed, as directed.

Scale the slopes throughout the Contract at the frequency required to remove loose or overhanging material.

Use a suitable standard steel mine scaling rod to hand-scale the slopes. Other methods such as machine scaling, hydraulic splitters or light blasting may be used instead of, or to supplement, hand-scaling, if allowed.

Measurement

00335.80 Measurement - The quantities of perimeter controlled blast holes will be measured on the length basis and will be determined by dividing the cut slope surface area by the perimeter controlled blast hole spacing. The cut slope surface area will be determined by Cross Section measurement from the top of the blasted Rock to the finished ditch bottom elevation.

The quantities shown in the Contract Schedule of Items have been computed from a theoretical plan length using 30-inch hole spacing. The actual quantities will depend on field conditions and results from blasting test sections.

Payment

00335.90 Payment - The accepted quantities of perimeter controlled blast holes will be paid for at the Contract unit price, per foot, for the item "Perimeter Controlled Blast Holes".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for blasting, scaling, or loosening materials for excavation.

When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00340 - Watering

Description

00340.00 Scope - This Work consists of furnishing and applying water or combinations of water and additives for:

- Compacting and preparing Roadbed excavations, Roadbed embankments, backfills, Subgrades, Subbases, Bases and Surfacings.
- Preventing or alleviating dust nuisance originating within the highway Right-of-Way and the Project limits, which is not caused by the Contractor's operations at the Contractor's plants or plant setups.
- Other watering when ordered.

00340.01 Definitions:

Additives - Emulsified Asphalt, magnesium chloride or other Materials added to water for the purpose of Aggregate binder or dust control.

00340.02 Exclusions - Watering that is specified as Incidental and included in payment for other items or parts of Work is excluded from measurement under this Section.

Materials

00340.10 Water - Furnish water free of silts and other matter harmful to the quality of the material to which it is applied or with which it is mixed.

Comply with Chapter 537 of the "Oregon Water Laws", which is administered by the Water Resources Department, covering the appropriation of water.

Most adjudicated water may be limited to agricultural uses, so it should not be assumed that there will be any water sources in the immediate area of the Project available for the Contractor's use.

00340.11 Water Mixtures:

(a) Use of Additives - When called for by the Special Provisions, or ordered, perform watering with a mixture of water and additives. Use an additive from the QPL and mix according to the manufacturer's recommendations.

(b) Magnesium Chloride - When required, furnish Magnesium Chloride ($MgCl_2$) in brine solution at 28 to 35 percent concentration by weight.

Equipment

00340.20 Watering Equipment - Perform uniform and controlled application of watering by one or more of the following methods:

- Tank trucks equipped with spray bars
- Hose and nozzle
- Wetting materials in stockpile or in excavation areas before excavating
- Other means, as directed

The use of splash boards will not be allowed without prior approval. When required, provide a metering device for water measurement.

Construction

00340.40 Watering:

(a) General - Make all necessary arrangements to obtain water and pay all costs involved in its procurement. Maintain an adequate supply of water at all times.

Perform watering only when and where directed at an approved rate and manner of application. Water at any hour of the Day, and on any Day of the week, as directed, for proper performance or protection of the Work and for alleviation of dust nuisance.

(b) Use of Additives - If an additive is combined with water in the watering Work, mix it in the proportions and manner specified, and use in the Work as directed.

Maintenance

00340.60 Avoidance of Detrimental Operations - Avoid wasting water or watering detrimental to other Work. Cease such operations until corrective measures are directed.

Measurement

00340.80 Measurement - The quantities of water will be determined by the following methods:

- Weight or volume, or both
- In tanks or tank trucks of predetermined capacity
- By approved meters

Measurement will be M-gallons (1,000 gallons = 1 M-gallon) not including the additives used in the watering as specified or ordered. For conversion purposes, water weighs 8.34 pounds per gallon or 62.4 pounds per cubic foot. Only quantities acceptably used in the Work, as specified, will be measured.

Quantities of additives combined with water for watering purposes will be determined separately from the water and will be measured on the volume basis in gallons.

Payment

00340.90 Payment - The accepted quantities of water and additives will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Watering	M-Gallon
(b)	____ in Watering	Gallon

Item (a) includes furnishing and developing the water supply, hauling and applying the water.

In item (b), the name of the additive will be inserted in the blank.

Item (b) includes furnishing the specified additive, for combining and mixing it with the water, and for all extra costs involved in the use of the additive in the watering Work not included in item (a).

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for obtaining permits, water rights, or any other costs related to complying with the "Oregon Water Laws".

When the Contract Schedule of Items does not indicate payment for Work performed under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

00340.91 Quantity Variations - Payment for watering items performed beyond 25 percent of the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the Work according to Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the Work, payment for the Additional Work will be made according to 00195.20.

Section 00350 - Geosynthetic Installation

Description

00350.00 Scope - This Work consists of furnishing and placing geosynthetics in drains, under embankments, for embankment reinforcement, under riprap, Buttresses, inlays, shear keys, over Roadbed Subgrades, and beneath Pavement overlays as shown or directed.

00350.01 Definitions - Terms not defined in this Subsection may be found in ASTM D123 and ASTM D4439. If there is a conflict, definitions in this Subsection take precedence.

Cross-Machine Direction - The direction in the plane of the fabric perpendicular to the direction of manufacture.

Drainage Geotextile - For installation as a filter in subsurface drains or other drainage locations.

Embankment Geotextile - For installation as a reinforcement within embankments and/or as a separator under embankments.

Geosynthetics - A planar product manufactured from polymeric material used with Soil, Rock, earth or other geotechnical, engineering related material as an integral part of a man-made product, Structure or system.

Geogrid - A geosynthetic used for reinforcement which is formed by a regular network of tensile elements with apertures of sufficient size to allow strike-through of surrounding Soil, Rock or other geotechnical material.

Geotextile - A permeable geosynthetic comprised solely of textiles.

- **Nonwoven Geotextile** - A textile produced by bonding and/or interlocking of fibers by mechanical, heat or chemical means.

- **Woven Geotextile** - A textile comprising of two or more sets of filaments or yarns interlaced in such a way that they result in a uniform pattern.

Machine Direction - The direction in the plane of the fabric parallel to the direction of manufacture.

Pavement Overlay Geotextile - For installation as a reinforcement beneath an asphalt concrete overlay.

Riprap Geotextile - For installation as a filter and/or separator behind or beneath riprap, Buttresses, inlays, shear keys and/or erosion control applications.

Roll - Unit of continuous geosynthetic without transverse seams as furnished by the manufacturer. Roll sizes may vary between manufacturers and types of geosynthetics.

Roll Values:

- **Average Roll Value** - The average roll value for each property is determined by testing a representative number of samples in a roll according to the test methods specified in Section 02320. An average of these tests becomes the average roll value for each roll tested.

- **Minimum Average Roll Value** - The minimum average roll value for each property is the mean of the average roll values for all rolls tested minus two standard deviations, all as determined by the manufacturer. The minimum average roll value for each property is determined by testing a

representative number of rolls in a production run according to ASTM D4354 sampling procedures and the test methods specified in Section 02320.

- **Minimum Value** - The minimum value is the specified value for each geosynthetic property that shall be met or exceeded by the manufacturer's minimum average roll value for the production run and, if sampled and tested by the Agency, by the average roll value for any roll.

Seam Allowance - The minimum distance from the edge of a geotextile to the stitch line nearest to that edge.

Seam Type - A designation relating to the essential characteristics of geotextile positioning and rows of stitching in a specified sewn seam as shown on the Plans.

Selvage - The finished edge of a geotextile parallel to the machine direction.

Stitch Type - A designation relating to the essential characteristics of the interlacing of sewn threads in a specified seam as shown on the Plans.

Subgrade Geotextile - For installation as a separator and/or reinforcement on Subgrades and in other material separation applications.

Ultraviolet Rays - Direct radiation from the sun during daylight hours, even on cloudy days.

Ultraviolet Stability - The ability of a geosynthetic to resist deterioration when exposed to UV radiation.

Materials

00350.10 Materials - Furnish Materials meeting the requirements of Section 02320.

Equipment

00350.20 Field Seam Stitching Equipment - Use field seam stitching Equipment that provides an acceptable lock-type stitch as recommended by the geotextile manufacturer and approved by the Engineer.

00350.21 Asphalt Distributor - Design, equip, maintain, and operate the asphalt distributor according to 00730.22.

Construction

00350.40 General - Provide geosynthetic as furnished by the manufacturer and protect against damage and deterioration. Prevent excessive mud, wet concrete, epoxy and like materials from coming in contact with the geosynthetic. Store all geosynthetics in a dry place and off the ground at all times according to ASTM D4873. Cover all geosynthetics with a dark protective covering when received. The geosynthetic will be rejected for use if the Engineer determines it has defects or deterioration, or has been damaged.

00350.41 Geotextile Installation Requirements:

(a) General:

(1) Placement:

a. Surface Preparation - Prepare the surface receiving the geotextile to a smooth condition free of obstructions, depressions and debris unless otherwise directed. Do not drag the geotextile on the ground or mishandle in any way.

Loosely place the geotextile without wrinkles so placement of the overlying material will not tear the geotextile. Lap or sew the geotextile at the ends and sides of adjoining sheets as specified.

b. On Slopes - Place the geotextile with the machine direction oriented up-down the slope. Lap the upper sheets over the lower sheets. When the geotextile is placed on a Slope steeper than 6V:1H, securely anchor the laps to the ground surface with pins or stakes as necessary to prevent the slippage and tearing of the geotextile. Start placement of fill material on the geotextile at the toe of the slope and proceed upwards.

c. Where Exposed to Water - If geotextiles are placed under water or in areas where water will flow, the geotextile may be placed with the machine direction parallel to the direction of water flow instead of the placement direction specified in 00350.41(a)(1)(b). Overlap sheets so the upstream sheet is placed over the top of the downstream sheet. Adequately secure the geotextile to prevent slippage. As the geotextile is placed under water, place the backfill material on it to the required thickness. Do not place geotextile more than 50 feet ahead of the specified cover material.

(2) Overlaps - Minimum overlap requirements for geotextiles are:

Application	Minimum Overlap Requirements (Inch)
Drains	12
Embankment Stabilization	24
Pavement Overlays	*
Riprap and Rock Buttresses	24
Roadbed Subgrade Stabilization	24

* Use sufficient overlap to ensure closure, but not more than 6 inches.

If the Engineer determines the specified overlap is not sufficient, increase the overlap to provide adequate coverage or, if approved by the Engineer, sew the geotextile together in the field. If field-sewn, the provisions of 00350.20 and 00350.41(a)(3) apply.

(3) Field Seams:

a. General - When field-sewn seams are required, make them as follows:

Sew field seams with polymeric thread consisting of polypropylene, polyester or kevlar, and as resistant to deterioration as the geotextile being sewn. Use a color of thread that contrasts with the geotextile being sewn so the stitches are exposed for inspection when the geotextile is placed. Seams shall meet the testing requirements of 02320.11(b).

b. Stitch Requirements - Use two rows of lock-type stitching, Type 401, to make the seams, as shown. The two rows of stitching shall be 1/2 inch apart with a tolerance of plus or minus 1/4 inch and not cross except for restitching.

c. Minimum Seam Allowance - The minimum seam allowance (the minimum distance from the edge of geotextile to the nearest stitching) is:

Seam Type (See Plans)	Minimum Seam Allowance (Inch)
Flat or Prayer Seam, Type SSa-1	1 1/2
"J" Seam, Type SSn-1	1
Butterfly-folded Seam, Type SSd-1	1

d. Seam Type - Obtain the geotextile manufacturer's recommendation for the type of seam and stitch to be used. If the Contractor does not obtain and provide the foregoing technical information use a "J" seam with at least three stitches per 1 inch. The flat, or prayer, seam may be used for repair of damaged in-place geotextile.

(4) Protection of Geotextile - Protect the geotextile at all times from ultraviolet (UV) rays, contamination by surface runoff and construction activities.

Traffic or construction Equipment will not be allowed directly on the geotextile except as authorized in 00350.41(f)(5) or as directed.

During installation, cover the geotextile with specified cover material as soon as possible. Do not leave in uncovered condition for more than 5 days.

Place cover material on the geotextile in such a manner that the geotextile is not torn, punctured or shifted. Use a minimum 6-inch thick cover layer or twice the maximum Aggregate size, whichever is thicker. Do not end-dump cover material directly on geotextiles other than riprap geotextile.

Limit construction vehicles in size and weight so rutting in the initial layer above the geotextile is not more than 3 inches deep or half the layer thickness, whichever is lesser. Do not turn vehicles on the first layer.

(5) Repair of Geotextile - Repair or replace all torn, punctured or contaminated geotextiles during construction at no cost to the Agency. Repair by placing a patch of the specified geotextile over the affected area. Overlap the existing geotextile with the patch according to 00350.41(a)(1). Where geotextile seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the Plans or Special Provisions, or as directed.

(b) Drainage Geotextile - When used in trenches for drains, place the geotextile in the trench as shown on the Plans to loosely conform to the shape of the trench with no wrinkles or folds.

(c) Embankment Geotextile - Construct embankment stabilization according to details shown on the Plans. Place the geotextile layers so the geotextile machine direction is transverse to the embankment centerline. Spread the geotextile so all slack and wrinkles are eliminated. Construct embankment in uniform layers according to Section 00330.

(d) Riprap Geotextile - Place geotextile behind and beneath riprap, Buttresses, inlays, shear keys and erosion control applications according to the details shown. Demonstrate to the satisfaction of the Engineer that the combination of the Rock-fill drop height and the thickness of any Aggregate cushion, when specified or required, is adequate to prevent puncturing or damaging the geotextile when placing the riprap or stone embankment material. If an Aggregate cushion is used, place according to 00350.41(a)(4). In addition, the following limits apply:

Size of Rock	Maximum Drop Height (Feet) Onto Geotextile Material	Onto an Aggregate Cushion Blanket
Greater than 200 pounds	0	3
200 pounds or less	3	3

After placing the riprap, backfill all voids in the riprap face so the geotextile is completely covered and not visible.

(e) Subgrade Geotextile - For Roadbed Subgrade separation, prepare the Subgrade according to Section 00330.

Correct geotextile failures, as evidenced by Soil pumping or Roadbed distortion, by removing any covering material in the affected area and placing a geotextile patch on the exposed geotextile according to 00350.41(a)(5). Cover the patch with the specified cover material and compact before proceeding.

(f) Pavement Overlay Geotextile:

(1) General - Place geotextile and Pavement overlay in four basic steps:

- Surface preparation
- Sealant application
- Geotextile placement
- Overlay placement

(2) Weather Limitations - Do not place sealant and geotextile unless the weather limitations of 00745.40 are met, as appropriate, except the minimum air temperature shall be 50 °F for paving grade asphalt sealant placement and 60 °F for asphalt emulsion sealant placement.

(3) Surface Preparation - Prepare the Pavement surface on which the sealant is to be placed according to 00730.42 and the following:

- Clean and fill cracks exceeding 1/8 inch width with a bituminous crack filler from the QPL.
- Repair minor irregularities or depressions as directed.
- Allow crack filling material to cure before placing geotextile.
- Where the Pavement is severely cracked, rutted, deformed or otherwise distressed, place a Leveling Course as directed instead of extensive surface preparation.

(4) Sealant Application - Use a normal paving grade asphalt. A cationic or anionic emulsion may be used as approved. Do not use cutbacks or emulsions that contain solvents.

Uniformly spray the asphalt sealant at normal application temperature by means of a pressure distributor conforming to 00350.21 on the prepared dry Pavement surface. Apply at the rate of 0.20 - 0.30 gallon per square yard, or as recommended by the geotextile manufacturer or as directed.

If using emulsions, increase the application rate 50 percent or as directed. Some underlying surfaces may require a higher application rate. Within street intersections, on steep grades or in other zones where vehicle speed changes are commonplace, reduce the normal application rate by 20 percent or as directed.

The target width of the sealant application shall be the geotextile width plus 6 inches. Apply the sealant only as far in advance of the geotextile installation as appropriate to ensure a tacky surface at the time of geotextile placement. Place the geotextile the same Day as the sealant. Do not allow traffic on the sealant. Clean excess asphalt from the road surface.

(5) Geotextile Placement - Place the geotextile into the sealant using mechanical or manual laydown Equipment capable of providing a smooth installation with a minimum amount of wrinkling or folding from the water (break) before placing the geotextile.

Slit wrinkles or folds exceeding 1 inch and lay flat. Shingle-lap not more than 6 inches in the direction of the paving. Broom and/or pneumatic roll to maximize geotextile contact with the Pavement surface. Additional hand-placed sealant material may be required at laps as determined.

Limit traffic to necessary construction Equipment and emergency vehicles on the geotextile before and during paving unless otherwise directed. Turn the paver and other vehicles gradually. Keep turning to a minimum to avoid geotextile movement and damage. Avoid abrupt starts and stops.

(6) Overlay Placement - Place the overlay the same Day the geotextile is placed. Remove sealant that bleeds through the geotextile. Do not windrow asphalt concrete material on the geotextile ahead of the paving machine. Do not use an asphalt concrete material pickup machine.

00350.42 Subgrade Reinforcement Geogrid Installation Requirements:

(a) Placement - Prepare the surface receiving geogrid to a smooth condition to the depth shown and as follows:

- Orient the geogrid rolls parallel to the roadway centerline.
- Unroll the geogrid in the same direction the cover material will be placed. If the geogrid shifts or becomes misaligned, realign it and anchor it according to the manufacturer's recommendations.

(b) Overlaps - Overlap the geogrid a minimum of 2 feet. Overlap the geogrid in the same direction the cover material is placed with the preceding layer lapped on top of the following layer.

(c) Protection of Geogrid - Drive rubber tired equipment on the geogrid at no more than 5 mph. Drive tracked equipment on the geogrid only after placing a minimum of 6 inches of cover material on top of the geogrid. Do not turn or make sudden stops or starts on the geogrid or cover material.

During installation cover the geogrid with cover material as soon as possible. Do not leave uncovered for more than 5 Calendar Days.

(d) Repair - Repair or replace damaged or torn geogrid according to manufacturer's recommendations at no cost to the Agency.

Measurement

00350.80 Measurement - The quantities of each geosynthetic installation will be measured on the area basis along the lines and grades of the surface area actually covered as shown or as required, except for drainage applications.

The quantities of drainage geotextile will be measured on the area basis, computed by multiplying the length of the trench where geotextile is used by the perimeter of the trench as determined from the Neat Lines shown, or as directed.

Payment

00350.90 Payment - The accepted quantities of geosynthetics will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Drainage Geotextile, Type ____	Square Yard
(b)	Embankment Geotextile	Square Yard
(c)	Riprap Geotextile, Type ____	Square Yard
(d)	Subgrade Geotextile	Square Yard
(e)	Pavement Overlay Geotextile	Square Yard
(f)	Subgrade Reinforcement Geogrid	Square Yard

In items (a) and (c), the type of geotextile will be inserted in the blank.

Item (e) includes preparation Work, sealant, and geotextile.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for constructing laps, seams, joints, or patches unless the Engineer orders additional amounts over the minimum. For laps wider than the minimum or specified width, payment will be made for the added lap width at the Contract unit price.

Section 00370 - Finishing Roadbeds

Description

00370.00 Scope - This Work consists of the following:

- **Within Roadbed Cross Section** - Trimming, shaping, and finishing the Subgrade, ditches, slopes, and other graded surface areas to the lines, grades, Cross Sections, and condition specified.

- **Outside Roadbed Cross Section** - Obliterating Surfacings by removing existing paved surfaces, and loosening, breaking up, and spreading the existing bases lying outside the new Roadbed Cross Section and blending into the adjacent terrain.

If existing paved surfaces and bases are to be excavated and removed, then performance, measurement, and payment of the Work will be according to Section 00330.

Construction

00370.40 Within Roadbed Cross Section - After the Roadbed earthwork has been substantially completed, do the following:

(a) Subgrade:

- Remove vegetative growth.
- Excavate unstable Subgrade material, and backfill according to 00330.41(a)(9).
- Trim and shape the entire Subgrade to be free of ruts, depressions and irregularities.
- Compact all fills according to 00330.43.
- Finish the surface to within a tolerance of plus or minus 0.06 foot from the established line, grade, and Cross Section or as directed.

(b) Ditches:

- Remove all litter, debris and obstructions.
- Trim and shape to Neat Lines all ditches, channels and canals provided for waterways.

(c) Slopes:

- Remove all exposed roots, debris, and all stones more than 3 inches in size which are loose or could become loosened.
- Make Roadbed embankment slopes as smooth, safe and sightly as practicable with the materials used to construct the embankments.
- Trim and shape all excavation and embankment side slopes.

(d) Structure Sites:

- Clean out all sewers, culverts, drains, and their appurtenances constructed under the Contract.
- Remove all extraneous matter in the vicinity of bridge ends, culvert ends, inlets, walls, and other areas.
- Trim and shape the cleaned areas.

(e) Disposal of Materials - Dispose of all materials removed in 00370.40(a) through 00370.40(d) according to 00290.20.

00370.41 Outside Roadbed Cross Section - Remove existing paved surfaces, if any, loosen the remaining Bases and Surfacings by scarifying, plowing, vibrating, rolling and/or other means, to a depth of at least 12 inches, or to solid Rock, whichever is the lesser depth.

- Break the loosened materials into fragments having no dimension greater than 3 inches, unless the Aggregate in the original material exceeds that size.
- Spread and mix the loosened and broken materials, and blend them into the adjacent terrain as directed.

Maintenance

00370.60 Maintenance - Maintain the finished Work in its finished condition until final completion of the Contract Work, or until it is covered with a subsequent Course of material placed under the Contract.

Measurement

00370.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00370.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Finishing Roadbeds	Lump Sum
(b) Obliterating Surfacings	Lump Sum

Item (a) includes trimming, shaping and finishing the Subgrade, ditches, and slopes, including areas occupied by approach roads, road connections, interchanges, ramps, frontage roads, multiple lanes, and any other areas on which earthwork is performed under this Contract.

Item (b) includes removing existing paved surfaces, and loosening, breaking up, spreading, and mixing the old bases lying outside the new Roadbed Cross Section and blending into the adjacent terrain.

Payment will be payment in full for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Excavation of unstable Subgrade material and backfill will be paid for according to 00330.90.

When the Contract Schedule of Items does not indicate payment for the Work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00390 - Riprap Protection

Description

00390.00 Scope - This Work consists of furnishing and placing an erosion resistant cover material for protecting slopes and basins at locations shown or as directed.

00390.01 Definitions:

Riprap Geotextile - A geotextile placed between the area prepared for it and the riprap.

Filter Blanket - A layer of graded Granular Material placed between the area prepared for it and the riprap.

Riprap Backing - An option of using either riprap geotextile or a filter blanket placed between the area prepared for it and the riprap.

Loose Riprap - Specified classes of graded Rock placed on prepared slope, riprap geotextile or filter blanket, as specified.

Keyed Riprap - Loose riprap placed on prepared slope, riprap geotextile or filter blanket, as specified, and keyed in place by slapping the surface with a piece of armor plating.

Grouted Riprap - Loose riprap with all or part of the spaces filled with portland cement mortar.

Riprap Basin - Energy dissipater consisting of loose riprap placed at pipe outlets as specified.

Materials

00390.10 Riprap Geotextile - Furnish riprap geotextile meeting the requirements of Section 02320.

00390.11 Riprap Requirements:

(a) General - Furnish Rock for loose riprap meeting the following requirements:

- Meet the test requirements of 00390.11(b).
- Be angular in shape. Thickness of a single Rock shall not be less than one-third its length. Rounded Rock will not be accepted unless authorized by the Engineer.
- Meet the gradation requirements for the class specified.
- Be free from overburden, spoil, shale and organic material. Nondurable Rock, shale or Rock with shale seams is not acceptable.

(b) Test Requirements - Furnish the Rock meeting the following test requirements:

Material Test	Requirement
Apparent Specific Gravity (AASHTO T 85)	2.50 Minimum
% Absorption (AASHTO T 85)	6.0 Maximum
Degradation (ODOT TM 208)	
Passing No. 20 Sieve	35.0% Maximum
Sediment Height	8.0" Maximum
Soundness (AASHTO T 104)	
Average Loss of 2 1/2" - 1 1/2" and 1 1/2" - 3/4" fraction after 5 alternations	16.0% Maximum

(c) Gradation Requirements - Grade loose riprap by class and weight of Rock according to the following:

Class 50	Class 100	Class 200	Class 700	Class 2000	
		Weight of Rock (Pounds)			Percent (by Weight)
50 - 30	100 - 60	200 - 140	700 - 500	2000 - 1400	20.0
30 - 15	60 - 25	140 - 80	500 - 200	1400 - 700	30.0
15 - 2	25 - 2	80 - 8	200 - 20	700 - 40	40.0
2 - 0	2 - 0	8 - 0	20 - 0	40 - 0	10.0 - 0

Uniformly grade each load of riprap from the smallest to the largest weight specified. Control of gradation will be by visual inspection.

(1) Control Sample - If directed, provide, at a satisfactory location near the Project, a Rock sample of at least 5 tons meeting the gradation for the class specified. This sample will be used as a frequent visual reference for judging the gradation of the riprap supplied.

(2) Sampling and Testing Assistance - Any difference of opinion between the Engineer and the Contractor shall be resolved by dumping and checking the gradation of two random truckloads of Rock. Mechanical Equipment, a sorting site and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the Agency.

00390.12 Grouted Riprap - Furnish Rock for grouted riprap meeting the requirements of 00390.11, and furnish the portland cement grout meeting the requirements of 02080.40.

00390.13 Filter Blanket - Furnish filter blanket Materials meeting the following requirements according to riprap class:

Riprap Class	Filter Blanket
Class 2000	16 inch layer of Class 50 riprap conforming to 00390.11
Class 700	9 inch layer of 6" - 0 stone embankment meeting the test requirements of 00330.16
Class 200	6 inch layer of 4" - 0 stone embankment meeting the test requirements of 00330.16
Class 100	No filter blanket required
Class 50	No filter blanket required

Construction

00390.40 Preparation - Remove brush, trees, stumps and other organic material from slopes to be protected by riprap and dress to a smooth surface. Remove all Unsuitable Material to the depth shown or directed and replace with approved material. Compact filled areas as specified in Section 00330.

Provide riprap protection as early as the Structure foundation construction permits. Prepare the surfaces to be protected as shown. Maintain the trench Slopes, riprap geotextile or filter blanket until the riprap is placed.

00390.41 Riprap Geotextile - If required, install riprap geotextile according to the requirements of Section 00350 and as shown or directed.

00390.42 Filter Blanket Construction - If required, place the filter blanket on the prepared area to the full specified thickness in one operation, using methods which will not cause segregation. The surface of the finished layer shall be reasonably even.

00390.43 Riprap Backing - When allowed in the Special Provisions or indicated on the Plans, the Contractor shall have the option of placing either riprap geotextile or a filter blanket behind the riprap. Install the backing according to 00390.41 or 00390.42. Use either riprap geotextile or a filter blanket under the riprap.

00390.44 Riprap:

(a) General - Unless otherwise directed, place the riprap protection as the embankment is constructed. Its placement shall lag behind embankment construction only as necessary to allow proper embankment construction and prevent mixture of embankment and riprap material.

(b) Loose Riprap - Place riprap on the prepared area:

- With a clam-shell, orange-peel bucket, skip or similar approved device which will contain the riprap material to its final destination. Do not open the bucket until it has been lowered to the slope on which the material is being placed.
- To its full Course thickness in one operation.
- According to 00350.41(d), if riprap is placed on geotextile.
- By methods that do not cause segregation of riprap or displace the underlying material.
- To produce a compact riprap protection in which all sizes of material are placed in their proper proportion.
- With some hand placing, or rearranging of individual stones by mechanical Equipment, or some other approved means to provide a smooth finished surface.

Where filter material and/or riprap are placed under water, increase their thicknesses as shown or as directed.

(c) Keyed Riprap - After placing loose riprap material according to 00390.44(a) and 00390.44(b), key the riprap into place by slapping the surface with a piece of armor plating (approximately 4 feet x 5 feet in size weighing approximately 5,000 pounds) or other approved means which will produce a nearly smooth surface.

(d) Grouted Riprap - Place loose riprap material according to 00390.44(a) and 00390.44(b). If the depth specified for grouting is more than 12 inches, place the riprap in Lifts of 12 inches or less and grout each Lift before placing the next Lift. Construct and grout the succeeding Lifts before the grout in the previous Lift has hardened.

Thoroughly moisten the stones and sluice any excess fines to the underside of the riprap before grouting. Deliver the grout to the place of final deposit by any means that will ensure uniformity and prevent segregation of the grout. Spade or rod the grout into the spaces to completely fill the voids in the riprap. Control pressure grouting and do not unseat the stones. Penetration of the grout shall be to the depth shown on the Plans. If a rough surface is specified, brush the stone until 25 to 50 percent of the depth of surface stone is exposed. For a smooth surface, grout the crevices to within 5/8 inch of the surface.

Provide weep holes through the riprap as shown or as directed.

Place and cure grout according to 00440.40(d) and 00440.40(e) except as provided above.

(e) Riprap Basins - Excavate, backfill and construct riprap basins, without a riprap geotextile or filter blanket, at pipe outlets with Class 50 riprap as shown or as directed.

Maintenance

00390.60 General - Maintain the riprap protection until accepted. Replace any material displaced by any cause at no additional cost to the Agency.

Measurement

00390.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Filter Blanket - Filter blanket will be measured on the area basis of the finished surface, limited to the Neat Lines shown or directed.

(b) Riprap Backing - Riprap backing will be measured on the area basis of the finished geotextile or the filter blanket surface, limited to the Neat Lines shown or directed.

(c) Riprap - Riprap will be measured on the volume basis in place or on the weight basis.

When measurement of riprap is on the volume basis in place and the Engineer determines that this basis is impractical, the pay volume will be determined by loose measure in the hauling vehicles on the basis that 1.00 cubic yard, vehicle measure, is equivalent to 0.70 cubic yard in place.

(d) Riprap Basins - Riprap basins will be measured on a unit basis of basins constructed.

Payment

00390.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Filter Blanket	Square Yard
(b)	Riprap Backing	Square Yard
(c)	Loose Riprap, Class ____	Cubic Yard or Ton
(d)	Grouted Riprap, Class ____	Cubic Yard or Ton
(e)	Keyed Riprap, Class ____	Cubic Yard or Ton
(f)	Riprap Basins	Each

In items (c), (d), and (e), the class of riprap will be inserted in the blank.

Item (d) includes the grout.

Riprap geotextile will be paid for according to 00350.90, except when it is included in item (b).

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00396 - Shotcrete Slope Stabilization

Description

00396.00 Scope - This Work consists of constructing pneumatically applied shotcrete stabilization blankets onto slope surfaces at locations shown or where directed.

00396.01 Definitions:

Cementitious Materials - As defined in 02001.02.

Dry-Mix Shotcrete - Shotcrete process in which all dry constituents except accelerator and water are mixed before introduction into the delivery hose. Compressed air is used to deliver the dry mix through the hose. Water is added under pressure in the nozzle body, where it is mixed thoroughly with the dry constituents before the mixture is jetted from the nozzle onto the substrate.

Fiber Reinforced Shotcrete - Shotcrete containing steel fiber or synthetic polymer fiber reinforcing complying with ASTM C1116/1116M.

Nozzle Operator - A worker trained to manipulate the nozzle (also referred to as the “gun”) to control consistency in the dry-mix process, and to control final placement of the concrete mix on the substrate.

Predampening - In the dry-mix process, the controlled addition of water to the Aggregates or premixed shotcrete Materials during batching to adjust the moisture content of the shotcrete mixture before introduction into the nozzle.

Rebound - Shotcrete or shotcrete constituents that fail to adhere to the substrate.

Shotcrete - A method used to place concrete onto a surface at high velocity. The concrete mix contains admixtures and additives as necessary to provide a quick setting time, high early strength, and satisfactory adhesion to the substrate.

Substrate - The surface on which shotcrete is placed.

Wet-Mix Shotcrete - Shotcrete process in which all constituents, except accelerator, are mixed before introduction into the delivery hose. Compressed air and accelerator are added to the mixture at the nozzle, in such a way that the quantity can be properly regulated.

00396.02 Submittals:

(a) Qualifications - Provide personnel experience documentation showing compliance with 00396.30.

(b) Product Data - Submit according to 00150.37, at least 28 Calendar Days before the preconstruction conference, a proposed mix design according to the requirements of this Section and 02001.15 as appropriate for shotcrete. Include strength test and air entrainment test results. Include all proposed additives, including but not limited to air entrainment additives, accelerators, and curing agents.

(c) Work Plan - Submit a detailed work plan according to 00150.37 at least 28 Calendar Days before the preconstruction conference. Include the following:

- Proposed process and Equipment for shotcrete application
- Sequence of the Work

- Material storage and handling procedures
- Methods for sampling and testing the shotcrete
- If steel fibers or synthetic polymer fibers are required, the process for blending them into the shotcrete mix

Materials

00396.10 Materials - Furnish Materials meeting the following requirements:

Bar Reinforcement 02510.10
Cement (Type I or II) 02010.10
Chemical Admixtures 02040
Coarse Aggregate 02690.20
Curing Materials 02050.10
Fine Aggregate.....02690.30
Non-Epoxy Grout.....02080.20
PVC Pipe.....02415.50
Water.....02020
Welded Wire Fabric.....02510.40

00396.11 Prepackaged Product - Premixed and prepackaged concrete products, with or without steel fibers or synthetic polymer fibers, manufactured as a shotcrete product may be used for site-mixed shotcrete if the Materials meet the Specifications and if approved.

00396.12 Aggregates - Combined Fine Aggregates and Coarse Aggregates shall meet the following grading requirements as determined by AASHTO T 27:

Sieve Size	Percent Passing (by Weight)
1/2"	100
3/8"	90 - 100
No. 4	70 - 85
No. 8	50 - 70
No. 16	35 - 55
No. 30	20 - 35
No. 50	8 - 20
No. 100	2 - 10

00396.13 Steel Fiber Reinforcement - If steel fiber reinforced shotcrete is required, the steel fibers shall:

- Be between 1/2 and 1 1/2 inches long.
- Meet the requirements of ASTM A820 Type 1, Deformed.
- Have a length-to-diameter ratio of less than 80.
- Have a minimum tensile strength of 160,000 psi.

Only steel fibers manufactured specifically for use in shotcrete applications will be allowed. The steel fiber content shall not be less than 100 pounds per cubic yard of shotcrete.

00396.14 Synthetic Polymer Fiber Reinforcement - If synthetic polymer fiber reinforced shotcrete is required, the synthetic polymer fibers shall:

- Be between 1/2 and 3 inches long.
- Meet the requirements of ASTM C1116 Type III.
- Have a minimum diameter of 0.012 inch.
- Have a minimum tensile strength of 75,000 psi.

Only synthetic polymer fibers manufactured specifically for use in shotcrete applications will be allowed. The proportion of synthetic polymer fibers in the mix shall follow the fiber manufacturer's recommendations.

00396.15 Shotcrete Mix Requirements - Determine the exact proportions both by weight and by volume of cementitious Materials, Fine Aggregate, Coarse Aggregate, fiber reinforcement (if any), admixtures, and water, subject to the Engineer's approval. Shotcrete shall meet the following minimum requirements:

- Maximum water-cement ratio of 0.45
- Entrained air content meeting the requirements of 02001.20(b) for the proposed maximum aggregate size and the intended exposure

00396.16 Acceptance Sampling and Testing:

(a) General:

(1) Test Panels - Prepare shotcrete test panels on vertically supported open-face forms. The forms shall:

- Have internal dimensions of at least 24 by 24 by 5 inches.
- Be rigid, nonabsorbent, and nonreactive with cement.

Place the shotcrete in the forms using the same shotcrete mix, air pressure, water pressure, and nozzle tip that will be used in the production shotcrete. Protect the panels for at least 24 hours or until final set has taken place.

(2) Preproduction Testing - Prior to beginning production shotcrete operations, prepare and test at least two test panels for each mix design. Cure the test panels in a manner appropriate to the anticipated field conditions. Before starting production Work, provide to the Engineer compressive strength test results showing that the mixture meets the minimum strength requirements. Do not begin production shotcrete Work until satisfactory test results are obtained.

(3) Production Testing - During shotcrete operations prepare, in the presence of the Engineer, a minimum of one test panel for each 50 cubic yards placed, but no fewer than one test panel daily for each nozzle operator plus one test panel shot whenever the nozzle Equipment is changed. Cure the production test panels under the same conditions as the production shotcrete. Identify each production test panel with the daily Work area reported according to 00396.46.

(b) Compressive Strength Tests:

(1) Compressive Test Cores - Obtain 3-inch diameter test cores from the cured shotcrete test panels prepared according to 00396.16(a)(1) and 00396.16(a)(2). Collect core samples a

minimum of 4 inches from the edge of the concrete in the test form. Test core samples for compressive strength according to AASHTO T 22 within 24 hours of coring.

(2) Shotcrete Compressive Strength - The shotcrete cores shall attain 2,500 psi compressive strength at 7 Calendar Days.

(c) Shotcrete Quality - Submit a visual description of each core. Include details concerning the presence of voids, sand pockets, laminations, and other deficiencies. The visual quality of the cores shall not be lower than Grade 2 according to shotcrete grading requirements of ACI 506.2.

(d) Failure of Shotcrete - If a shotcrete section represented by any test panel is deficient in any of the criteria specified in 00396.16(b) or 00396.16(c), provide remedy as directed at no additional cost to the Agency. Remedies may include, but are not limited to, the application of additional shotcrete to the deficient area or removal and replacement of the deficient section.

Equipment

00396.20 General - Provide mixing Equipment capable of thoroughly mixing the Materials in sufficient quantity to maintain uniform and continuous application.

00396.21 Pump System - The pump system that conveys premixed shotcrete constituents shall deliver a uniform and continuous flow of Material, without segregation or loss of constituents.

00396.22 Air Compressor - Furnish air compressor(s) capable of providing:

- A supply of clean air adequate for maintaining sufficient nozzle velocity for all parts of the Work and for the simultaneous operation of a blow-pipe for clearing away rebound; and
- A minimum of 250 cubic feet of air per minute per operating nozzle.

00396.23 Dry-Mix Delivery Equipment - Furnish dry-mix delivery Equipment capable of discharging the cement/Aggregate mixture into the delivery hose and delivering a continuous stream of uniformly mixed Material to the discharge nozzle. Equip the discharge nozzle with a manually operated water injection system (water ring) for directing an even distribution of water through the cement/Aggregate mixture. The water valve shall be capable of ready adjustment to vary the quantity of water, and shall be convenient to the nozzle operator. Provide greater water pressure than the operating air pressure at the discharge nozzle to ensure that the water is thoroughly mixed with the other Materials. Use steady, nonpulsating water pressure. Regularly inspect and replace Equipment parts, especially the nozzle liner and water ring, as necessary or as directed.

When using the dry-mix process, furnish and use predampening Equipment.

00396.24 Wet-Mix Delivery Equipment - Wet-mix delivery Equipment shall be capable of discharging the premixed Materials into the delivery hose and delivering a continuous stream of uniformly mixed Material to the discharge nozzle. Follow the manufacturer's recommendations on the type and size of nozzle to be used, and on cleaning, inspection, and maintenance of the Equipment.

Labor

00396.30 Personnel Qualifications - At least 7 Calendar Days before beginning shotcrete Work, provide written evidence that the on-site supervisor, nozzle operator, and delivery Equipment operator have performed satisfactory Work in similar capacities elsewhere for a sufficient length of time to be fully qualified to perform their duties.

The on-site supervisor shall have not less than 2 years of full-time experience as a shotcrete nozzle operator.

All nozzle operators shall have current certification by the American Concrete Institute for wet-mix or dry-mix vertical placement of shotcrete, as appropriate to the proposed mixing process.

The nozzle operator and delivery Equipment operator shall each have at least 1 year of full-time experience on similar applications with the same type of Equipment as proposed for the Project. Before starting shotcrete Work, the nozzle operator shall, in the presence of the Engineer, demonstrate the ability to apply shotcrete on a test panel according to 00396.16. Visual quality of core samples from test panels shall meet requirements of 00396.16(c). Before being allowed to place shotcrete in permanent construction, each nozzle operator shall make one satisfactory test panel for each mix used during the course of the Work.

The nozzle operator shall be assisted by a helper, able to operate a blow-pipe for the purpose of keeping the work area free of rebound.

Construction

00396.40 Surface Preparation - Before applying shotcrete to Rock surfaces, remove all loose material and vegetation and clean the surface with air, water jets or other approved means. Use air jets to remove loose material from Soil surfaces.

Do not place shotcrete on any surface that is frozen or spongy, or where there is free water. Dampen the surface before applying shotcrete.

00396.41 Shotcrete Blanket Thickness Control - Control shotcrete blanket thickness by installing noncorrosive pins, nails or other gauging devices normal to the face of the substrate so that they protrude the required shotcrete thickness outside the face. Place the pins on a maximum 5-foot square pattern. When welded wire fabric reinforcement is used, place at least a 1-inch cover of shotcrete over the wire fabric.

00396.42 Anchor Bars - Clean and blow clear all drilled holes before installing the anchor bars. Completely fill drilled holes with non-epoxy grout, using a grout tube extending to the bottom of the hole.

00396.43 Welded Wire Fabric - Place welded wire fabric as shown or directed. Overlap sheets at least 8 inches and secure with tie wire.

00396.44 Weep Holes - Install weep holes as shown or directed. Do not drill holes larger than 3 inches in diameter. Install the PVC drain pipe before applying shotcrete. Extend the end of the pipe 1 to 3 inches beyond the final slope face. Protect pipe ends during shotcreting, and clear weep hole drain pipes after shotcrete is placed.

00396.45 Batching and Mixing Shotcrete:

(a) Dry-Mix Process - Batch the cement/Aggregate mix by weight or volume. Predampen the dry-mix after it flows out of the packaging but before it flows into the main hopper in order to ensure that the premixed constituents will flow at a uniform rate. Do not use predampened cement/Aggregate mix in the Work if it is allowed to stand more than 45 minutes.

(b) Wet-Mix Process - Batch and mix wet-mix shotcrete according to ASTM C94.

(c) Fiber Reinforcement - Demonstrate the procedure for adding fibers to the shotcrete in the field and obtain the Engineer's approval before beginning production Work. If fibers are added to

the dry or wet mix on-site, use a screen having a mesh of 1 1/2 to 2 1/2 inches to prevent fiber balls from entering the shotcrete line, unless it is demonstrated that fiber balls can be prevented without a screen. Do not add fibers to the dry or wet mix at a rate faster than can be blended with the other constituents without forming balls or clumps. If bulk fibers show a tendency to tangle together, pass them through a vibrating screen or sift them into the mix so they enter it as individual elements and not as clumps.

00396.46 Shotcrete Application - Apply shotcrete from the lower portion of the area to the top so rebound does not accumulate on the area still to be covered. Hold the nozzle approximately perpendicular to the working face, and at a distance that minimizesrebound and maximizes compaction. Shotcrete shall emerge from the nozzle in a uniform and continuous flow. When, for any reason, the flow becomes intermittent, divert the nozzle from the Work until uniform and continuous flow resumes. A nozzle operator's helper, equipped with blow-pipe, shall attend the nozzle operator at all times during shotcrete placement to keep the Work area free of rebound.

Do not work rebound material into the finished product. Do not salvage rebound or include it in later batches.

Suspend placement operations if:

- High wind prevents the nozzle operator from properly applying the material;
- The ambient temperature is below 40 °F; or
- Rain or other external factors wash cement out of the freshly placed material or cause sloughs in the Work.

Taper construction joints over a distance of at least 12 inches to a thin edge. Thoroughly wet the surface of such joints before any adjacent section of shotcrete is placed. Do not make square construction joints.

Report daily, in writing, the quantity and limits of shotcrete applied on each day of shotcrete operations. Identify in these reports the production samples collected according to 00396.16(b) for each reported Work area.

If shotcrete containing steel fibers is applied in areas accessible to the public, apply a minimum 1/2-inch thick finish coat of shotcrete without steel fibers to protect the public from injury by brushing against the fibers.

Remove dummy areas, sags, and other defects and replace with a new layer, at no additional cost to the Agency. Replace any damaged fabric reinforcement with lapped and tied wire fabric.

Allow previous layers of shotcrete to take initial set before applying additional layers. Remove all loose Material before applying additional layers.

00396.48 Finishing and Curing - Leave the shotcrete surface with a natural "gun" finish.

Apply Type 2, white-pigmented curing compound to the shotcrete immediately after application. Keep shotcrete surfaces from freezing for at least 7 Calendar Days after application. Before placing subsequent shotcrete, remove all curing compound in contact with exposed welded wire fabric, anchor bars or previous shotcrete surfaces by sandblasting.

Measurement

00396.80 Measurement - The quantities of shotcrete will be measured on the area basis. Measurement will be of the finished shotcrete surface area.

Payment

00396.90 Payment - The accepted quantities of shotcrete will be paid for at the Contract unit price, per square yard, for the item "Shotcrete Slope Stabilization".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00398 - Rock Slope Stabilization and Reinforcement

Description

00398.00 Scope - This Work consists of furnishing and installing Rock slope stabilization and reinforcement systems, in close conformity to the lines, grades, and dimensions shown or established.

00398.02 Definitions:

Anchored High Tensile Strength Wire Mesh Slope Protection - A system of woven, diamond-patterned mesh made of a single type of high tensile strength wire, supported by wire ropes secured with slope protection anchors, and held against the slope with a pattern of anchor nails, spike plates, and boundary ropes.

Anchor Nail - A steel rod inserted into a predrilled or self-drilled hole in Soil or Rock, with a mechanical connection to the wire mesh, in an anchored high tensile strength steel wire mesh slope protection system. It is used to secure the wire mesh directly to the slope.

Barrier Mounted Rock Protection Screen - A system of screening and concrete barrier designed to intercept small falling rocks.

Boundary Rope - A component of an anchored high tensile strength steel wire mesh slope protection system. It is secured by slope protection anchors, and assists in holding the wire mesh against the slope under tension.

Cable Net Slope Protection - A system of cable net draped over a rockfall slope area and anchored with slope protection anchors. The cable net is backed with secondary wire mesh to prevent smaller rocks from reaching the Highway. Cable net slope protection is used where rocks are generally less than 5 feet in diameter.

Flexible Barrier System - A proprietary rockfall catchment system constructed of high-strength structural net (e.g., interlocking steel rings, high tensile strength mesh, or interlaced cable panels) suspended from support posts and incorporating braking elements.

Gabion Wire Mesh Slope Protection - A system of gabion wire mesh draped over a rockfall slope area and anchored with slope protection anchors. Gabion wire mesh is used where rocks are generally less than 2 feet in diameter.

High Tensile Strength Wire Mesh Slope Protection - A system of woven, diamond-patterned mesh made of a single type of high tensile strength wire draped over a rockfall slope and anchored with slope protection anchors. High tensile strength wire mesh slope protection is used where rocks are generally less than 4 feet in diameter.

Post-Supported Rock Protection Screen Behind Barrier/Guardrail - A wire mesh screen placed behind a barrier or guardrail at the Highway Shoulder edge and supported by posts.

Post-Supported Wire Mesh Slope Protection - Wire mesh suspended above the ground with support posts and draped over a rockfall slope. Post-supported wire mesh is used to intercept falling Rock generally less than 2 feet in diameter from slopes above the installation. The draped portion controls rockfall within the installation area.

Rock Reinforcing Bolt - A steel rod inserted into a predrilled hole in Rock, tensioned to a required load, and grouted in place.

Rock Reinforcing Dowel - An untensioned steel rod inserted into a predrilled hole in Rock and grouted in place.

Slope Protection Anchor - A steel bolt or wire rope, emplaced in Rock, Soil, or mixed Rock and Soil, used to secure the support rope in a slope protection system.

Spike Plate - A diamond-shaped steel plate used with an anchor nail in an anchored wire mesh slope protection system to structurally connect the wire mesh to the anchor nail.

Supplemental Anchor Nail - An anchor nail installed between regular pattern anchor nails to improve the fit of the wire mesh to the slope contours as part of an anchored wire mesh slope protection system.

Support Rope - A wire rope along the top of a wire mesh slope protection system. It is secured by slope protection anchors, and supports the upper edge of the wire mesh.

Wire Mesh Slope Protection - Collective term referring to high tensile strength wire mesh slope protection systems, anchored high tensile wire mesh strength slope protection systems, post-supported wire mesh slope protection systems, and gabion wire mesh slope protection systems.

00398.03 Required Submittals:

(a) Rock Reinforcing Bolt and Rock Reinforcing Dowel Submittals - Submit a detailed work plan according to 00150.37 to the Engineer at least 10 Calendar Days prior to the preconstruction conference. Include the following:

- Construction schedule and sequence.
- Drilling methods and Equipment.
- Specifications and manufacturer's data sheets for Rock reinforcing bolts and dowels, couplers, bearing plates, Rock reinforcing bolt mechanical anchorage system (if used), flat washers, and beveled washers.
- Drill hole diameter.
- Grout mix specifications and placement procedures, including manufacturer's data sheets.
- Type of corrosion protection, either galvanizing or epoxy coating, for the Rock reinforcing bolts and dowels.
- Installation and stressing procedures, and Equipment.
- Calibration data for each torque wrench, test jack, and pressure gauge to be used.

The Engineer will respond within 21 Calendar Days after receipt of the work plan. Do not proceed with the Work until the Engineer has approved the work plan in writing.

(b) Proprietary Flexible Barrier System Submittals - Submit stamped Working Drawings according to 00150.35, at least 30 Calendar Days before beginning fabrication or construction of the flexible rockfall barrier system.

Submit field construction manuals, maintenance manuals, and product brochures prepared by the manufacturer of the proprietary flexible rockfall barrier system according to 00150.37 at least 30 Calendar Days before beginning fabrication or construction of the flexible rockfall barrier system.

(1) Working Drawings - Working Drawings shall include at least the following information:

- **General Notes** - Necessary information on the design and construction of the flexible rockfall barrier system.
- **Materials and Quantity Summary List** - A table of all items comprising the system, and the quantities of each item.
- **Plan and Elevation Views** - Include the net system alignment and stationing referenced to construction centerline, locations of support posts and footings, all support ropes (end, lateral, top, and bottom), anchor ropes, braking elements, net height, and section lengths.
- **Typical Sections** - Include net system footing options, footing-to-post connections, net connections, anchor type(s), retaining rope and braking element connections, and anchor locations.
- **Structural and Geometric Details** - Include structural and geometric details for:
  - Footings and leveling pads
  - Rock and Soil footings
  - Anchors
  - End, lateral, and intermediate support ropes
  - Support columns, including column plates, breakaway connections, and cable guide assemblies

(2) Work Plan - Submit a detailed work plan to the Engineer at least 10 Calendar Days prior to the preconstruction conference. Include the following:

- Construction sequence.
- Slope access plan and Equipment.
- Color(s) for powder coating or otherwise coloring all wire rope and cable to match the mesh color, if mesh color is specified or shown. Colors shall conform to Federal Standard 595C.
- Manufacturer’s data sheet for materials to restore corrosion protection on exposed steel.
- Description of anchors.
- Drilling methods and Equipment.
- Description of slope protection anchors, including the manufacturer's data sheets and corrosion protection.
- Drill hole diameter.
- Grout mix from the QPL, including manufacturer’s data sheets. Include the procedures for placing the grout.
- Installation procedures.
- Anchor testing schedule and acceptance criteria.
- Description of testing procedures and Equipment.
- Calibration data according to 00398.21 for each torque wrench, test jack, and pressure gauge to be used.
- Proposed herbicide for stump treatment, if applicable, including manufacturer's data sheets.

(3) Field Construction Manual - Provide a field construction manual, prepared by the manufacturer of the proprietary flexible rockfall barrier system, including step-by-step directions for constructing the system. This manual shall include anchor testing procedures and acceptance criteria.

(4) Field Maintenance Manual - Provide a field maintenance manual, prepared by the manufacturer of the proprietary flexible rockfall barrier system, including step-by-step instructions for maintaining the system. The manual shall include a Project-specific list of all proprietary components with stock or product reference numbers and illustrations, and a Project-specific list of all non-proprietary components.

(c) Anchored High Tensile Strength Wire Mesh Slope Protection Submittals - Submit a detailed work plan according to 00150.37 to the Engineer for approval, at least 10 Calendar Days before the preconstruction conference. Include the following:

- Documentation demonstrating satisfactory performance of the steel mesh furnished by this Supplier in other projects completed for use as part of an anchored high tensile strength steel mesh system where the site conditions were similar to the conditions on this Project.
- An inclusive list, with catalogue cuts, of all system appurtenances including anchor nails, spike plates, grout, lacing wire rope, wire rope clips, wire rope thimbles, ferrules, slope protection anchors, and other fastening hardware.
- Mill certificates for the wire rope.
- Procedures for temporarily securing mesh at the top of the slope during installation, including the type(s) of temporary anchor and the plan for removal of temporary support that is not incorporated into the final Work.
- Equipment and procedures for installing and anchoring the system boundary ropes.
- Equipment and procedures for installing the high tensile strength steel mesh.
- Procedures for attaching mesh panels to each other and to boundary ropes, and for placing the mesh panels at the design location on the slope.
- Procedures for installing anchor nails and spike plates.
- Calibration data for torque wrenches, including a graph of torque versus tension for each torque wrench to be used.
- Color(s) for powder coating or otherwise coloring all wire rope and cable to match the mesh color, if mesh color is specified or shown. Colors shall conform to Federal Standard 595C.
- Manufacturer's data sheets for materials to restore corrosion protection on exposed steel.

The Engineer will respond within 21 Calendar Days after receipt of the work plan. Do not proceed with the Work until the Engineer has authorized the work plan in writing.

(d) Personnel Submittals - Submit documentation showing the qualifications of drill operators, installers, and on-site supervisor according to 00398.32. The Engineer will respond within 21 Calendar Days after receipt of the submittal. Do not proceed with the Work until the Engineer has approved the submittal in writing.

Materials

00398.10 Slope Protection Anchors:

(a) Steel Anchor Bolts - Furnish 1-inch diameter, continuously threaded or deformed, Grade 75 steel anchor bolts, complete with keyhole plate, grout tube, washer, and nut, meeting the requirements of AASHTO M 31 (ASTM A615). Provide anchor bolts made of one continuous bar.

Welding and couplers will not be allowed. Galvanize all steel anchor bolts according to AASHTO M 232 (ASTM A153). Provide grout tubes, grout sealers, and other grouting accessories for grouting anchor bolts of type recommended by the manufacturer and as approved.

(b) Steel Plates, Washers, and Nuts - Furnish steel plates, washers, and nuts for steel anchor bolts meeting the requirements of ASTM F432. Provide 3/8-inch, flat steel plates that provide not less than 6 by 6-inch area for each bolt. Provide steel or malleable iron beveled washers and hardened steel machine washers. Provide heavy hexagonal type nuts. Galvanize all plates, washers, and nuts according to AASHTO M 232 (ASTM A153), Class C, except castings shall be Class A and forgings shall be Class B.

(c) Wire Rope - Furnish wire rope for slope protection anchors meeting the current requirements of Federal Specification RR-W-410 and ASTM A1023. Provide general purpose, 3/4-inch diameter, 6x19 independent wire rope core (IWRC), galvanized wire rope, with the wire rope core made from extra improved plow steel. Minimum breaking force shall be 58,800 pounds. Attach ferrules to the rope to prevent withdrawal from the encapsulating concrete during testing. Ferrules and thimbles shall be galvanized according to AASHTO M 232 (ASTM A153).

(d) Concrete - Furnish concrete for anchors, support posts, and brace footings meeting the requirements of Section 00440; or site-mixed, commercially bagged, premixed concrete with a minimum 28-Day compressive strength of 3,000 psi.

(e) Cement Grout - Furnish non-epoxy cement grout for anchors in Rock from section 02080.20 of the QPL. Follow the manufacturer's recommendations for water-cement ratio, mixing and set times.

00398.11 Posts, Braces, and Appurtenances for Post Supported Wire Mesh - Furnish Schedule 40, hot-dip galvanized steel pipe conforming to ASTM A53, Grade B, for posts, post sleeves, and braces. Posts and braces shall be 4-inch outside diameter. Post sleeves shall be 4.5-inch outside diameter (to accommodate post). Furnish post caps, strap clamps, bolts, and nuts that are hot-dip galvanized according to AASHTO M 232 (ASTM A153). Repair all cutting, welding, and drilling as well as other damage to the galvanizing according to 02420.10(d).

00398.12 Top Horizontal Support Rope and Support Post Retaining Rope - Furnish top horizontal support rope and support post retaining rope of the sizes shown and meeting the current requirements of Federal Specification RR-W-410 and ASTM A1023. Provide Type 1, general purpose, Class 2, 6x19 IWRC, galvanized wire rope, with the wire rope core made from extra improved plow steel.

If a mesh color is specified, powder coat according to Section 00593 all wire rope and cable to match the mesh color.

00398.13 Hardware for Post Supported Wire Mesh - Furnish rings and eyes of drop-forged steel, heat-treated after forging. Furnish wire rope thimbles and clips sized for the wire rope shown. All rings, eyes, thimbles, wire rope clips, U-bolts and miscellaneous hardware shall be galvanized according to AASHTO M 232 (ASTM A153), Class C, except castings shall be Class A and forgings shall be Class B.

If a mesh color is specified, powder coat according to Section 00593 all hardware to match mesh color.

00398.14 Wire Mesh Materials:

(a) Gabion Wire Mesh Fabric - Furnish gabion wire mesh fabric meeting the requirements of ASTM A975, Style 1, 8 by 10 mesh type with Class 3 coating, soft temper.

(b) PVC Coated Gabion Wire Mesh Fabric - Furnish PVC coated gabion wire mesh fabric meeting the requirements of ASTM A975, Style 3, 8 by 10 mesh type with Class 3 coating, soft temper. Obtain the Engineer's approval of the PVC coating color.

(c) Gabion Wire High Tensile Steel Fasteners and Lacing Wire - Furnish 11 gauge, high tensile steel fasteners meeting the requirements of ASTM A975 and ASTM A764, with Class 3 zinc coating according to ASTM A641 and minimum panel-to-panel connection strengths meeting the requirements of ASTM A975.

If stainless steel fasteners are shown, provide fasteners conforming to ASTM A313, Type 302.

Provide lacing wire with the same coating material as the gabion wire mesh fabric and conforming to ASTM A641 and ASTM A975. If PVC coating is required, provide the same color as the gabion wire mesh fabric.

(d) High Tensile Strength Wire Mesh Fabric - Furnish diamond mesh fabric of woven construction consisting of a single type of wire, with the ends of each wire formed into a loop and twisted. The loops of the wire mesh shall be fastened together to prevent unraveling of the mesh. The wire shall be alloyed, high-strength carbon steel wire with minimum diameters and tensile strengths complying with ASTM A1007 (Level 3 drawn Zn5 Al wire), as summarized in Table 00398-1. Minimum wire diameter is shown on the Plans. The wire shall be hot-dip galvanized with a zinc/aluminum coating with a minimum weight of 0.40 ounce per square foot for Level 3 drawn Zn5 Al wire according to ASTM A1007.

The size of the mesh opening shall be a maximum of 3.25 by 5.6 inches (± 3%). The depth of the mesh shall be a minimum of 0.4 inch (± 10%).

Table 00398-1

Minimum Wire Diameter (inch)	Minimum Wire Strength (pounds)	Bearing Resistance Against Punching in Combination with a 50 square inch Diamond Plate (psi)
0.079	1,200	24,000
0.118	2,800	40,000
0.157	4,900	60,000

00398.15 Cable Net - Furnish cable net consisting of individual square or diagonal panels joined along their edges. Furnish cable net panels composed of woven wire ropes or strand with a maximum opening size of 12 by 12 inches. Interior wire rope junctions shall be bound with either double knots of 1/8-inch diameter corrosion resistant wire, or high-strength, corrosion resistant clips with slotted bottoms made from 0.08-inch plate.

Furnish net panels that are constructed from one of the following:

- 1x3 high tensile steel wire spiral rope.
- 7x7 or 7x19 galvanized aircraft cable (GAC), extra improved plow steel, with a minimum nominal diameter of 5/16 inch (0.31 inch)

Wire rope or cable for net panels shall have a breaking strength of at least 9,200 pounds.

Use net panels with a grid size opening no larger than 12 by 12 inches. For the net panels made with GAC wire rope, use wire rope that is fabricated and galvanized according to ASTM A1023.

As required, furnish PVC coated gabion wire mesh fabric meeting the requirements of ASTM A975, Style 3, 8 by 10 mesh type with Class 3 coating, soft temper. Obtain the Engineer's approval of the PVC coating color.

Attach gabion wire mesh fabric to the cable net on the Rock side of the system. Attach gabion wire mesh to the cable net on 12-inch centers both horizontally and vertically, using 11 gauge high tensile strength galvanized fasteners.

00398.16 Rock Reinforcing Bolts and Rock Reinforcing Dowels - Rock reinforcing bolts, rock reinforcing dowels, and all appurtenant hardware shall be galvanized or epoxy coated prior to installation. Cement grout will not be allowed as a substitute for the required protective coatings.

(a) Rock Reinforcing Bolts - Provide rock reinforcing bolts, including mechanical anchorage system, plates, washers, and nuts from the QPL. If mechanical anchorage is not selected, use a rock reinforcing bolt system from a manufacturer regularly engaged in the manufacturer of rock reinforcing bolts.

Provide grout tubes, grout sealers, and other grouting accessories for grouting rock reinforcing bolts of types recommended by the manufacturer and as approved.

(b) Rock Reinforcing Dowels - Provide rock reinforcing dowels, plates, washers, and nuts from a manufacturer regularly engaged in the manufacturer of rock reinforcing dowels. Provide grout meeting the requirements of 00398.10(e).

00398.17 Flexible Rockfall Barrier Systems - For proprietary flexible rockfall barrier systems, provide products from the selected manufacturer according to the manufacturer's specifications and these applicable material Specifications. The flexible rockfall barrier system Maximum Energy Level impact rating is shown. If there is a conflict between the manufacturer's specifications and the Agency's Specifications, the Agency's Specifications will take precedence.

Obtain all materials for the selected proprietary flexible rockfall barrier system from the same manufacturer. Use only one proprietary flexible rockfall barrier system on the Project unless otherwise specified.

00398.18 Anchored High Tensile Strength Steel Wire Mesh Slope Protection - All mesh and components, except anchor nails, shall be powder coated by the Supplier. The color will be selected by the Engineer from the color(s) submitted according to 00398.03(c).

(a) Anchor Nails (Predrilled) - Provide Grade 75 all-thread rods, Grade 75 bolts, or equivalent, of the diameter shown, with a corrosion allowance of 0.079-inch zinc galvanization included in their diameter. Provide nails with a minimum ultimate strength of 55,000 psi that are groutable using a tremie tube grouting system and capable of being post-tensioned to the minimum design load shown. Required minimum nail length is shown. Provide centralizers every 5 feet along each nail and a tremie tube for grouting.

(b) Anchor Nails (Self-Drilling) - Provide self-drilling, hollow-core anchor nails of the diameter shown, that comply with ASTM A615, and are supplied with a 3-inch diameter sacrificial bit. Self-drilling anchor nails shall be made from high-strength steel with a minimum ultimate strength of 55,000 psi and shall be groutable and capable of being post-tensioned to the minimum design load shown.

(c) High Tensile Strength Steel Wire Mesh - Furnish a diamond mesh of woven construction, consisting of a single type of wire, with the ends of each wire formed into a loop and twisted. The loops of the wire mesh shall be fastened together to prevent unraveling of the mesh. The wire shall

be alloyed high-strength carbon steel wire with minimum diameter and tensile strength conforming to ASTM A1007 (Level 3 drawn Zn5 Al wire) as summarized in Table 00398-1. Minimum wire diameter is shown on the Plans. The wire shall be hot-dip galvanized with a zinc/aluminum coating, with a minimum weight of 0.40 ounce per square foot for Level 3 drawn Zn5 Al wire.

The size of the mesh opening shall be a maximum of 3.25 by 5.6 inches (± 3%), and the depth of the mesh shall be a minimum of 0.4 inch (± 10%).

(d) Connection Clips - Connection clips shall be fabricated from high-strength steel wire with a minimum diameter of 0.15 inch and a minimum ultimate tensile strength of 4,900 pounds according to ASTM A1007 (Level 3 drawn Zn5 Al wire). The clip shall measure 2.36 by 0.83 inches and have two reversed end hooks on one side of the clamp. The wire shall be galvanized with a 95 percent zinc and 5 percent aluminum coating, with a minimum weight of 0.49 ounce per square foot.

Hog ring connectors are not allowed.

(e) Spike Plates - Provide diamond-shaped spike plates made from 0.28-inch steel with a width of 7.48 inches and a length of 13 inches. Spike Plates shall be hot-dip galvanized according to ASTM A123 (ASTM A123M) with a minimum layer thickness of 85 microns.

(f) Boundary Rope - Provide galvanized 1/2-inch diameter wire rope for attaching the mesh at installation boundaries. Rope shall be Type 1, general purpose, Class 2, 6x19 IWRC, with a minimum breaking strength of 23,940 pounds, conforming to Federal Specification RR-W-410 or equivalent, including galvanizing.

Provide anchors for boundary rope according to 00398.10(c).

(g) High Early Strength Grout - Provide non-shrink, Type III portland cement grout capable of attaining a minimum unconfined compressive strength of 4,000 psi in not more than 3 Days, as confirmed according to AASHTO T 106. Test non-shrink properties according to AASHTO T 160. Percent length change shall not exceed 0.05 percent at 28 Days for water-cured samples. Add fluidifying agents as needed.

(h) Miscellaneous Materials - All miscellaneous materials for system installation, such as wire rope clips, thimbles, and other miscellaneous items shall be from the Supplier of the high tensile strength steel wire to assure and compatibility of system components.

(i) Supplemental Anchor Nails - Provide anchor nails conforming to 00398.18(a) or (b) with a minimum length of 5 feet.

Equipment

00398.20 Anchor, Bolt, and Dowel Equipment - Provide all Equipment necessary to install slope protection anchors, Rock reinforcing bolts, and Rock reinforcing dowels in their holes, and to tighten nuts, eyes and other hardware to the manufacturer's required tension.

Provide and maintain in good working condition the necessary torque wrenches and related Equipment for the installation of steel bolt and slope protection anchors, Rock reinforcing bolts, and Rock reinforcing dowels.

00398.21 Anchor Testing Equipment - Furnish all torque wrenches, jacks, pressure gauges and other Equipment required to perform proof testing of installed anchors, Rock reinforcing bolts, and Rock reinforcing dowels. Use pressure gauges and load cells of the types and sizes commonly used in the testing of Rock bolts and anchors.

Calibrate torque wrenches, jacks, and pressure gauges before use. Perform calibration tests, using an independent testing laboratory, within 60 Calendar Days of the date calibration data is submitted. The torque wrenches shall have a capacity at least 20 percent greater than the Rock reinforcing bolt manufacturer's recommended torque to achieve the design and test loads. The torque wrenches shall have an accuracy of at least ± 2 percent of the full-scale reading, and a resolution of at least 1 percent of the full-scale reading.

Labor

00398.30 Measurement Assistance - Furnish labor, at no additional cost to the Agency, to assist with the measurement of quantities of wire mesh slope protection systems and cable net slope protection system placed on the slopes.

00398.32 Rock Reinforcing Bolt and Rock Reinforcing Dowel Installation Personnel - Furnish personnel skilled in the installation of Rock reinforcing bolts and Rock reinforcing dowels. Experience shall be relevant to anticipated Rock conditions and size of Rock reinforcing bolts and Rock reinforcing dowels being installed. The on-site supervisor and drill operator shall have no less than 2 years of demonstrated experience in Rock reinforcing bolt and Rock reinforcing dowel installation. Submit documentation of experience to the Engineer at least 10 Calendar Days prior to the preconstruction conference. Include names and current phone numbers of references, project names and locations, and the year of project completion.

Construction

00398.40 General - Construct the kinds and types of Rock slope protection at the locations shown or directed. Verify existing ground elevations, anchor locations, footing locations, elevations, and alignments prior to construction. Do not begin construction prior to receipt of the Engineer's written authorization.

The Contractor may encounter a variety of foundation conditions during construction of Rock slope protection systems. Be prepared to install Rock slope protection items in all types of materials including Soil, mixed Rock and Soil, and solid Rock.

00398.41 Preparation Work - Clear and grub the area according to Section 00320.

Remove all shrubs, brush, snags, downed timber, float Rock, and other obstacles, including trees up to 6 inches in diameter that interfere with construction. If directed, preserve trees and geographic features at the top of draped wire mesh, anchored mesh, and cable net systems by adjusting post and anchor locations to miss them.

Excavate for concrete footings to reasonably Neat Lines, but not less than the specified dimensions in Soil or Rock. Do not disturb the original ground at the sides and bottom of the excavation.

Dispose of materials, including excess excavation, according to 00290.20.

00398.42 Support Posts - Evenly space support posts at intervals not exceeding those shown. Measure the interval between posts parallel to the grade of the post line and in the line of the posts from center to center of posts. Set support posts at the beginning and end of each continuous length and at abrupt changes in vertical and horizontal alignments. Place all support posts plumb and in line, unless otherwise directed.

Securely fasten diagonal braces to end support posts and intermediate support posts as shown. Excavate and place concrete for brace footings as shown.

Dimensions of footings shall not be less than shown and shall fill the excavated areas. Moisten the sides of the excavation to a depth of 2 inches and remove all loose Soil and Rock in the hole prior to placing concrete. If the hole is over-excavated, fill the entire cavity with concrete. Place the concrete with contact against firm Soil at the sides and bottom and tamp around anchor bolts, slope protection anchors, or post sleeves while the anchor bolts, slope protection anchors, or post sleeves are held firmly in proper position. Strike off, slope, or crown the surface of the concrete at the ground level and smooth it to shed water.

Allow concrete to cure for at least 5 Days before the support ropes and retaining ropes are attached and subjected to strain.

00398.43 Slope Protection Anchors in Solid Rock - Where solid Rock is encountered without an overburden of Soil, install steel anchor bolts and slope protection anchors according to the following:

(a) Wire Mesh Slope Protection - Install all anchors 6 feet into the solid Rock, or as shown. Overdrill the hole a minimum of 2 inches longer than the anchor length.

(b) Post-Supported Wire Mesh Slope Protection - Install post anchors 3 feet into solid Rock, or as shown. Install end anchors and support post retaining rope anchors 6 feet into solid Rock, or as shown. Overdrill the hole a minimum of 2 inches longer than the anchor length.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - Install all anchors 6 feet into solid Rock, or as shown. Overdrill the hole a minimum of 2 inches longer than the anchor length.

Install centralizers according to 00398.45.

Place grout according to the manufacturer's recommendations and as directed.

00398.44 Slope Protection Anchors in Soil and Mixed Soil and Rock - Where an overburden of Soil, loose Rock, or Surfacing materials covers solid Rock, install the anchors according to the following:

(a) Wire Mesh Slope Protection - Install all anchors to a depth of 6 feet. If solid Rock is encountered before this depth is reached, install anchors according to 00398.43(a), unless otherwise directed.

(b) Post-Supported Wire Mesh Slope Protection - Install post anchors to a depth of 3 feet. Install end anchors and support post retaining rope anchors to a depth of 6 feet. If solid Rock is encountered before these depths are reached, install anchors according to 00398.43(b), unless otherwise directed.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - Install all anchors to a depth of 6 feet. If solid Rock is encountered before this depth is reached, install anchors according to 00398.43(c), unless otherwise directed.

Install centralizers according to 00398.45.

Place grout according to the manufacturer's recommendations and as directed.

00398.45 Centralizers - Install centralizers that support the bolt or cable in the center of the hole. Place centralizers within 1 foot of each end of the anchor, and according to the following:

(a) Wire Mesh Slope Protection - Center anchor rods, bolts and other structural elements within the anchor holes.

(b) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - Use centralizers in all end anchor holes.

00398.46 Slope Protection Anchor Proof Testing - Slope protection anchors shall have a minimum pullout capacity of 20,000 pounds per foot. Field verify pullout capacity by testing not less than 25 percent of the total number of anchors installed. The Engineer will determine which anchors are to be tested.

Replace failed slope protection anchors at no additional cost to the Agency. Install replacement anchors within 10 feet of the original location. If suitable support cannot be obtained within 10 feet of the original anchor location, notify the Engineer.

Test slope protection anchors either vertically or laterally. Perform vertical testing against a temporary yoke or load frame. Do not allow any part of the yoke or load frame to bear within 3 feet of the anchor. Determine applied test loads with either a calibrated pressure gauge or a load cell. Use pressure gauges or load cells commonly used in the testing of Rock bolts and anchors.

Perform lateral testing by attaching a steel cable to the anchor and connecting it to a load cell at the base of the slope. The cable shall not come in contact with the slope below the crest of the slope. Position the load cell far enough away from the toe of the slope that the cable under tension is near parallel to the slope. Determine applied test loads with either a calibrated pressure gauge or a load cell conforming to 00398.21.

A pullout test consists of loading the anchor assembly to the minimum pullout capacity. The anchor is acceptable if it sustains this load for 10 minutes with no loss of load.

00398.47 Wire Mesh Installation and Cable Net Installation - Install gabion wire mesh, high tensile strength wire mesh, or cable net systems as shown and according to the following:

(a) Wire Mesh Slope Protection - Place gabion wire mesh with the fabric curl toward the slope. Loop the fabric over the top horizontal support rope and attach to itself with high-tensile steel fasteners or lacing wire as shown. Do not tension the fabric in any direction. Allow it to remain loose to increase its dampening effect on rolling rocks.

Lap the gabion or high tensile strength wire mesh or cable net system as shown. If horizontal laps are needed, lap the upper fabric over the lower fabric to avoid the possibility of falling material hanging up on the lap. Locate the bottom of the fabric so material dislodged under the fabric can fall freely from the bottom, but will not flow or bounce onto the Roadway. Secure the ends of all lacing wires to the fabric with a minimum of one and one-half turns.

(b) Post-Supported Wire Mesh Slope Protection - Place gabion or high tensile strength wire mesh for post-supported wire mesh slope protection according to 00398.47(a). Adjust the turnbuckles at the ends of the top horizontal support rope for a maximum sag of 1 inch between any two support posts.

(c) Post-Supported Rock Protection Screen Behind Barrier/Guardrail - Attach the gabion or high tensile strength wire mesh to the support posts and top horizontal support rope as shown. Lap the gabion wire mesh fabric as shown. Do not tension the fabric in any direction. Adjust the turnbuckles at the ends of the top horizontal support rope for a maximum sag of 1 inch between any two support posts.

00398.48 Support Rope and Post Retaining Rope Attachment - For post-supported wire mesh slope protection and post-supported Rock protection screen behind barrier or guardrail, install top horizontal support ropes on the posts as shown. Ensure that the top horizontal support rope will move

freely in the U-bolt hangers. Use one continuous length of cable for each complete section of screen. Attach the top horizontal support rope to the end anchors as shown. Tension the rope so that the in-place wire mesh will be fully supported. Take up additional tension with turnbuckles. Ensure that a minimum of 4 inches of take-up remains in the turnbuckle when full tension has been applied.

In addition, for post supported wire mesh protection, install the post retaining ropes to the anchors and support posts as shown. Tension the ropes with the turnbuckles so that the cable is taut but does not bend the support post toward the slope when the wire mesh is installed. Ensure that a minimum of 2 inches of take-up remains in the turnbuckle when full tension has been applied.

00398.49 Barrier Mounted Rock Protection Screen - Install concrete barrier according to Section 00820 and as shown. Attach protective screen to the concrete barrier as shown.

00398.50 Rock Reinforcing Bolts and Rock Reinforcing Dowels:

(a) General - Protect Rock reinforcing bolts and Rock reinforcing dowels at all times from damage and corrosion. Corrosion, pitting or damage to the Rock reinforcing bolt will be cause for rejection. Damage includes, but is not limited to, abrasions, cuts, nicks, welds, and weld splatter. Prior to installation, remove all mill scale, flaking rust, and grease.

Drill holes to the diameter and depth recommended by the manufacturer, and at least 6 inches longer than the bolt or dowel. Unless otherwise directed, align drill holes normal to the Rock face. Maintain a driller's log for each bolt and dowel boring that records, at a minimum, the relative Rock hardness, drilling rate, and groundwater conditions. Provide driller's logs to the Engineer on a weekly basis.

Place centralizers on Rock bolts and dowels on 10-foot centers prior to installation of the bar, with a minimum of two centralizers per anchor. Locate an inner centralizer within 2 feet of the end of the bar. Locate an outer centralizer within 3 feet of the Rock face.

Maintain at least three-quarters of the surface area of the bearing plate in contact with the Rock face. Chip out surrounding Rock as necessary to provide this contact and ensure that the axis of the bolt is within 5 degrees of perpendicular to the bearing plate. Where necessary, a bearing pad may be used to achieve the required contact and angle between the installed bolt and the bearing plate, or where the Rock beneath the bearing plate is not sound. Allow sufficient cure time for bearing pads constructed with cementitious materials.

Clean the drill holes of all drill cuttings and debris prior to installing the bolts or dowels. Install and proof test as follows:

(b) Rock Reinforcing Bolts:

(1) Installing Mechanical Bolts - Install bolts immediately after cleaning the drill hole. Tension each bolt to the design load before grouting. Conduct proof testing of each bolt as described below. Place grout in the drill hole to fill the space between the bolt and the sides of the hole, and to fully encapsulate the bolt. If necessary, control leakage of grout into Rock seams using approved methods and as directed. Pump the grout to the far end of the drill hole and continue pumping until grout is forced out of the de-airing tube at the face of the hole. After testing and grouting, cut the bolt off, if necessary, so that no more than 3 inches extends beyond the nut. Treat the cut steel according to 02530.71.

(2) Installing Grouted Bolts - Install bolts immediately after cleaning the drill hole. Within 24 hours of installing the bolt, place grout to fill the Rock bond length and half the unbonded length. Start at the far end of the drill hole and fill to the extent shown. Record the quantity of grout and grout pressures.

Allow the first placement of grout to cure fully before tensioning or applying any load. Conduct proof testing of each bolt as described in 00398.50(b)(3). Within 24 hours of tensioning the Rock bolt, fill the remainder of the drill hole with grout using a tremie tube. Check the grout level within 24 hours of completing the second stage grouting, and top off with additional grout using a tremie tube as necessary to fill the annular space. After testing and grouting, cut off any excess bolt length so that no more than 3 inches extends beyond the nut. Treat the cut steel according to 02530.71.

(3) Proof Testing Bolts - Tension each installed bolt to 120 percent of the design load, using a calibrated hollow ram hydraulic jack. Hold that tension for a minimum of 10 minutes. Any loss of load during the 10-minute time period will result in failure of the test. If a bolt fails this test, the bolt will be rejected. Install, at no additional cost to the Agency, a replacement bolt in a separate hole adjacent to the failed bolt, and repeat the test. The Engineer may require additional proof testing if any bolt fails.

(c) Rock Reinforcing Dowels:

(1) Installing Dowels - Install dowels immediately after cleaning the drill hole. Place the grout mix in the drill hole according to the manufacturer's recommendations. After installation of the plate and nut, torque the nut to a nominal 100 foot-pounds to ensure proper seating against the Rock surface. Conduct proof testing of Rock reinforcing dowels as described in 00398.50(c)(2). After testing, cut off any excess bolt length so that no more than 3 inches extends beyond the nut. Treat the cut steel according to 02530.71

(2) Proof Testing Dowels - Proof test at least 10 percent of the installed dowels, but not less than three dowels. The Engineer will interpret the results. Tension the Rock reinforcing dowel to 10 kips with a calibrated hollow ram hydraulic jack. Hold the load for 10 minutes with no loss of load. A Rock reinforcing dowel will be considered to have failed if any movement of the dowel occurs. The Engineer may require additional proof testing if any Rock reinforcing dowel fails. Replace failed dowels with a new dowel installed in a separate hole, at no additional cost to the Agency.

00398.51 Flexible Rockfall Barrier Systems - Provide for a representative (the "Field Representative") from the proprietary flexible rockfall barrier system vendor or manufacturer to be present at the start of system construction. Before beginning Work involving the flexible Rockfall barrier system, the Contractor's supervisory personnel, together with any Subcontractors and their supervisory personnel who are to be involved in the flexible Rockfall barrier system installation Work, and the representative from the proprietary flexible rockfall barrier system vendor or manufacturer shall meet with the Engineer for a flexible rockfall barrier system preconstruction conference at a time mutually agreed upon. If all invitees are not in attendance, reschedule the flexible rockfall barrier system preconstruction conference for the start of system construction.

Ensure that the Field Representative is available as needed during the construction of the flexible rockfall barrier system to provide instructions and recommendations, and to assist the Contractor or Engineer. Follow instructions and recommendations of the Field Representative, as approved by the Engineer.

00398.52 Anchored Wire Mesh Slope Protection - Install high tensile strength steel mesh at the locations shown.

(a) General - Complete clearing, grubbing and scaling prior to placing mesh, to maximize contact with the ground surface and prevent bridging on exposed vegetation or Boulders between anchor nails.

(b) Mesh Installation - Install mesh so as to conform to the slope surface and to the elevations shown, to the extent practicable. Provide a minimum of 5 feet mesh coverage above the crest of the cut slope to fully accommodate a minimum of one row of anchor nails. Extend the lateral coverage of the anchored wire mesh slope system to provide a minimum of 6 feet of mesh coverage onto adjacent Soil cut, Rock, or undisturbed ground. Where installations terminate near road grade, hold the bottom of the mesh 5 feet above the Roadside ditch. Adjust final row nail spacing to properly secure the bottom of the mesh.

During installation, temporarily secure the mesh at the top of the slope, as needed, to facilitate installation. Construct any required temporary anchoring according to the Contractor's approved work plan.

Install boundary rope anchors as shown and according to 00398.43(a) and 00398.44(a). Centralizers and pullout testing are not required for boundary rope anchors.

No Equipment operation is allowed on slope areas that have been covered with mesh.

Connect adjacent mesh panels as shown, using connection clips.

Diagonal cutting of the high tensile strength mesh is not allowed. If needed, use spreading tools obtained from the manufacturer to facilitate the passage of drill bits through the mesh openings.

(c) Anchor Nail Installation - The general layout and spacing pattern of the anchors is as shown. Adjust the final constructed pattern to fit the slope shape and stabilization requirements, as directed. Determine the type of anchor nail (predrilled or self-drilling) appropriate for the subsurface conditions encountered. Document the nail type installed at each location and provide this documentation to the Engineer when requested.

Maintain a driller's log for each anchor nail installation, recording relative Rock hardness, drilling rate, and groundwater conditions. Provide driller's log to the Engineer on a weekly basis.

For nails to be installed in predrilled holes, drill a nominal 3-inch diameter hole perpendicular to the slope surface. Over-drill each hole a minimum of 6 inches beyond the required length of the nail.

Grout the nails by placing grout through a tremie tube attached to the side of the nail until the grout is approximately 8 inches below the ground surface.

For self-drilling nails, use the sacrificial drill bit to advance the nail to the prescribed depth. Inject cement grout as the nail is advanced, in order to fully encapsulate the nail.

For installations through Soil, excavate a nominal 14-inch diameter by 8-inch deep hole around each nail head to accommodate the diamond plate and to ensure optimal load transfer from the nail head to the mesh.

Clean grout remnants from the threads of the nail so that proper tensioning can be achieved. Install spike plates, washers, nuts and associated hardware according to the manufacturer's recommendations and as shown.

(d) Anchor Nail Proof Testing - Once the cement grout has achieved its initial set at three days, install the spike plate and nut, and tension each anchor nail to the load capacity shown. After 10 minutes, test the tension in the anchor nail with the calibrated torque wrench for use as part of the approved work plan submittal. If a nail fails this test, replace the nail with an additional nail installed in a separate hole. If testing indicates that the required tension cannot be achieved, increase drill hole depth and/or diameter as required to obtain a successful test.

After testing, cut off any excess nail, so that no more than 3 inches extends beyond the nut. Treat the cut steel according to 02530.71.

(e) Supplemental Anchor Nails - Supplemental anchors may be needed to accommodate slope geometry. Obtain the Engineer's approval of supplemental anchor nail locations. Install and test supplemental anchor nails as described above. Supplemental anchor nails do not replace pattern anchor nails and will not be accepted as replacements for rejected pattern anchor nails.

Measurement

00398.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Area Basis - The following will be measured on the area basis, along the lines and grades on the slope, for installed wire mesh fabric, or cable net, as appropriate, installed:

- Gabion wire mesh slope protection
- High tensile strength wire mesh slope protection
- Anchored wire mesh slope protection
- Post-supported wire mesh slope protection
- Cable net slope protection

(b) Length Basis - The following will be measured on the length basis, from center to center of end posts along the line and grade of each separate run:

- Barrier mounted Rock protection
- Flexible rockfall barrier system
- Rock protection screen behind barrier and guardrail

The following will be measured on the length basis, along the full embedded and protruding length of the bolt or dowel:

- Rock reinforcing bolts
- Rock reinforcing dowels

(c) Unit Basis - Supplemental anchors will be measured on the unit basis.

Payment

00398.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Gabion Wire Mesh Slope Protection	Square Foot
(b)	High Tensile Strength Wire Mesh Slope Protection	Square Foot
(c)	Anchored High Tensile Strength Wire Mesh Slope Protection	Square Foot
(d)	Post-Supported Wire Mesh Slope Protection	Square Foot
(e)	Cable Net Slope Protection	Square Foot
(f)	Flexible Rockfall Barrier System	Foot
(g)	Barrier Mounted Rock Protection Screen	Foot
(h)	Rock Protection Screen Behind Barrier and Guardrail	Foot
(i)	Rock Reinforcing Bolt	Foot
(j)	Rock Reinforcing Dowel	Foot
(k)	Supplemental Anchor Nail	Each

Item (g) includes the concrete barrier.

Item (k) includes supplemental anchor nails approved according to 00398.52(e).

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- proof testing
- coatings
- slope protection anchors
- anchor nails
- replacement anchors
- wire rope
- concrete
- grout
- steel posts and braces
- miscellaneous hardware

PART 00400 - DRAINAGE AND SEWERS

Section 00405 - Trench Excavation, Bedding, and Backfill

Description

00405.00 Scope - This Work consists of excavating trenches, constructing trench foundations, and placing bedding, pipe zone material and backfill.

00405.01 General - Excavate, backfill and dispose of excess excavated materials in connection with minor Structures and conduits such as subsurface drain, culvert, siphon, irrigation and sewer pipe of nominal inside diameters not exceeding 72 inches. Perform excavation for major Structures and conduits with a nominal inside diameter or width greater than 72 inches according to Section 00510.

Trench excavation does not include earthwork covered under any other Section, or any earthwork that may be specifically included and provided for other Pay Items of the Contract. Dispose of excess excavated materials and perform other matters not covered in this Section according to Section 00330.

00405.02 Definitions:

Boulder Excavation - The removal, without drilling, blasting or splitting, of masses of Rock having one or more dimensions of 3 feet or greater.

Common Excavation - The removal of all material not classified as Rock excavation.

Flexible Pipe - For the purpose of these Specifications, potable water pipes and pipes constructed of corrugated metal, PVC, and polyethylene are considered flexible pipes.

Pipe Bedding - Furnishing, placing and compacting specified materials on the trench foundation so as to uniformly support the barrel of the pipe.

Pipe Zone - The area from the top of the bedding to a point 8 inches, minimum, above the top outside of the pipe barrel for the full width of the trench.

Rigid Pipe - For the purpose of these Specifications, pipes constructed of concrete and ductile iron are considered rigid pipes.

Rock Excavation - Excavation of solid ledge Rock that, in the opinion of the Engineer, requires for its removal drilling and blasting, wedging, sledging, barring, or breaking up with power-operated tools. The term "Rock Excavation" indicates a method of removal and not a geological formation.

Surface Removal - The removal of surface material such as Topsoil, sod, Pavement, sidewalks, or gravel, that requires different Equipment or methods than those used for trench excavation.

Trench Backfill - Furnishing, placing, and compacting material other than Controlled Low-Strength Material (CLSM) in the trench, between the top of the pipe zone material and the bottom of the pavement base Rock, ground surface or surface material.

Trench Excavation - The removal of all material encountered in the trench to the depths as shown or as directed. Trench excavation is classified as either common or Rock excavation.

Trench Foundation - The bottom of the trench on which the pipe bedding is to lie and which provides support for the pipe.

00405.03 Lines, Grades, and Cross Sections - Excavate trenches to the lines, depths, grades and Cross Sections shown on the Plans or as established. Variations will be allowed only when necessary to ensure firm foundations and when such variations will not be detrimental to the Work.

Materials

00405.10 General - Materials may be native or imported, as specified.

00405.11 Trench Foundation - Where additional excavation is required due to groundwater or other unstable conditions so that the native material cannot support the pipe, furnish one of the following materials for trench foundation:

- Selected general backfill conforming to 00330.13.
- Selected granular backfill conforming to 00330.14.
- Selected stone backfill conforming to 00330.15.
- Other approved material.

00405.12 Bedding - If groundwater is present in the bedding zone, use 3/4" - 0 Aggregate bedding. If groundwater is not present, and unless otherwise specified, furnish one of the following materials for bedding the pipe:

- Commercially available 3/4" - 0 Aggregate.
- Reasonably well-graded, from maximum size to dust, sand with 100 percent passing the 3/8 inch sieve.
- Commercially available 3/8" - 0 or No. 10 - 0 sand.
- CLSM conforming to Section 00442.

00405.13 Pipe Zone Material - For flexible pipes, backfill the pipe zone with bedding material as described in 00405.12.

For rigid pipes, unless otherwise directed, furnish either:

- 1" - 0 or 3/4" - 0 base Aggregate conforming to 02630.10, or
- Commercially available 1" - 0 or 3/4" - 0 Aggregate.

00405.14 Trench Backfill - Furnish the following materials where shown or required:

(a) Class A Backfill - Use native or common material that, in the opinion of the Engineer, meets the characteristics required for the specific surface loading or other criteria of the backfill zone.

(b) Class B Backfill - Use Granular Material consisting of gravel or crushed Rock meeting the requirements of Section 00641. Designated size shall be 1" - 0 or 3/4" - 0.

(c) Class C Backfill - Use clean sand with no particle size larger than 1/4 inch.

(d) Class D Backfill - Use pit run or bar run material, well-graded from coarse to fine. The maximum dimension shall be 3 inches.

(e) Class E Backfill - Use CLSM conforming to Section 00442.

00405.15 Quality Control - Provide quality control according to Section 00165.

Labor

00405.30 Quality Control Personnel - Provide technicians having CEBT, CAgT, and CDT technical certifications.

Construction

00405.40 General - Perform all excavation and backfilling according to the following requirements:

(a) Limitation on Commencement - Do not commence excavation until the undisturbed or existing ground has been measured and the measurements have been approved by the Engineer.

(b) Natural Stream Protection - Hold to a minimum excavations in, or adjacent to, natural streambeds. Comply with 00290.30(a). Restore the streambed according to 00405.46(f).

(c) Partial Embankment Construction for Exposed Pipe - Construct partial embankment according to 00330.42(c)(6) and as shown, before excavating trenches.

(d) Temporary Handling of Water - Provide temporary measures according to 00405.43.

00405.41 Trench Excavation - Excavate trenches according to the following:

(a) Within Paved Areas to Be Preserved - Excavate trenches for pipe installation by the open excavation method, unless otherwise directed. Do not disturb the adjoining Pavement more than necessary.

(b) Open Trench Limit - Limit the length of open trench to 100 feet, or as allowed. Related resurfacing shall be completed within 800 feet of the open trench limit.

(c) Trench Width - Keep the trench width at the ground surface to the minimum necessary to install the pipe in a safe manner, but not less than 24 inches. In all cases, make trenches of sufficient width to allow for shoring and to permit proper jointing of the pipe and backfilling of material along the sides of the pipe. Refer to the Standard Drawings for minimum trench widths for various diameter pipes. Make excavations for manholes and other Structures wide enough to provide a minimum of 12 inches between the Structure surface and the sides of the excavation. Keep the top of the trench within Right-of-Way or permit limits.

(d) Trench Grade - Excavate trenches to the lines and grades shown or established, with proper allowance for pipe thickness, pipe bedding and foundation stabilization. Place pipe bedding on a firm, undisturbed, foundation, true to grade. If the trench is excavated below grade without authorization, restore to grade with material of the type specified for pipe bedding at no additional cost to the Agency. Place the material over the full width of the trench, in compacted layers not exceeding 6 inches.

(e) Disposal of Excess Material - Place excavated material at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic, or interfere with the function of existing drainage facilities.

Make arrangements for and dispose of all excess material not required elsewhere on the Project in an approved manner, at no additional cost to the Agency, and according to 00330.41(a)(4).

(f) Trench Protection - Provide the materials, labor and Equipment necessary to protect trenches at all times. Provide safe working conditions in the trench and protect the Work, existing property, utilities, Pavement, and the public. The method of protection shall be according to the Contractor's

design. The Contractor may elect to use any combination of shoring, overbreak, tunneling, boring, sliding trench shields or other methods of accomplishing the Work, provided the method meets with the approval of the Engineer and complies with all applicable local, state, and federal safety codes.

Be responsible for damages resulting from improper removal of shoring or from failure to shore.

(g) Existing Abandoned Facilities - Remove and dispose of existing abandoned pipe, Structures and other facilities as necessary to construct the trench according to 00310.41(c).

00405.42 Rock Excavation - Where Rock excavation as defined in this Section is required, remove the Rock to provide the minimum clearances shown on the Standard Drawings. Excavate and remove the overburden and expose the Rock to allow the Engineer to measure the Rock prior to removal.

If using explosives, comply with the requirements of 00170.94. Prior to blasting, obtain the approval of the Engineer and the appropriate permits. Provide all tools and devices required for loading and using explosives, blasting caps and accessories. When blasting Rock in trenches, cover the area to be shot with blasting mats or other protective material to prevent the scattering of Rock fragments outside of the excavation.

00405.43 Dewatering - Promptly remove and dispose of all water entering the trench during the time the trench is being prepared for the pipe laying, during the laying of the pipe and until the backfill at the pipe zone has been completed. Dispose of the water in an approved manner without damage to adjacent property.

Control groundwater to prevent softening of the bottom of excavations or formation of "quick" conditions or "boils". Design and operate dewatering systems to prevent removal of the natural Soils and so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent Structures or property.

When dewatering near a river, lake, or stream, conform to the requirements of 00290.30(a) and Section 00280. When the presence of water or other conditions in the excavated area would be detrimental to the purpose of the Work, obtain approval of the Engineer for the temporary measures required to correct or care for the condition.

If water or other conditions encountered require permanent correction or care not anticipated by the Contract and not due to the Contractor's neglect or method of operation, perform the Work according to 00140.60.

00405.44 Trench Foundation - Make the full length and width of completed trench bottoms firm. Do not place bedding material before the trench foundation is inspected and approved. If bell and spigot pipe is used, recess the trench bottom to accommodate the bell.

When, in the judgment of the Engineer, the existing material in the bottom of the trench is unsuitable for supporting the pipe, excavate below grade, as directed. Replace the excavated material with imported trench foundation material conforming to 00405.11. Place the trench foundation material in 6 inch layers and compact according to 00330.43 except compact selected stone backfill material in 12 inch layers. Bring the trench foundation material to the elevation established.

00405.45 Pipe Bedding - Spread the bedding smoothly to the proper grade so that the pipe is uniformly supported along the barrel. Excavate bell holes at each joint to permit proper assembly and inspection of the joint. Bedding under the pipe shall provide a firm, unyielding support along the entire pipe length.

00405.46 Backfilling - Backfill with material conforming to 00405.13 and the details shown, or as directed.

(a) General - Begin backfilling when:

- The foundation has been prepared, if required.
- The bedding has been prepared.
- The drainage facilities and fittings are installed.
- The installation has been inspected and approved.

Thoroughly tamp and compact all trench backfill with machine or pneumatic operated tampers of a size and type that will obtain the required density. When fill is to the top of the pipe, compact the trench backfill in a manner to avoid damage to the installed pipe.

Test for density according to 00330.43.

Backfill either to the top of the trench, the surrounding ground level, or the upper limit of excavation, as directed. Dispose of excess excavated material not used in backfill Work according to Section 00330.

(b) Pipe Zone - Place the materials in the pipe zone in layers not greater than 6 inches thick and in a manner that equalizes pressure on the Structure and minimizes stress. Before placing backfill material, condition, aerate, or wet the material so that the moisture content of each layer is within minus 4 percent to plus 2 percent of optimum moisture content.

As required under the haunches of pipe and in areas not accessible to mechanical tampers or to testing, compact with hand methods to ensure intimate contact between the backfill material and the pipe or Structure. Place backfill material between corrugations when the pipe product is manufactured with external corrugations. Provide thorough compaction.

Ponding or jetting will not be allowed within the pipe zone.

(c) Trench Backfill - The following requirements apply in the trench backfill area and in the pipe zone, except where in conflict with the requirements of 00405.46(b):

(1) General - Use Class B trench backfill unless otherwise specified or approved.

The Engineer may sample excavated material to determine the suitability of the Class A material for use as backfill. If the material is approved, the Contractor may elect to use the material in place of the specified backfill. Prevent excavated material from becoming saturated beyond the critical moisture limits, and replace any saturated Class A material with Class B, C, or D material, as specified, at no additional cost to the Agency.

(2) Class A, B, C, or D Backfill - Backfill the trench above the pipe zone in successive Lifts. Do not allow the backfill to free-fall into the trench until at least 3 feet of cover is provided over the top of the pipe. Modify the method of compaction as necessary to protect the pipe.

Compact each layer of trench backfill material within the Roadway and Shoulders, and within a 2V:1H Slope line projected from each Subgrade Shoulder, to not less than 95 percent of maximum density. Compact all other trench backfill material to not less than 90 percent of maximum density.

Determine the maximum density by AASHTO T 99. If the specified compaction is not obtained, the Contractor may be required to use a modified compaction procedure or reduce the thickness of Lifts. If approved materials meeting the Specifications cannot be compacted to the required density regardless of compactive effort or method, the Engineer may reduce the required density

or direct that alternate materials be used. Do not proceed with excavation and pipe laying operations until the backfill can be compacted to the satisfaction of the Engineer.

If the material is not density testable, the Engineer will observe each layer for deflection or reaction under the compaction Equipment to verify that no soft or pumping areas remain. Compact until there is no perceptible deflection under the compaction Equipment.

When the backfilling is complete, finish the surface area as specified. In paved or graveled areas, maintain the surface of the trench backfill level with the existing grade with 3/4" - 0 crushed Aggregate material, or asphalt concrete if directed, until final Pavement replacement is complete and accepted.

(3) Class E Backfill - Backfill the trench above the pipe zone with CLSM material. If the CLSM is to be used as a temporary Surfacing, backfill the CLSM to the top of the trench and strike it off to provide a smooth surface. If the CLSM is not to be used as a temporary Surfacing, backfill the CLSM up to the bottom of the proposed resurfacing. No compaction of CLSM is allowed. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed, if it has hardened sufficiently to prevent rutting.

(d) Ponding or Jetting of Backfill Materials - Ponding or jetting will not be allowed within Roadbed lateral limits. Ponding or jetting will be allowed outside Roadbeds when approved by the Engineer in writing.

Use Class C or D trench backfill material at no additional cost to the Agency. Provide drainage at the bottom of the trench to remove water from the jetting operation. Compact to the density and deflection requirements of 00405.46(c).

Furnish Equipment that provides a minimum gauge pressure of 35 psi at the discharge nozzle. Use a rigid pipe that will reach within 1 foot of the bottom of the backfill. Insert the pipe at intervals not exceeding 4 feet throughout the entire width and length of the trench backfill.

(e) Temporary Trench Plating - When temporary steel plates are installed over a street cut, they shall be capable of carrying at least an MS-18 loading. Place steel plates with a minimum of 12 inches bearing on all sides of a cut. Anchor steel plates to minimize shifting. Shim the edges of all steel plates with cold mix asphalt.

(f) Restoration of Streambeds - Comply with 00290.30(a) and Section 00280. Upon completion of the Work:

- Restore the streambed to its former condition of resistance to scour.
- Remove all matter that has come into the stream due to the Contractor's activities.

00405.48 Surface Removal:

(a) General - For trench resurfacing, see Section 00495.

(b) Topsoil - Where trenches cross lawns, garden areas, pastures, cultivated fields or other areas on which Topsoil exists, remove the Topsoil to a minimum 12-inch depth and place the material in a stockpile. Do not mix the Topsoil with other excavated material. After the trench has been backfilled, replace the Topsoil.

In lieu of stockpiling the Topsoil, approved imported Topsoil may be substituted, to a depth specified or approved, at no additional cost to the Agency.

Maintain the finished grade of the Topsoil level with the area adjacent to the trench until final acceptance by the Engineer, and repair damage to adjacent Topsoil caused by the Contractor's operations. Remove all Rock, gravel, Clay and other foreign materials from the surface. Regrade and add Topsoil as required.

(c) Pavement, Curb, and Sidewalk - Use saws to cut portland cement concrete Pavement, curbs and sidewalks, regardless of thickness. In bituminous Pavement, when no Pavement overlay will occur, saw-cut the Pavement along each edge of the area to be removed. When Roadways will receive a Pavement overlay as part of the Project or following trench resurfacing, bituminous Pavement to be removed may be cut by wheel cutter, jack hammer, or other approved methods.

Upon completion of backfill and just prior to Pavement resurfacing, saw the Surfacing on both sides of the trench a minimum of 6 inches wider than each top of the trench. In areas of any undermined or damaged Surfacing, re-saw to a width outside these areas. When saw-cutting, follow lines parallel to the pipe centerline.

Where the width changes in areas of asphalt Pavement resurfacing, cut the transition between the different widths at 45 degrees. When the pipeline changes direction, or there is a connecting pipeline that requires the saw cut alignment to change at an angle greater than 60 degrees, make a minimum 24-inch transition saw cut. If there is damaged or undermined Surfacing at the transition point, make the transition saw cut beyond the damaged or undermined Surfacing. Make the transition saw cut angle half the angle change in the direction of the pipeline or connecting line.

If the asphalt Surfacing is to be overlaid, the second saw cut will only be required to firm Subgrade.

A second saw cut for concrete sidewalks, driveways and Pavements will not be required unless needed to reach firm Subgrade.

Remove and dispose of Pavement lying within the limits of the cuts and from any adjoining areas damaged by the cutting and removal operations according to Section 00310.

Measurement

00405.80 Measurement - Except for Rock excavation, boulder excavation, and trench foundation, no measurement of quantities will be made for Work performed under this Section.

Imported Topsoil will be measured according to 01040.80.

00405.81 Rock Excavation and Boulder Excavation - The quantities of Rock excavation and boulder excavation will be measured as follows:

(a) Rock Excavation - Rock excavation will be measured on the volume basis. Measurement will be of the actual dimensions of Rock removed within the following limits:

- **Length** - Length will be the horizontal distance measured along the centerline of the trench excluding manholes, inlets, and other Structures.

- **Width** - Width will be the width of the Rock removed but will not be greater than the outside diameter of the pipe bell plus 12 inches.

- **Depth** - Depth will be measured at 30-foot intervals, or as specified, along the centerline of the trench. The depth will not be greater than 6 inches below the outside bell of the pipe.

Rock excavation for manholes, inlets, and other Structures will be computed from the Rock excavated to a depth 6 inches below the bottom of the Structure and an area within a line parallel with, and 12 inches outside of, the actual dimensions of the manhole, inlet, or Structure.

No separate measurement will be made for the following:

- Soft or disintegrated Rock.
- Hardpan or cemented gravel that can be removed with a hand pick or power-operated excavator or shovel.
- Loose, shaken, or previously blasted Rock or broken stone in Rock fillings or elsewhere.
- Rock outside of the minimum limits of measurement allowed, which may fall into the excavation.

(b) Boulder Excavation - Boulder excavation will be measured on the volume basis. Measurement will be made in the field by the Engineer after removal of each boulder from the excavation but prior to removal from the site. Each boulder removed will be measured for length, width, and height. The volume of each boulder will be determined as the product of 85 percent of each of the three measured dimensions.

00405.82 Trench Foundation - The quantities of unsuitable trench foundation will be measured on either the weight basis or the volume basis as follows:

- **Weight Basis** - Trench foundation will be measured on the weight basis. The quantity of replacement foundation Material will be based on weigh tickets from scales meeting the requirements of Section 00190. Present weigh tickets to the Engineer for signature on the Day the Material is delivered.

- **Volume Basis** - Trench foundation will be measured on the volume basis, computed using the following dimensions:

  - **Length** - Length will be the horizontal distance measured along the centerline of the trench. Measurement will be continuous through manhole or Structure locations.

  - **Width** - Width will be the nominal inside diameter of the pipe plus two times dimension "B" from "Table A" shown on the Standard Drawings.

  - **Depth** - Depth will be the vertical distance from the top of the underlying surface (following excavation of Unsuitable Material) to the bottom of the pipe bedding. The depth will be measured at intervals of 30 feet, or as specified, along the centerline of the trench and the average depth between points will be used for the volume computation.

Payment

00405.90 Payment - The accepted quantities of Rock excavation, boulder excavation, and trench foundation will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Rock Excavation	Cubic Yard
(b)	Boulder Excavation	Cubic Yard
(c)	Trench Foundation	Ton or Cubic Yard

Item (c) includes removal of Unsuitable Material and replacement as necessary to provide a stable foundation for the pipe.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Imported Topsoil will be paid for according to 01040.90.

No separate or additional payment will be made for:

- trench excavation
- trench backfill
- saw cutting
- trench protection
- pipe bedding
- pipe zone Material
- dewatering

Section 00406 - Tunneling, Boring, and Jacking

Description

00406.00 Scope - This Work consists of installing conduits, pipes, casings, linings, and sleeves by tunneling, boring, and jacking without excavating the overlying surface.

00406.01 Descriptive Terms:

Tunneling - Tunneling includes all methods by which an underground passageway is excavated and lining materials are brought in and placed.

Boring - Boring includes all methods by which a conduit, casing, pipe or sleeve is pushed or pulled into place and in which the excavation method precludes the stationing of a worker within the conduit without stopping or removing the excavation Equipment.

Jacking - Jacking includes all methods by which a conduit, casing, pipe or sleeve is pushed or pulled into place with one or more workers inside to excavate and assist in keeping the conduit on the required grade and alignment.

Materials

00406.10 Pipe Bedding and Pipe Zone Material - Furnish pipe bedding and pipe zone Material meeting the requirements of Section 00405.

00406.11 Pipe - Furnish pipe Materials meeting the strength, class, and type specified or shown.

00406.12 Casing - Furnish casing of a size to permit proper construction to the required lines and grades. Furnish casings that are made of smooth steel pipe or concrete pipe suitable for the purpose intended. Optionally, the casing may be constructed of galvanized, standard-offset, tunnel liner plate with gauge and section modulus as approved.

The class of casing specified is based on the superimposed loads and not on the stresses resulting from jacking or boring operations. Any increase in casing strength to withstand jacking or boring operations shall be the responsibility of the Contractor.

When pressure grouting is specified, equip jacked casings 36 inch diameter and larger with nipples installed at the springline and the crown, at 10 foot centers.

00406.13 Grout - Furnish grout for filling the annular space between the carrier pipe and the casing pipe of one part portland cement, five parts sand, and seven parts 3/8 inch maximum size rounded Aggregate by volume, or as approved.

Furnish grout for pressure grouting outside jacked carrier or casing pipe of one part portland cement and three parts sand by volume, or as approved.

00406.14 Sand - Furnish sand for filling the annular space between the carrier pipe and the casing pipe of clean, sharp, and well-graded so that 100 percent passes the No. 8 sieve, and between 10 percent and 35 percent passes the No. 50 sieve, or as approved.

Construction

00406.40 Excavation - Excavation for Work under this Section is unclassified and includes whatever materials are encountered to the depths shown or required.

00406.41 Required Submittals - Before beginning the Work, submit the following to the Engineer according to 00150.35:

(a) Tunneling - Submit the following stamped Working Drawings:

- Tunnel shaft bracing design and dimensions
- Tunnel support details
- Method of back-packing tunnel supports
- Design of bracing to prevent lining from shifting or flotation
- Backfill material or pressure concrete mix design, placement method and Equipment
- Poling plate dimensions and details, when required

(b) Boring and Jacking - Submit the following unstamped Working Drawings:

- Jacking pit construction
- Casing or conduit
- Jacking head
- Excavation method
- Tee or wye installation
- A substitute design for any part of the system that is changed as a result of the jacking or boring operation
- Bracing to prevent pipe shift and flotation, if placed in a casing, and the Materials, method and Equipment for backfilling
- Backfill material or pressure grout mix, placement method and Equipment

Submit for review the following stamped Working Drawings:

- Jacking pit bracing
- Any Structure that is required because of the particular method or procedure used by the Contractor

00406.42 Tunneling - Construct the pipe on a firm Subgrade, thoroughly compacted and true to grade. If the material in the bottom of the tunnel is ledge Rock, extend excavation of the tunnel to a depth below the bottom of the pipe, and provide a bedding of crushed Aggregate or concrete as specified in Section 00405. Restore to grade any excavation made below grade without approval by backfilling with approved bedding material, at no additional cost to the Agency.

00406.43 Boring and Jacking - Boring or jacking may be allowed in lieu of the open trench method or tunneling with approval of the Engineer. Jack or bore all conduit, casings, pipe or sleeves to the required line and grade.

Equip the leading section of pipe or casing with a jacking head. Perform all excavation entirely within the jacking head.

Should loss of surrounding material occur during the jacking or boring operation, backpack or grout the voids before the completion of the shift. Fill or backpack all voids with grout or Granular Material as approved.

00406.44 Concrete Pipe - Protect the driving ends of concrete pipe against spalling and other damage. Protect intermediate joints by the installation of sufficient bearing shims to properly distribute

the bearing stresses. Remove all sections of conduit showing signs of failure and replace with new sections, or with approved cast-in-place sections, that are adequate to carry the loads imposed on them.

00406.45 Smooth Steel Casing - Join sections of smooth steel casing to be jacked or bored by welding the joints with a continuous weld for the full circumference, or by other approved means. Provide joints capable of resisting the jacking or boring forces.

Brace pipe installed in casing to prevent shifting or flotation. Fill the void between the casing and the pipe with grout or other material, as specified or approved.

00406.46 Grouting Voids Outside Casing - On pipes 36 inches or larger, fill completely the void space between the tunnel and the casing or liner plate with approved grout. After the casing or carrier pipe has been jacked or tunneled into position, fill with grout under pressure, through the grout holes provided, to fill all voids outside the pipe using the following sequence:

- Grout at the springline hole at one end and pump the grout until it appears in the grout hole at the crown.
- Grout through the opposite springline hole until the grout appears at the hole in the crown.
- Grout through the hole at the crown until the grout appears in the next set of holes along the pipe.
- Plug the holes at the starting point and move to the next set of holes.
- Repeat the sequence until the full length of the pipe has been grouted.

Provide a continuous color video recording of the grout placement, to provide documentation that grout was properly placed according to the above Specifications. On the video, identify the location of the grouting operation in relationship to the end of the casing, tunnel or liner plate.

00406.47 Cradles for Cased or Tunneled Pipe - Where cradles are shown, provide a strapped cradle under the barrel of the carrier pipe. The barrel shall bear continuously on the cradles.

00406.48 Placing Fill in Casing - Where shown, completely fill the annular space between the pipe and the casing, tunnel liner or tunnel wall with approved grout or sand to prevent pipe flotation. Pour or pump the fill from the two ends and from intermediate points as necessary. Complete grouting in a continuous operation without stopping. Perform sand filling using a gunite machine or other approved Equipment.

00406.49 Railroad Crossings - Perform all Work in Railroad rights-of-way according to the railroad permit.

Measurement

00406.80 Measurement - No measurement of quantities will be made for tunneling, boring, or jacking Work, or for casing or conduit used to install pipe.

Where tunneling, boring, jacking, or open trench excavation is used at the Contractor's option in lieu of another specified method, measurement will be made as originally bid.

The quantities of pipe installed by tunneling, boring, or jacking will be measured according to the appropriate items under which this Work is required.

Payment

00406.90 Payment - The additional effort required to install conduits, pipes, casings, linings, and sleeves by tunneling, boring, or jacking (other than under a railroad) will be paid for at the Contract lump sum amount for the item "Tunneling, Boring, and Jacking".

If tunneling, boring, jacking, or open trench excavation is used at the Contractor's option in lieu of another specified method, payment will be made as originally bid.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Tunneling, boring, or jacking under a railroad will be paid for according to 00445.91.

Pipe will be paid for according to the appropriate items under which this Work is required.

Section 00411 - Pipe Bursting and Slip Lining

Description

00411.00 Scope - This Work consists of furnishing and installing high density polyethylene (HDPE) pipe in gravity sewer pipe by the pipe bursting and slip lining methods.

00411.01 Submittals - Submit the following at least 10 Calendar Days before the preconstruction conference.

- Method of pipe bursting, including listed Equipment by size, make, model and manufacturer.
- Method of slip lining, including listed Equipment by size, make, model and manufacturer.
- Certification that the HDPE pipe meets requirements in ASTM F714.
- Contingency repair plan including methods and Equipment to be used to repair or replace unacceptable defects.
- Stamped Working Drawings according to 00150.35 and include the structural design, final design and associated calculations.
- Installation plan that includes the method of installation, sequencing, host pipe preparation, lubricant, and temporary modification of existing Structures,
- Property notification fliers.
- Host pipe point repair plan, including methods and Equipment.
- Sewer bypass and flow diversion plan according to 00490.40.
- Complete Video Pipe Inspection per Section 00415.

Materials

00411.10 Pipe - Furnish high molecular weight, high-density polyethylene pipe and fittings that are made from virgin grade material, to the diameter specified, and to tolerances meeting the requirements of ASTM F714 with a minimum ratio of orthogonal diameters, before installation, of 0.95.

(a) Markings - Provide pipe Materials that are legibly marked, by the pipe manufacturer, with the following information:

- Name and trademark of manufacturer.
- Nominal pipe size.
- Dimension ratio.
- The letters PE followed by the polyethylene grade according to ASTM D1248, followed by the hydrostatic design basis in hundreds of psi.
- Manufacturing standard reference.
- A production code from which the date and place of manufacture can be determined.

(b) Pipe Color - Provide uniformly colored black or gray pipe.

(c) Dimension Ratio - Provide nominal 8 to 18 inch sized pipe having a minimum dimension ratio (DR) of 17.

00411.11 Service Connections - Furnish lateral service connections to the sewer main with manufactured gasket tees, electrofusion saddle tees, or approved equal that provide water-tight connections between the rehabilitated sewer main and the service line connection.

Equipment

00411.20 Pipe Bursting, Fusion, and Pipe Assembly Equipment - Use Equipment, approved by the pipe manufacturer and the Engineer, designed for pipe bursting, butt fusion, and saddle fitting welding. Use heating faces that have a non-stick coatings. Provide joining Equipment capable of attaining appropriate fusion temperature, alignment, and pressure.

Use manufacturer's recommended pipe bursting tools for the diameter of pipe to be installed, as well as the diameter and material of pipe to be replaced.

Labor

00411.30 Personnel Qualifications - Provide installers that are certified by the manufacturer and have at least 2 years of experience of butt fusion welding of 8-inch and larger diameter pipes. Provide a supervisor with the same certification as the installers in addition to having installation experience on at least 50,000 feet of 8-inch and larger diameter pipes.

Construction

00411.40 Pipe Joining - Perform joining methods meeting the requirements of ASTM F2620 and the pipe manufacturer's recommendations, or as approved.

Perform full penetration welds that provide a homogeneous material across the entire Cross Section of the weld. Remove fusion beads greater than 1/16 inch on the inside of the pipe using an approved cutting device.

Perform trial fusion welds in the field and provide samples before installation of the pipe. Use the same fusion machine that was used in the trial welds for the final welds incorporated into the Work.

Electrofusion may be used for field closures as necessary when fusion Equipment can be utilized in a trench type environment.

Other joining methods may be used if the pipe material is selected from the QPL.

00411.41 Receiving Pits and Insertion Pits - Locate all pits to suit the specified pipe lining operation. Use existing manholes where practicable. Remove manhole inverts, benches, and channels to permit access for installation Equipment. Enlarge the input and output pipe openings if required to accommodate the maximum outside diameter size of the insertion Equipment. Do not put undue stress on existing Structures. Reinstall inverts and reconstruct benches and channels after pipe liners have been installed.

In areas where new manholes are not being installed or existing manholes are not available, excavate and restore pits at no additional cost to the Agency.

00411.42 Installation:

(a) Pipe Bursting - Break existing pipe by utilizing a constant tension system with a hydraulic or pneumatic bursting device that breaks away the pipe. A static "cone cracking" method may be used if approved. Create a void of sufficient size to accommodate the pipe. Continue pipe bursting and lining without interruption for the entire pipe segment unless otherwise approved. Extend the pipe 12 inches into the manhole or concrete Structure to allow for contraction/relaxation after installation.

(b) Slip Lining - Do not score or damage the liner pipe during the installation process. Fill annular space between the new liner and the host pipe as approved.

00411.43 Connections:

(a) General - After completing the installation, allow the pipe to stabilize for at least 12 hours before making the final connections.

(b) Manholes - Make all connections to concrete manholes, Structures, and pipelines using slip-on sanded adaptors.

(c) Service Line - Reconnect all service lines as approved after the air tests have been performed and accepted.

Finishing and Cleaning Up

00411.70 Manhole Base Reconstruction - Reconstruct manhole bases by removing the existing base and constructing a new base with a finished surface no higher than 6 inches below the outside portion of the lowest pipe outflow. Shape new smooth, depression-free channels to the elevation shown. Remove the bottom manhole step as required for the new base. Do not damage existing manhole walls or existing pipes. Repair all cracks with non-shrink grout.

00411.71 Testing - Conduct pipe testing according to 00445.72.

Measurement

00411.80 Measurement - The quantities of pipe bursting and the quantities of slip lining of the various kinds, types, and sizes will be measured on the length basis. The length will be measured, with no deduction for Structures or fittings, along the pipe flow line from center to center of manholes, inlets, Structures, special sections, or the ends of pipe, whichever is applicable.

The quantities of service line reconnections will be measured on a unit basis, regardless of size.

Payment

00411.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Pipe Bursting, ____ Inch.	Foot
(b)	Slip Lining, ____ Inch……	Foot
(c)	Service Line Reconnections	Each

In items (a) and (b), the nominal size of the new liner pipe will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00412 - Cured-in-Place Pipe Lining

Description

00412.00 Scope - This Work consists of rehabilitating existing pipes by furnishing and installing pipe liners by cured-in-place pipe (CIPP) lining methods as shown.

00412.01 Submittals - Submit the following at least 10 Calendar Days before the preconstruction conference:

- Certification by the lining system manufacturer that the installer is licensed and certified as competent to perform the Work.
- Documentation showing the installer meets the qualifications listed in 00412.30, and a list of the key qualified personnel who are assigned to Work on this Project.
- Certification of test results confirming that the CIPP liner system meets the minimum chemical resistance requirements according to ASTM F1216 and ASTM F1743.
- Catalog data, and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of system components of the tube and resin system. Include manufacturer's recommendation for handling, storage, insertion, curing, trimming, finishing, and repair of damaged liner.
- Calculations for the volume of resin to be used for each segment and detailed description of the wet-out process. Include the tube and resin manufacturer's wet-out recommendations including the roller gap, material feed speed and vacuum requirements for each liner size and thickness.
- End seal material to be used, and method of installation. If a grout sealing method is proposed or suggested, provide certification from the grout manufacturer or Supplier that the grout material for sealing Structures and service laterals is compatible with the proposed resin and liner system and is suitable for use in aqueous environments.
- Sampling and testing plan for physical properties according to ASTM F1216 and ASTM F1743, including name and location of laboratory performing testing on installed liner system. Provide certification that each test shall be performed by a laboratory with appropriate accreditation for the specific test to be performed.
- Installation plan describing project staging, liner shot plan and sequence, and the manufacturer’s standard procedures for liner installation. Include allowable pulling forces, installation pressures, allowable curing temperatures, and temperature monitoring plan.
- Contingency repair plan including methods and equipment to be used to repair or replace unacceptable liner defects identified in 00412.73.
- Stamped design of the proposed liner according to 00150.35 and 00412.02.

Upon liner system delivery, submit wet-out logs documenting resin volumes used.

00412.02 Design Parameters - Follow the design considerations of ASTM F1216 and meet the following:

Condition	Parameter
Service Life	Greater than 50 year
Pipe Conditions	Fully deteriorated
Load Conditions:	
Soil	125 lb/cf minimum
Traffic	LRFD HL- 93 live load
Groundwater Elevation above invert	*
Pipe Ovality	5%
Modulus of Soil Reaction	700psi
Enhancement Factor	7.0
Long-Term Flexural:	
Strength	50% of initial (ASTM D790)
Modulus of Elasticity	50% of initial (ASTM D790)
Maximum Deflection	5%
Minimum Factor of Safety	2.0

* Parameters will be listed in the Special Provisions.

Materials

00412.10 Tube - Furnish tubing that consists of absorbent nonwoven felt fabric meeting the requirements of ASTM F1216, Section 5.1 and exhibits the following characteristics:

- A smooth, impermeable, bonded coating on the inside of the finished pipe.
- Sewn or bonded seams, stronger than non-seamed material, as recommended by the tube manufacturer.
- No allowable delamination in the cured CIPP.

Verify pipe lengths and pipe diameters before ordering tubing.

00412.11 Resin - Furnish resins meeting the requirements of ASTM F1216, Section 5.2, or ASTM F1743, Section 5.2.3. Comply with the structural requirements specified for the installed liner system.

Furnish thermosetting polyester, vinylester, or epoxy resin and a catalyst system compatible with the installation process, and is able to cure in the presence or absence of water. Color the resin with a pigment compatible with the resin system.

00412.12 Liner Properties - Furnish liners that have the minimum physical properties stated in ASTM F1216, ASTM F1743 and ASTM D2990, and are also resistant to chemical properties and flow characteristics typically found in municipal sanitary sewer flows. Fabricate the liner to a size that when cured, will tightly fit the pipe being rehabilitated. The finished liner system shall be homogeneous across the wall thickness containing no intermediate or encapsulated elastomeric layers.

Characteristic	Test Method	Epoxy/Vinylester	Polyester Resin
Initial Flexural Strength	ASTM D790	5,000 psi	4,500 psi
Initial Flexural Modulus of Elasticity	ASTM D790	400,000 psi	250,000 psi (min.)

Labor

00412.30 Personnel Qualifications - Provide installers who:

- Are licensed, and certified by the manufacturer of the CIPP product system to be used on the Project.
- Have at least 3 years of active experience in the installation of CIPP.
- Have installed at least 50,000 feet of CIPP in similar conditions.

Construction

00412.40 General - Handle and store all liner material to ensure that the material is not torn, cut, exposed to direct sunlight or otherwise damaged. Before installing the liner, verify its condition with the Engineer. If any part of the liner material becomes torn, cut, or damaged before or during insertion, repair or replace it at no additional cost to the Agency before proceeding further.

00412.41 Pipe Cleaning - Clean the pipe by removing all debris, sediment, and other accumulated material. Do not use chemicals without the written approval of the Engineer. Remove and dispose of all debris according to 00290.20.

00412.42 Pre-Installation:

(a) Video Pipe Inspection - After cleaning the pipe, perform a pre-installation video inspection according to Section 00415, at least 5 Calendar Days before beginning pipe lining Work.

(b) Pre-Installation Point Repairs - If pre-installation video inspection reveals unanticipated obstructions, reduction in cross-sectional area, sags, previous repairs, or any structural defects in the pipe, submit a point repair plan to the Engineer for approval. All point repairs must restore the host pipe to a condition suitable for CIPP lining.

Approved unanticipated point repairs to restore the host pipe suitable for UV-CIPP lining will be paid for according to 00195.20.

00412.43 Installation - Install CIPP according to ASTM F1216 Section 7, ASTM F1743 Section 6, and the manufacturer's recommendations.

(a) General - Liners may be installed in continuous runs through manholes where there are two or more continuous host pipe segments requiring lining.

Provide temporary downstream dams or filtration measures in the pipeline to catch excess resin and construction debris.

Do not allow the temperature of water discharged from processing liners to exceed the level allowed by State or local requirements.

Provide a "back-up" robotic cutter assembly train and key spare components on-site during CIPP lining activities.

(b) Pipe Liner End Seal - Install an end seal when reconnecting to the rehabilitated host pipe.

00412.44 Service Line Reconnection - Reinstate active service laterals using an internal cutter. Open hole to a minimum of 95 percent, but do not exceed 105 percent of the service lateral diameter. Make each connection free from burrs or projections, and with a smooth and crack-free edge.

Finishing, Cleaning Up, and Testing

00412.70 General - Remove temporary dams or filtration measures after Work is complete and pipe is clean and restored.

00412.71 Post Installation Video Inspection - After installation of the UV-CIPP perform a post-installation video inspection of the pipe according to Section 00415.

00412.72 Material Sampling and Testing - Obtain samples and perform material testing according to ASTM F1216 and ASTM F1743. Perform one physical properties test per 1,000 feet installed, or as specified.

Individually label and log each sample with the following information:

- Project name
- Name of Contactor
- Sampler's name
- Sample number
- Date and time of sample
- Location of sample
- Initial cure start date and time
- Name and location of third party laboratory

Flexural properties must meet or exceed the values according to 00412.12.

00412.73 Repairs - Before making repairs, provide the CIPP liner system manufacturer's recommendations for liner repairs, subject to approval by the Engineer. Repair or replace CIPP liners that have:

- Wrinkles, fins or other discontinuities in the lower one-third of the pipe that are perpendicular to the flow and exceed 1/2 inches in height, or are greater than 3 percent of the host pipe inside diameter.
- Wrinkles, fins or other discontinuities in the upper two-thirds of the pipe that are perpendicular to the flow and are greater in height than 5 percent of the host pipe inside diameter.
- Blisters or dry spots present.
- Leakage through the liner in excess of ASTM F1216 and ASTM F1743 standards.
- Separation of the liner from the host pipe.
- Delamination of CIPP layers.

00412.75 Contractor Warranty - The Contractor unconditionally warrants to the Agency the product and installation under this Section against failure, according to this Subsection and 00170.85(b)(1).

"Unconditionally warrant" means that the warranty covers all failures, regardless of the source or cause of the failure, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of materials.

The Agency inspection of any portion of the Work during the Contract and during the product installation, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the obligations under this warranty.

(a) Warranty Period - The warranty period shall be for 1 year.

(b) Failure - For purposes of the warranty, failure is defined as one or more of the following:

- Wrinkles, fins or other discontinuities in the lower one-third of the pipe that are perpendicular to the flow and exceed 1/2 inch in height, or are greater than 3 percent of the host pipe inside diameter.
- Wrinkles, fins or other discontinuities in the upper two-thirds of the pipe that are perpendicular to the flow and are greater in height than 5 percent of the host pipe inside diameter.
- Blisters or dry spots.
- Leakage through the liner in excess of ASTM F1216 and ASTM F1743 standards.
- Separation of the liner from the host pipe.
- Delamination of CIPP layers.

(c) Remedy - Upon notification by the Engineer of a failure as defined above, provide the following remedy at no additional cost to the Agency:

- Liner repair plan and written timeline of when the Work will be completed within 10 Calendar Days of the Agency's written notification of failure.
- One of the following, as approved:
  - Install a second liner,
  - Remove the failed liner and install a full-thickness liner,
  - Construct a full pipe replacement, or
  - Install a liner repair.
- Complete one of the approved remedy's within 60 Calendar Days of the Agency's written notification of failure.
- Use materials and procedures meeting the Specifications.
- Coordinate timing of repair Work with the Engineer.

(d) Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure causes or may cause a hazard, the failure may be temporarily corrected by Agency or other forces at no additional cost to the Agency. Replace temporary repairs with permanent repairs at no additional cost to the Agency and according to the Specifications and within the time specified in 00412.75(c).

Measurement

00412.80 Measurement - The quantities of installed CIPP liners, of the various kinds, types, and sizes, will be measured on the length basis. The length will be measured, with no deduction for Structures or fittings, along the pipe flow line from center to center of manholes, inlets, Structures, special sections, or the ends of pipe, whichever is applicable.

The quantities of service line reconnections will be measured on the unit basis, regardless of size.

Payment

00412.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	CIPP Liner, ____ Inch	Foot
(b)	Service Line Reconnections	Each

In item (a), the nominal size of the host pipe will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00413 – GRP Cured-in-Place Pipe Lining & UV Care

Description

00413.00 Scope - This Work consists of rehabilitating existing pipes by furnishing and installing Glass Reinforced thermosetting Plastic (GRP) cured-in-place pipe (CIPP) liners as shown and using ultraviolet (UV) cure methods.

00413.01 Submittals - Submit the following at least 10 Calendar Days before the preconstruction conference:

- Certification by the lining system manufacturer that the installer is licensed and certified as competent to perform the Work.
- Documentation showing the installer meets the qualifications listed in 00413.30, and a list of the key qualified personnel who are assigned to Work on this Project.
- Manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of system components of the tube and resin system. Include manufacturer's recommendation for handling and storage.
- Independent third party certification of test results confirming that the CIPP liner system meets the minimum chemical resistance requirements and initial structure properties according to ASTM F2019.
- Calculations for the volume of resin to be used for each segment and detailed description of the resin impregnation (“wet out”) process. Include the tube and manufacturer's resin impregnation (“wet out”) recommendations including the roller gap, material feed speed and vacuum requirements for each liner size and thickness. Upon liner system delivery, submit impregnation (“wet out”) logs documenting resin volumes used.
- Detailed installation plan describing project staging, liner shot plan and sequence, and the manufacturer’s standard procedures for liner installation. Include allowable pulling forces, installation pressures, allowable curing temperatures, temperature monitoring plan, and speed of the UV light train for proper curing of the installed liner.
- Liner shot and curing schedule for each installation. Include curing log and pressures at the upstream and downstream end of the pipe during the curing process.
- End seal material to be used, and method of installation. Hydraulic cements and quick-set cement products are not acceptable.
- Field sampling and testing plan for physical properties according to ASTM F2019. Include the name and location of independent third party laboratory performing testing on the installed liner system. Provide certification that the independent third party laboratory has the appropriate accreditation for each specified tests to be performed.
- Contingency repair plan including methods and equipment to be used to repair or replace unacceptable liner defects identified in 00413.72.
- Stamped design of the proposed liner according to 00150.35 and 00413.02.

00413.02 Design Parameters - Follow the design considerations of ASTM F2019 and meet the following:

Condition	Parameter
Service Life	Greater than 50 years
Pipe Conditions	Fully deteriorated
Load Conditions:	
Soil	125 lb/cf minimum
Traffic	LRFD HL-93 live load
Height of fill from invert	*
Groundwater Elevation above Invert.	*
Pipe Ovality	3% minimum
Modulus of Soil Reaction	700 psi
Enhancement Factor	7.0
Long-Term Flexural:	
Strength	50% of initial (ASTM D790)
Modulus of Elasticity	50% of initial (ASTM D790)
Maximum Deflection	5%
Minimum Factor of Safety	2.0
Poisson's Ratio of	0.3

***** Parameters will be listed in the Special Provisions.

Materials

00413.10 Tube - Furnish tubing that consists of at least two separate tubes made of corrosion resistant (E-CR or equivalent) glass fibers according to ASTM D578 and ASTM F2019. Verify pipe lengths and pipe inside diameters before ordering tubing. Provide flexible tubing that exhibits the following characteristics:

- Constructed to withstand pulling and installation forces.
- Fabricated to a size that when installed, conforms to the internal circumference and length the of host pipe.
- Sewn or bonded seams, stronger than the non-seamed material, as recommended by the tube manufacturer.
- Includes an impermeable inner and outer foil layer to contain resin migration and contamination. The inner foil should release easily from the inside wall for removal after completion of installation or remain if fabricated as a permanent part of the system and an integral part of the fabric tube by bonding or fusing to the fabric tube.
- Homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers.
- Do not include any material in the tube that may cause delamination in the CIPP.
- After installation the wall color of the interior pipe surface of CIPP is a light reflective color.

00413.11 Resin - Furnish resins meeting the requirements of ASTM F2019, Section 5.4 for UV-Light. Comply with the structural requirements specified for the installed liner system and the following:

- Compatible with the installation process.
- Chemically resistant UV cured isophthalic, polyester resin or vinyl ester resin.
- Capable of curing in the presence and absence of water.

Completely impregnate ("wet out") the liner with resin in the manufacture's plant under quality controlled conditions. Attach certification (provided by the manufacturer), according to ASTM F2019, to the impregnated fabric tube. No onsite or mobile resin impregnation is allowed.

00413.12 Liner Properties - Fabricate the liner to a size that when cured, will tightly fit the pipe being rehabilitated and meet the following requirements:

- Furnish liners that have the minimum physical properties stated in ASTM F2019 and tested according to ASTM D790.
- Be resistant to chemical properties

Characteristic	Test Method	Test Value
Initial Flexural Strength	ASTM D790	6,500 psi*
Flexural Modulus of Elasticity	ASTM D790	725,000 psi

*Minimum flexural strength in both the circumferential and longitudinal direction.

00413.13 Delivery and Storage - Deliver and store all product materials according to the manufacturer's recommendations and accompanied by the material safety data sheets. Store and transport the impregnated liner according to ASTM F2019, Section 6.4 and the manufacturer's recommendations. Use tubing material that is homogenous throughout, free from tears, holes, cracks, foreign materials and other surface defects.

Labor

00413.30 Personnel Qualifications - Provide installers who:

- Are licensed, and certified by the manufacturer of the CIPP product system to be used on the Project.
- Have at least 3 years of active experience in the installation and UV curing methods of GRP CIPP according to ASTM F2019.
- Have installed at least 50,000 feet of UV-GRP CIPP according to ASTM F2019.

or

- Provide a manufacturer's representative with at least three years' experience with UV-GRP CIPP installation in pipes and has installed at least 50,000 feet of UV-GRP CIPP according to ASTM F2019.
- The Contractor is responsible to ensure the manufacturer's representative is on-site during the initial installation. When the representative is not on-site, provide the telephone number of a manufacturer's representative who is available on a 24-hour basis throughout the Project duration.

Provide a supervisor for the UV-GRP CIPP installation who is assigned to the Project full time during the UV-GRP CIPP installation Work and has supervised at least 30,000 feet of UV-GRP CIPP according to ASTM F2019.

Construction

00413.40 General - Field verify pipe inside diameter(s) throughout the pipe, length(s), alignment, material and condition of the host pipe prior to ordering liner material and construction. Handle and store all liner material to ensure that the material is not torn, cut, exposed to direct sunlight or otherwise damaged. Before installing the liner:

- Verify the liners condition with the Engineer. If any part of the liner material becomes torn, cut, or damaged before or during insertion, repair or replace the liner at no additional cost to the Agency before proceeding further.

00413.41 Pipe Cleaning - Clean the pipe by removing all debris, sediment, and other accumulated material. Do not use chemicals without the written approval of the Engineer. Remove and dispose of all debris according to 00290.20.

00413.42 Pre-Installation:

(a) Video Pipe Inspection - After cleaning the pipe, perform a pre-installation video inspection of the pipe according to Section 00415.

(b) Pre-Installation Point Repairs - If pre-installation video inspection reveals unanticipated obstructions, reduction in cross-sectional area, sags, previous repairs, or any structural defects in the pipe, submit a point repair plan to the Engineer for approval. All point repairs must restore the host pipe to a condition suitable for UV-CIPP lining.

Approved unanticipated point repairs to restore the host pipe suitable for UV-CIPP lining will be paid for according to 00195.20

Seal all active water infiltration into the pipe prior to application of the liner with an approved epoxy or resin mixture compatible with the GRP CIPP liner system used.

00413.43 Installation - Install liner system according to ASTM F2019 and the manufacturer's recommendations.

(a) General - Provide temporary downstream dams or filtration measures in the pipeline to catch excess resin and construction debris.

Provide a "back-up" robotic cutter assembly train and key spare components on-site during CIPP lining activities.

(b) Pipe Liner End Seal - Install a continuous or properly trimmed end seal between the end of the new liner and the host pipe connection. Insert end seals at each structure opening centered with the host pipe. Butt the trimmed end seal edges against each other at the crown of the pipe using a 45 degree miter cut. Seals, with any gap between the ends, will not be accepted.

(c) Installation - Prior to inserting the liner, install a slip sheet through the entire length of the host pipe to protect the liner from damage during installation.

Attach the liner securely to a constant tension winch and pull into place. Do not exceed the manufacturer’s recommendations for pulling forces (tension) and speed.

Inflate the liner by air to an initial pressure, recommended by the manufacturer, until the liner fits tight against the wall of the existing host pipe. Ensure the pressure head used during the installation process is sufficient to hold the liner tight to the pipe wall, and prevent wrinkles in the cured liner. During the curing process use the same pressure head to prevent water infiltration from entering the pipeline. Maintain the pressure head long enough to allow pockets of water to exfiltrate through the host pipe and prevent lifts in the liner and resin washout.

(d) UV Curing Method - Cure the liner according to ASTM F2019, Section 6.7, with the following modifications:

A camera must be located on the ultraviolet light assembly to view that the liner is properly inflated and identify any liner problems before curing begins.

Operate the ultraviolet curing lamps in a sufficient frequency range to ensure the curing of the resin.

Submit a documented record of time, rate of travel of the ultraviolet light assembly, internal pressures, and the amount of lamps in operation during the curing process to the Engineer upon request.

Finishing, Cleaning Up, and Testing

00413.70 General - Ensure the cured liner is continuous and free from visual defects such as foreign inclusions, dry spots, pinholes, delamination, and wrinkles at any location. Verify the lining is impervious and free of any leakage from water infiltration into the lined pipe or exfiltration from the lined pipe.

Cut both ends of the cured liner flush at the inlet and outlet points of the pipe, and sealed with an epoxy or resin mixture compatible with the liner/resin system, providing a watertight seal.

Remove any temporary dams or filtration measures after Work is complete and pipe is clean and restored.

00413.71 Post Installation Video - After installation of the UV-CIPP perform a post-installation video inspection of the pipe according to Section 00415.

00413.72 Material Sampling and Testing - Obtain restrained samples and perform material testing according to ASTM F2019 Section 7 for UV cure with the following modifications:

Individually label and log each sample with the following information:

- Project name
- Name of Contractor
- Sampler's name
- Sample number
- Date and time of sample
- Location of sample
- Initial cure start date and time
- Name and location of third party laboratory

Flexural properties must meet or exceed the values according to 00413.12.

If core sample method was used, repair core hole samples using the same tube that was used in the installed liner, and an epoxy or resin mixture compatible with the GRP CIPP liner system used. Repair patches must fill the cores completely. Apply a second oversized 1.5mm thickness patch over the repaired hole to ensure a watertight seal.

00413.73 Repairs - Before making repairs, provide the CIPP liner system manufacturer's recommendations for liner repairs, subject to approval. Repair or replace CIPP liners at no additional cost to the Agency per the manufacturer's recommendations that have:

- Wrinkles, fins or other discontinuities in the lower one third of the pipe that are perpendicular to the flow and exceed 1/2 inches in height, or are greater than 3 percent of the host pipe inside diameter.
- Wrinkles, fins or other discontinuities in the upper two thirds of the pipe that are perpendicular to the flow and are greater in height than 5 percent of the host pipe inside diameter.
- Holes, blisters, dimples, lifts or dry spots present.
- Tears or gouges.
- Leakage of water through the liner according to ASTM F2019 Section 7.3.
- Separation of the liner from the host pipe.
- Delamination of CIPP layers.
- Design thickness is less than 90 percent of submitted value as determined by ASTM F2019.
- Any space or gap between the outside surface of the liner and the inside surface of the existing pipe that exceeds 0.040 inches.

00413.75 Contractor Warranty - The Contractor unconditionally warrants to the Agency the product and installation under this Section against failure, according to this Subsection and 00170.85(b)(1).

"Unconditionally warrant" means that the warranty covers all failures, regardless of the source or cause of the failure, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of materials.

The Agency inspection of any portion of the Work during the Contract and during the product installation, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the obligations under this warranty.

(a) Warranty Period - The warranty period shall be for 1 year.

(b) Failure - For purposes of the warranty, failure is defined as one or more of the following:

- Wrinkles, fins or other discontinuities in the lower one-third of the pipe that are perpendicular to the flow and exceed 1/2 inch in height, or are greater than 3 percent of the host pipe inside diameter.
- Wrinkles, fins or other discontinuities in the upper two thirds of the pipe that are perpendicular to the flow and are greater in height than 5 percent of the host pipe inside diameter.
- Holes, blisters, dimples, lifts or dry spots.
- Tears or gouges.
- Leakage of water through the liner according to ASTM F2019 Section 7.3.
- Separation of the liner from the host pipe.
- Delamination of CIPP layers.
- Design thickness is less than 90 percent of submitted value as determined by ASTM F2019.
- Any space or gap between the outside surface of the liner and the inside surface of the existing pipe that exceeds 0.040 inches.

(c) Remedy - Upon notification by the Engineer of a failure as defined above, provide the following remedy at no additional cost to the Agency:

- Liner repair plan and written timeline of when the work will be completed within 10 Calendar Days of the Agency's written notification of failure.
- One of the following, as approved:

  - Install a second liner,
  - Remove the failed liner and install a full-thickness liner,
  - Construct a full pipe replacement, or
  - Install a liner repair.
- Complete one of the approved remedies within 60 Calendar Days of the Agency's written notification of failure.
- Use materials and procedures meeting the Specifications.
- Coordinate timing of repair Work with the Engineer.

(d) Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure causes or may cause a hazard, the failure may be temporarily corrected by Agency or other forces at no additional cost to the Agency. Replace temporary repairs with permanent repairs at no additional cost to the Agency and according to the Specifications and within the time specified in 00413.75(c).

Measurement

00413.80 Measurement - The quantities of installed CIPP liners, of the various kinds, types, and sizes, will be measured on the length basis. The length will be measured, with no deduction for Structures or fittings, along the pipe flow line from center to center of manholes, inlets, Structures, special sections, or the ends of pipe, whichever is applicable.

Payment

00413.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) CIPP Liner, ____ Inch	Foot

In item (a), the nominal size of the host pipe will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00414 - Pipe Renewal - Spray Applied Pipe Structural Liner

Description

00414.00 Scope - This Work consists of lining existing pipes with a spray applied pipe structural liner (SAPL) that is a factory blended cementitious or geopolymer mortar Material. Apply the SAPL by spin cast method or spray by hand on metal, concrete, clay, and brick pipes only.

00414.01 Submittals - Submit the following at least 10 Calendar Days before the preconstruction conference:

- Certification by the lining system manufacturer that the installer is licensed and certified as competent to perform the Work.
- Documentation showing the installer meets the qualifications listed in 00414.30, and a list of the qualified personnel who are assigned to Work on this Project.
- Certification that manufacturing processes operate under a quality management system according to recognized industry standards.
- Manufacturer's technical data showing complete information on material composition and physical properties. Include manufacturer's recommendation for handling, storage, installation, curing, finishing, and for the repair of a damaged liner.
- Independent third party certification of test results confirming that the SAPL liner system meets the structure properties according to 00414.10.
- Field sampling and testing plan for physical properties according to 00414.10. Include the name and location of independent third party laboratory performing testing on the installed liner system. Provide certification that the independent third party laboratory has the appropriate accreditation for each specified tests to be performed.
- Contingency repair plan including methods and Equipment to be used to repair or replace unacceptable SAPL defects identified in 00414.72.
- Stamped design of the proposed liner according to 00150.35 and 00414.02.

00414.02 Design Parameters - Use the following design parameters for a fully deteriorated gravity pipe design:

Condition	Parameter
Soil modulus of Reaction	2,000 psi maximum
Load Conditions:	
Soil	120 lb/cf minimum
Traffic	LRFD HL-93 live load
Height of fill from invert	*
Groundwater Elevation above Invert	*
Minimum Factor of Safety	2.0

***** Parameters will be listed in the Special Provisions.

The minimum liner thickness, independent of design for all structural applications:

- 1.0 inch for all pipes less than 48 inches in diameter or equivalent.
- 1.5 inches for all pipes greater than 48 inches in diameter or equivalent.

Materials

00414.10 Liner Properties - Furnish a cementitious or geopolymer mortar Material that meets the following minimum physical property requirements.

PropertyTest	Method	Duration	Test Value
Minimum Compressive Strength	ASTM C109	1 Day	3,000 psi
		28 Days	8,000 psi
Minimum Flexural Strength	ASTM C293	7 Days	850 psi
		28 Days	1,100 psi
Modulus of Elasticity	ASTM C469	28 Days	3,600,000 psi
Bond Strength	ASTM C882	28 Days	2,000 psi
Freeze Thaw Resistance	ASTM C666	300 Cycles	Min. 90%

00414.11 Delivery and Storage - Deliver and store all product Materials according to the manufacturer's recommendations and accompanied by the material safety data sheets.

Deliver all Materials in the manufacturer's original unopened packages. Check to ensure each package is labeled with the manufacturer's brand name, batch number and expiration date. Do not use Material that has exceeded the expiration date, or Material from defective, punctured or damaged packages.

Equipment

00414.20 Equipment - Use Equipment approved by the manufacturer to apply the SAPL and that meets the following requirements:

(a) Spin Cast Nozzle - Use spin cast nozzle capable of bidirectional operation and attached to a reciprocating head.

(b) Pumps - Use pumps equipped with multiple sensors that stop the pump if the lining Material runs out or overflows.

(c) Mixer - Provide a high shear mixer to ensure a uniform and thorough mix of the water and Material prior to pumping.

Labor

00414.30 Personnel Qualifications - Provide installers who:

- Are licensed, and certified by the manufacturer of the SAPL product to be used on the Project.
- Have at least 3 years of active experience in the spin cast installation of cementitious or geopolymer mortar liners.
- Have installed at least a cumulative of 5,000 feet of cementitious or geopolymer mortar by spin cast and hand application.

or

- Provide a manufacturer's representative with at least five years' experience with cementitious or geopolymer mortar SAPL.
- The Contractor is responsible to ensure the manufacturer's representative is on-site during the installation. When the representative is not on-site, provide the telephone number the manufacturer's representative, or alternate, who is available on a 24-hour basis throughout the Project duration to the Superintendent and the Engineer.

Provide a supervisor for the cementitious or geopolymer mortar liner Material installation who is assigned to the Project full time during the pipe structural liner Work and has supervised at least 15,000 feet of cementitious or geopolymer mortar liner by spin cast and hand application.

Construction

00414.40 General - Field verify pipe inside diameter(s) throughout the pipe, length(s), alignment, Material and condition of the host pipe prior to ordering liner Material and construction.

00414.41 Pipe Cleaning - Clean the pipe by removing all debris, sediment, and other accumulated Material. Do not use chemicals without the written approval of the Engineer. Remove and dispose of all debris according to 00290.20.

00414.42 Pre-Installation:

(a) Video Pipe Inspection - After cleaning the host pipe, perform a pre-installation video inspection of the pipe according to 00415, at least 5 Calendar Days before beginning pipe lining Work.

(b) Pre-Installation Repairs - Repair any deterioration or loss of Material of the pipe invert using a highly flowable lean concrete mix according to 00442. Seal all open joints with an approved hydraulic cement or geopolymer lining Material prior to the lining of the pipe.

Repair or restore the host pipe suitable for cementitious or geopolymer mortar lining as directed. Repairs will be paid for according to 00195.20

Seal all active water infiltration into the pipe prior to application of the SAPL by applying quick-setting mortars or chemical grouts approved by the Engineer.

When requested by the Engineer, perform a new or supplemental pre-construction video inspection of the pipe according to Section 00415 after the repairs have been completed.

00414.43 Installation - Install the SAPL according to the manufacturer's recommendations and control the temperature and humidity. The SAPL shall be smooth, uniform and free of any defects.

(a) Application Thickness - Apply the SAPL in a uniform thickness. The minimum uniform thickness per Pass is 1/2 inch and the maximum uniform thickness is 3/4 inches per Pass. During installation ensure the corrugation troughs are completely filled.

Plastic indicator tabs may be attached on the Structure to verify the design thickness is achieved. Position the tabs height just below the specified liner thickness.

Verify Material thickness at three various random locations around the pipe perimeter a minimum of once every 10 linear feet along the pipe profile. Measure the Material thickness over the corrugation crests using a depth gauge. Ensure the Material thickness over projecting bolts on structural plate culverts is a minimum of 1/2 inch. Apply additional Material at locations less than the design thickness using the rotating applicator head.

(b) Curing - Cure the Material in moist and moderate conditions according to the manufacturer’s recommendations.

(c) General - Submit a daily written report of:

- Time, calibration and rate of travel of the applicator to achieve the specified design thickness.
- Verified Material thickness according to 00414.43(a).
- The outside ambient air temperature and the temperature and humidity inside the host pipe.

Finishing, Cleaning Up, and Testing

00414.70 General - Ensure the cured cementitious or geopolymer mortar is continuous and free as from visual defects such as foreign inclusions, delamination, and cracking at any location. Verify the SAPL is impervious and free of any leakage from water infiltration or exfiltration from the lined pipe.

Remove temporary dams or filtration measures after Work is complete and pipe is clean and restored.

00414.71 Post Installation Video - After installation of the applied Material perform a post-installation video inspection of the pipe according to Section 00415.

00414.72 Material Sampling and Testing:

(a) Pre-Placement Samples - Obtain two samples of Material the first and last day of construction, for a total of four samples. Additional samples during the application may be taken at the request of the Engineer. Employ an independent third party ACI certified testing agency to properly obtain and transport the test samples and perform Material testing according to 00414.10.

Individually label and log each sample with the following information:

- Project Name
- Name of Contractor
- Sampler's name
- Product batch number(s)
- Sample number
- Liner installation date
- Date and time of sample
- Location of sample within culvert
- Name and location of third party laboratory

(b) Core Samples - When requested by the Engineer, core the liner at three different clock positions at established intervals through the pipe at no additional expense to the Agency. The measurement of the actual liner thickness will equal the average core thickness of all core samples taken. Repair the core holes in the pipe liner according to the manufacturer's recommendations at no additional cost to the Agency.

00414.73 Repairs - Repair defective areas to meet the requirements of the Plans and Specifications. Before making repairs, provide the manufacturer's recommendations for liner repairs, subject to approval by the Engineer. Repair or replace liners that have:

- Installed thickness less than 90 percent of the specified design thickness.
- 28 Day compressive strength less than 8,000 psi, as determined by ASTM C109.
- 28 Day minimum flexural strength less than 1,100 psi as determined by ASTM C293.
- Infiltration or exfiltration of water through the liner.

- Cracks larger than 0.032 inches wide.
- Separation of the liner from the host pipe.

If repairs are necessary perform an additional post-installation video inspection of the repaired areas of the pipe according to Section 00415.

00414.75 Contractor Warranty - The Contractor unconditionally warrants to the Agency the product and installation under this Section against failure, according to this Subsection and 00170.85(b)(1).

"Unconditionally warrant" means that the warranty covers all failures, regardless of the source or cause of the failure, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of Materials.

The Agency inspection of any portion of the Work during the Contract and during the product installation, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the obligations under this warranty.

(a) Warranty Period - The warranty period shall be for 1 year.

(b) Failure - For purposes of the warranty, failure is defined as one or more of the following:

- Infiltration or exfiltration of water through the liner.
- Cracks larger than 0.032 inches wide.
- Separation of the liner from the host pipe.

(c) Remedy - Upon notification by the Engineer of a failure as defined above, provide the following remedy at no additional cost to the Agency:

- Provide a liner repair plan and written timeline of when the Work will be completed within 10 Calendar Days of the Agency's written notification of failure.
- One of the following, as approved:
  - Remove the failed liner and install a full-thickness liner,
  - Construct a full pipe replacement, or
  - Install a liner repair.
- Complete one of the approved remedy's within 60 Calendar Days of the Agency's written notification of failure.
- Use Materials and procedures meeting the Specifications.
- Coordinate timing of repair Work with the Engineer.

(d) Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure causes or may cause a hazard, the failure may be temporarily corrected by Agency or other forces at no additional cost to the Agency. Replace temporary repairs with permanent repairs at no additional cost to the Agency and according to the Specifications and within the time specified in 00414.75(c).

Measurement

00414.80 Measurement - The quantities of installed spray applied pipe structural liner will be measured on the length basis. The length will be measured, with no deduction for Structures or fittings, along the pipe flow line from center to center of manholes, inlets, Structures, special sections, or the ends of pipe, whichever is applicable.

Payment

00414.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) SAPL Liner, ____ Inch	Foot

In item (a), the nominal size of the host pipe will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00415 - Video Pipe Inspection

Description

00415.00 Scope - This Work consists of inspecting pipes by video accompanied by a recorded narrative and written report of the findings.

Equipment

00415.20 Mainline Inspection Equipment - Use the following Equipment unless otherwise approved.

(a) Video Camera - Use a digital color video camera with the ability to rotate 360 degrees, tilt to a 90 degree angle to the axis of the pipe and a zoom ratio of at least 40:1. A light source that provides a clear image of the full pipe circumference and all areas of concern. Provide a camera and lighting system capable of operating in 100% humidity conditions.

(b) Transporter - Use an all-wheel drive or track mounted transporter capable of inspecting pipes ranging in size from 12 to 60 inches and does not obstruct the camera view. A vertical and horizontal adjustable camera to maintain the camera along the approximate center of the pipe at all times. The transporter will have an adjustable operating speed while recording not to exceed 30 feet per minute.

(c) Recording Device - Provide a device capable of recording video with the pipe identification, a remote meter counter displaying length along the profile in tenths of feet and indicating the camera's position from the starting point. Calibrate the meter counter to be accurate within 0.5 percent over the length of pipe being inspected. The device must be capable of recording a digital video with a minimum resolution of 720 x 480.

00415.21 Service Line Lateral Inspection Equipment - Use the following Equipment unless otherwise approved.

(a) Push Camera - Provide a portable camera system that can be manually inserted into service line laterals. The imaging capabilities and illumination requirements for the push camera system are similar to 00415.20(a). Provide a hand-held push camera on site at all times.

(b) Lateral Launch Camera - Provide a camera component as part of the mainline video inspection system that can be launched into a service line lateral connection while inspecting mainline. The lateral launch camera is capable of inspecting the length of the lateral from the mainline connection to beyond the edge of the Right-of-Way. The imaging capabilities and lighting requirements for the lateral launch camera system are similar to 00415.20(a).

(c) Electronic Location Device - Provide a radio transmitter that can be attached to the video camera system that can be detected from the surface to determine the horizontal and vertical position of the pipes below ground. Provide a locator device on site at all times.

00415.22 Mainline Inspection Equipment with Laser Profiler - Use Equipment that meets the following requirements.

(a) Laser Profiler - Use non-rotating laser projector, certified "eye safe", laser light source and internal optics capable of projecting a 360 degree narrow beam of laser light onto an internal pipe wall and meets the following requirements:

- Pipe profile from 12 to 60 inches in diameter.

- Capable of measuring deflection and deformities to an accuracy of 0.5 percent and provide a repeatability of 0.12 percent or better.
- Measurement accuracy of at least 0.1 inch for cracks and other defects.
- Show calibration procedure on video display at each measurement.

(b) Software - Use software meeting the technical requirements of ASTM F3080 and the current supported version as provided by the manufacturer.

(c) Equipment - Use a transporter, camera, and recording device according to 00415.20.

00415.23 Manual Inspection - For pipes larger than 48 inches and when the entire length of the pipe is accessible, a handheld video camera and a light source may be used. The video camera and lighting must meet the requirements of 00415.20(a). A digital camera may be used as a supplement for taking photographs. Use a light source that provides a clear, focused and high quality photograph of the culvert surface under all conditions.

Construction

00415.40 Video Inspection:

(a) Notice and Access - Notify the Engineer a minimum of 48 hours before beginning cleaning or video inspection. Allow the Engineer access at all times, to observe the video monitor and all other operations.

(b) Cleaning - Clean the pipe by removing all debris, sediment, and other accumulated material that would prevent the video camera and laser profiler from moving through the pipe or adversely affect the accuracy of the survey. Remove and dispose of all debris according to 00290.20.

00415.41 Pre-Installation Video Inspection - Perform a pre-installation video inspection at least 5 Calendar Days before beginning Work. Begin Inspection at one end of the pipe and proceed through the entire pipe length at a speed not greater than 30 feet per minute. Move the camera through the pipe and provide a continuous 360 degree pan of each pipe joint. Stop and record all cracks, deformities and defects to document the pipe condition, including the location of all lateral connections to the mainline.

Provide a verbal narrative on each video inspection recording. Include the company name, operator's name, date and time of the inspection, site location, description of the pipe type, size and length, and direction of travel. As part of the recorded audio portion of the video, include a description of all observed defects, deformities, location of lateral connections and locations where digital photographs are taken.

If, during the inspection operation, the camera will not pass through the entire segment, set up Equipment so that the inspection can be performed from the opposite access point back to the obstruction.

(a) Mainline Inspection - Use video inspection equipment meeting the requirements of 0415.20. Each video inspection will display and record an on-screen header containing: location, pipe type, size, date and time of inspection, direction of travel, distance and owner.

(b) Manual Inspection - Use video inspection equipment meeting the requirements of 00415.23.

Measure crack widths using a feeler gauge or crack comparator ruler capable of measuring 0.01 inches. Use a tape measure to measure the widest opening at each joint at least to the nearest 1/2 inch.

00415.42 Post Installation Video Inspection - Perform post construction video inspection according to 00415.40 and 00415.41.

Perform post construction deflection testing for all plastic, metal, and aluminum pipe using one of the approved following methods.

Video inspect the pipe interior no sooner than 30 Days after the trench backfill and compaction have been completed. If the Contract duration does not permit a 30 Day waiting period the Engineer may adjust the duration period.

(a) Remote Video Inspection with Laser Profiler - Use video inspection equipment meeting the requirements of 00415.21. Calibrate the laser profiler according to the manufacturer's specifications and ASTM F3080 Section 9.

Advance the transporter with camera and laser profiler at a speed appropriate with the software's capacity to accurately measure and digitally record 30 individual light ring images per second. Advance the transporter with camera and laser profiler at a speed not greater than 30 feet per minute. A minimum, five full laser ring images shall be taken every inch.

(b) Manual Inspection Deflection - Physical Testing

In addition to 00415.41(b):

Measure the deflection of the pipe using either a metal or fabric tape and read at least to the nearest 1/2 inch. Measure the smallest inside diameter three times for each pipe section in the run. Take the first measurement vertically from the crown to invert (12 o'clock to 6 o'clock positions). Take the second measurement by rotating 60 degrees from vertical (2 o'clock to 8 o'clock positions). Take the third measurement by rotating 120 degrees from vertical (4 o'clock to 10 o'clock positions). For all measurements, stretch tape to full extent across the inside of the pipe.

Calculate percent deflection using the following formula:

$$\text{Percent Deflection} = [(D1 - D2) \div D1] \times 100$$

where:

D1 = Initial measurement according to AASHTO Nominal Diameter
D2 = Most deflected measurement in each pipe run after construction

Finishing and Cleaning Up

00415.70 Video Inspection Recording and Written Inspection Report - Furnish two copies of all preconstruction and post construction inspection video and reports within three Calendar Days after completing the inspections. If inspection video or audio recording quality is poor, the Engineer has the right to reject the recording and request new video inspection at no additional cost to the Agency.

(a) Inspection Report - Provide an inspection report that includes each defect, deformity, and joint along with the distance from the inspection starting point. Provide still digital images in the report along with a reference and description of each defect, deformity and joint.

(b) Deflection Report - Provide an inspection report and include a report generated from the laser profiler software. If a manual inspection was performed according to 00415.41(b) then provide all measurements and calculations.

00415.71 Corrections to Deficiencies in Work - Submit a repair plan to the Engineer for approval of all detrimental pipe deficiencies that are revealed in the recording and written report. Repair all deficiencies within 48 hours after receiving notification. Re-perform the video inspection, submit the new video, and update the written report at no additional cost to the Agency.

Where the pipe deflection is in excess of 5 percent of the nominal diameter submit a remediation plan to the Engineer. The remediation plan must be a stamped Working Drawing according to 00150.35. Replace pipe where the deflection exceeds 7.5 percent of the nominal diameter at no additional cost to Agency.

Measurement

00415.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Mainline Video Inspection - Mainline video inspection will be measured on the length basis. The length will be measured, with no deduction for Structures or fittings, along the pipe flow line from center to center of manholes, inlets, special sections, or the ends of pipe, whichever is applicable. Pipes with sloped ends will be measured from the top of the sloped end section.

(b) Service Line Lateral Video Inspection - Service line lateral video inspections, regardless of length, will be measured on the unit basis. When multiple service line laterals are connected to the mainline by a single shared connection, each service line lateral will be counted separately.

(c) Mainline Video with Laser Profile Inspection - Mainline video with laser profile inspection will be measured on the length basis. The length will be measured, with no deduction for Structures or fittings, along the pipe flow line from center to center of manholes, inlets, special sections, or the ends of pipe, whichever is applicable. Pipes with sloped ends will be measured from the top of the sloped end section.

(d) Manual Inspection - Manual inspection regardless of length, will be measured on the unit basis.

Payment

00415.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Mainline Video Inspection	Foot
(b)	Service Line Lateral Video Inspection	Each
(c)	Mainline Video with Laser Profile Inspection	Foot
(d)	Manual Inspection	Each

Payment will be payment in full for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- providing the hand-held push camera and locator device on site at all times
- excavation Work
- restoration Work

Section 00430 - Subsurface Drains

Description

00430.00 Scope - This Work consists of constructing subsurface drains to the lines and grades shown or established using drain pipe, special filter material or granular drain material, and drainage geotextile.

00430.01 Descriptive Terms - The terms used in designating drain pipe or when referring to them on the Plans are as follows:

Aluminum - The base metal for aluminum sheets.

Concrete, Steel, Aluminum, Polyethylene, Polyvinyl Chloride - The basic material of the pipe.

Drain Pipe - Perforated pipe of specified material.

Metal - Aluminum and steel.

Steel - The base metal for galvanized or aluminum coated sheets.

Subsurface Drain - Drainage system beneath the Base, usually with a perforated drain pipe, to collect and drain groundwater.

00430.02 Contractor's Options - If the Contractor has an option of using different kinds of pipe, the option and its limitations will be shown.

The limiting factors and requirements shown are minimums. The Contractor may substitute stronger, larger, and higher quality material at any installation site, provided the substitution meets the approval of the Engineer and is made at no additional cost to the Agency.

00430.03 Size Determination - The nominal size of pipe will be determined according to AASHTO tolerances for pipe dimensions for the appropriate kind or class of pipe.

Materials

00430.10 Materials - Furnish materials meeting the following requirements:

Commercial Grade Concrete	00440
Delineators	00840
Drainage Geotextile	02320
Perforated Concrete Pipe	02410.10
Perforated Corrugated Aluminum Alloy Pipe	02420.50
Perforated Corrugated Polyethylene Pipe	02415.10
Perforated Corrugated Steel Pipe	02420.30
Perforated Polyvinyl Chloride Pipe	02415.50
Protective Coatings	02420.20
Special Filter Materials	02610.10

Furnish wire mesh that is commercial quality 1/4 inch galvanized metal screening.

00430.11 Granular Drain Backfill Material - Furnish granular drain backfill material of 1 1/2" - 3/4", 1 1/4" - 3/4", or 3/4" - 1/2" crushed or uncrushed Rock or gravel meeting the requirements of 02690.20(c) and the following gradation requirements:

Sieve Size	Percent Passing (by weight) Designated Sizes 1 1/2" - 3/4"	1 1/4" - 3/4"	3/4" - 1/2"
2"	100		
1 1/2"	95 - 100	100	
1 1/4"	–	90 - 100	
1"	–	–	100
3/4"	0 - 15	0 - 15	90 - 100
1/2"	0 - 2	0 - 2	0 - 15
1/4"	–	–	0 - 3

Construction

00430.40 General - Excavate trench, prepare bedding, backfill, except as noted in 00430.46, according to Section 00405 and dispose of excavated materials according to Section 00330. If required, place geotextile according to Section 00350 before backfilling.

Install a Type W-1 delineator at each outlet protection block as shown.

00430.41 Foundations in Unyielding Material - Excavate Rock, hardpan or other unyielding materials a minimum of 3 inches below established grade of the pipe exterior to place special filter material or drain backfill material.

00430.42 Laying Pipe - Lay the pipe according to Section 00445. Place pipe with perforations down unless otherwise directed.

00430.43 Joining Pipe - Fasten pipes together with appropriate coupling fittings or bands as specified for the type of pipe used. Close upstream end of pipe with plugs suitable to prevent entry of Soil materials.

00430.44 Contact Surfaces, Aluminum to Concrete - Coat aluminum pipe and aluminum coated steel pipe that contacts portland cement concrete with asphalt mastic according to Section 00445.

00430.45 Inspection - The installation will be inspected after the pipe is laid and joined and before backfilling. Remove and reinstall or replace any pipe found to be out of alignment, unduly settled or damaged.

00430.46 Backfilling:

(a) Special Filter Material - After the pipe is installed and inspected, place up to 12 inches of uncompacted special filter material above the top of the pipe. Above this, place approved backfill material or special filter material, as directed, and compact according to Section 00405.

(b) Granular Drain Backfill Material - Drainage geotextile is required when using granular drain backfill material. Place granular drain backfill material according to (a) above and as shown.

Measurement

00430.80 Measurement - The quantities of subsurface drain pipes of the various kinds, types, and sizes will be measured, with no deduction for fittings and special sections, along the pipe flow line from end to end of pipe.

The quantities of subsurface drain outlets will be measured on the unit basis.

Drainage geotextile will be measured according to 00350.80.

Delineators will be measured according to 00840.80.

Trench resurfacing will be measured according to 00495.80.

Payment

00430.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	____ Inch Drain Pipe	Foot
(b)	Subsurface Drain Outlets	Each

In item (a), the nominal diameter of pipe will be inserted in the blank.

Item (b) includes furnishing and installing pipe, constructing outlet protection blocks, connecting pipe to inlets, and excavating and disposing of excess materials.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Drainage geotextile will be paid for according to 00350.90.

Delineators will be paid for according to 00840.90.

Trench resurfacing will be paid for according to 00495.90.

No separate or additional payment will be made for trench excavation, backfill, special filter Material, or granular drain backfill Material or for fittings and special pipe sections.

Section 00440 - Commercial Grade Concrete

Description

00440.00 Scope - This Work consists of furnishing, placing and finishing Commercial Grade Concrete (CGC).

Materials

00440.10 Materials - Furnish Materials meeting the following requirements:

Admixtures	02040
Bonding Agents	02070
Cement	02010
Curing Materials	02050
Grout	02080
Supplementary Cementitious Materials	02030
Water	02020

00440.11 Proportions - Furnish, in writing to the Engineer, the proportions by weight of the following Materials before using any CGC:

- air entraining admixtures
- cement
- each size of Aggregate
- fly ash
- other admixtures
- water

00440.12 Properties of Commercial Grade Concrete - Furnish a workable CGC mixture that is uniform in composition and consistency, and unless otherwise shown or specified, has the following characteristics:

- **Entrained Air** - 4.0 to 7.0 percent
- **Slump** - 5 inches or less
- **Compressive Strength** – ASTV minimum of 3,000 psi at 28 days
- **Temperature** - Minimum 50 °F to maximum 90 °F

00440.13 Field-Mixed Concrete - CGC mixed Work items listed in 00440.14(a) may be field-mixed conventionally, or by volumetric/mobile mixers conforming to ASTM C685. When approved, concrete sidewalks, concrete driveways, and other flat concrete surfaces may be field-mixed using volumetric/mobile mixers conforming to ASTM C685.

Pre-packaged dry blended concrete from the QPL may be used for Work items listed in 00440.14(a).

00440.14 Acceptance Sampling and Testing:

(a) General - Acceptance sampling and testing will be based on samples obtained at the site of placement from the discharge of the delivery vehicle. All sampling and testing shall be performed by a QCT.

CGC mixture may be accepted visually for the following items of Work:

Work Item	Section
Bollards	00815
Electrical Conduit Backfill	00960
Fence Post Footings	01050
Hydrant Thrust Blocks	01160
Irrigation System Thrust Blocks	01120
Mailbox Support Footings	01070
Outlet Protection Blocks	00430
Perforated Steel Square Tube Sign Support Footings	00920

(b) Delivery Tickets - Send a delivery ticket with each load of CGC recording the source, Day, time of batch, size of load, and quantity of individual constituents in the load. Delivery tickets are not required for field-mixed concrete except when volumetric/mobile mixers are used.

(c) Plastic CGC - Acceptance of plastic CGC will be based on tests performed by the QCT according to the MFTP and 00440.12.

(d) Hardened CGC - Acceptance of the hardened CGC will be according to 00440.12. Cast one set of cylinders per 20 cubic yards, with a maximum of one set per Day.

00440.15 Quality Control - Provide quality control according to Section 00165.

Labor

00440.30 Quality Control Personnel - Provide technicians having CSTT and QCT technical certifications.

Construction

00440.40 General:

(a) Mixing - Mix CGC to the extent that ensures a uniform distribution of materials throughout the mixture.

(b) Placing - Place CGC according to the appropriate Sections in which CGC is required and the following:

- Place using the best common practices to avoid segregation.
- Vibrate and spade to achieve a dense homogeneous concrete, free of voids and Rock pockets.
- Place within 90 minutes after batching and mixing.

(c) Forms - Provide forms for CGC according to the appropriate Sections in which CGC is required and best common practices. Place to the lines and grades shown or directed.

(d) Weather - Do not place CGC when the air temperature is below 35 °F without approval.

Protect CGC from freezing if the air temperature is expected to drop below 35 °F during the first 5 Calendar Days after placement.

(e) Curing - Cure CGC by covering with wet burlap, canvas, sand, or other acceptable material, and keep moist for a minimum of 7 Calendar Days.

Curing compounds may be used except on concrete surfaces or reinforcement that will come in contact with adjacent concrete pours. Use curing compounds according to the following:

Section	Item	Type 1 or 1-D (Clear)	Type 2 (White-Pigmented)
00480	Drainage Curbs	*	*
00599	Slope Paving Curbs and Berm Paving	Yes	No
00759	Walks, Curb Ramps, Driveways, Surfacings, Curbs, and Islands	*	*
* Use Type 2 except when the Engineer requires Type 1 or 1-D			

Apply curing compounds at a rate of not be less than 1 gallon per 150 square feet.

00440.41 General Surface Finish - Give concrete surfaces a general surface finish, according to 00540.53(a), in addition to the finish specified for a particular item of Work.

00440.42 Replacement or Price Reduction - Remove concrete represented by cylinders that fail to meet the minimum strength requirement and replace at no additional cost to the Agency. If the Engineer determines that the low-strength concrete is suitable for the purpose intended, the Contractor may accept a price reduction established by the Engineer instead of removal and replacement.

Measurement

00440.80 Measurement - No measurement of quantities will be made for CGC.

Payment

00440.90 Payment - No separate or additional payment will be made for CGC. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00442 - Controlled Low Strength Materials

Description

00442.00 Scope - This Work consists of furnishing and placing controlled low-strength materials (CLSM).

00442.01 Definition - Controlled low-strength material is highly flowable lean concrete mix; a mixture of fly ash, cement, fine Aggregates, water and admixtures, if necessary.

Materials

00442.10 Materials - Furnish Materials meeting the following requirements:

Admixtures 02040
Fly Ash 02030.10
Portland Cement 02010.10

00442.11 Fine Aggregates - Furnish fine Aggregates that are commercial quality concrete sand.

00442.12 Proportioning of CLSM Mixture - Furnish the following, to the Engineer, prior to using any CLSM on the Project:

- Written certification of proposed CLSM materials proportions and compressive strength.
- 28-Day cylinder reports from a trial CLSM batch based on above certification. Include evidence that compressive strength requirements for specific applications are met.

00442.13 Compressive Strength - CLSM shall attain a 28-Day compressive strength of 100 psi - 200 psi.

00442.14 Acceptance - Acceptance will be based on the Engineer's review and approval of written certification and trial batch cylinder reports as required by 00442.12.

Measurement

00442.80 Measurement - No measurement of quantities will be made for CLSM.

Payment

00442.90 Payment - No separate or additional payment will be made for CLSM. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00445 - Sanitary, Storm, Culvert, Siphon, and Irrigation Pipe

Description

00445.00 Scope - This Work consists of constructing or reconstructing culvert, siphon, sanitary sewer, storm sewer, and irrigation pipes in the kinds, sizes, and lengths and at the locations shown or as directed to the lines and grades established. The Work includes furnishing and constructing joints and connections to other drainage Structures or systems, as necessary, for complete installation.

00445.01 Definitions and Descriptive Terms - The following terms have the meanings presented below when used in this Section:

Aluminum, Concrete, Steel and Polyethylene - The basic material of the pipe

Concrete Block - Encasements, thrust blocks, anchor blocks, plugs and cutoff diaphragms

Culvert - Concrete, corrugated metal, ductile iron, polyethylene, steel reinforced polyethylene, or polypropylene pipe

Flexible Pipe - Pipes constructed of corrugated or spiral rib metal, PVC, polyethylene, steel reinforced polyethylene, or polypropylene. For the purposes of these Specifications, all potable water pipes are considered to be flexible pipes.

HDPE - High Density Polyethylene

Irrigation Pipe - Gravity or low-pressure transmission pipe. Refer to Section 01120 for sprinkler-type irrigation pipe.

Joint - The place where the ends of sections or modified sections of pipe contact one another

Metal - Aluminum and steel

Pavement - Pavement as defined in Section 00110, as well as driveways, curbs, gutters, walks, dikes, walls and other similar asphalt or portland cement concrete Structures

Pipe - All pipe, regardless of kind, size, shape or use

PVC - Polyvinyl Chloride

Rigid Pipe - Pipes, other than potable water pipes, constructed of concrete and ductile iron

Sanitary Sewer Pipe - Concrete, PVC, solid-wall HDPE or ductile iron pipe

SDR (Standard Dimensional Ratio) - The pipe's minimum outside diameter divided by its wall thickness

Section - The individual pieces in which the furnished pipe is manufactured

Siphon, Storm Sewer, and Irrigation Pipe - Concrete, PVC, HDPE, ductile iron or metal pipe

Steel Reinforced Polyethylene - Steel reinforced ribbed high density polyethylene

00445.02 Contractor's Options - If the Contractor has an option of using different kinds of pipe, the option and its installation and other limits will be shown on the Plans or on a "Pipe Data" sheet in the Plans.

The limiting factors and requirements shown on the Plans or on the Pipe Data sheet are minimums. The Contractor may substitute stronger, larger, and higher quality material at any installation site, provided the substitution is approved and is made at no additional cost to the Agency.

00445.03 Size Determination - The nominal size of pipe will be determined according to AASHTO tolerances for pipe dimensions for the appropriate kind or class of pipe.

Materials

00445.10 General - The manufacturer or fabricator shall furnish appropriate certification, based on the manufacturer's quality control tests, that the materials used in the production of the pipe meet the Specifications. Materials and strength shall be as specified for the particular kind of pipe and fittings required.

Use flexible elastomeric gasket joints on all pipes and fittings. Furnish caps or plugs with each fitting, outlet or stub as required, with the same type gasket or joint as the pipe.

For sanitary sewers provide tee or wye fittings in the main of the same materials as the pipe. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

Cap or plug all fittings and provide with gaskets of the same material as used in the pipe joint. Fit with an approved mechanical stopper, or install an integrally cast knockout plug. The cap or plug shall be capable of withstanding test pressures without leaking and, when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

00445.11 Materials - Furnish Materials meeting the following requirements:

Commercial Grade Concrete in Blocks	00440
Corrugated or Spiral Rib Aluminum Alloy Pipe	02420.40
Corrugated or Spiral Rib Steel Pipe and Pipe Arches	02420.10
Corrugated Polyethylene Pipe	02415.10
Ductile Iron Pipe.	02420.11
Metal Reinforcement in Blocks	02510.10
Nonreinforced Concrete Pipe	02410.10
Polypropylene Pipe	02415.40
Polyvinyl Chloride Pipe	02415.50
Protective Coatings	02420.20
Reinforced Concrete Pipe	02410.10
Rubber Gaskets	02440.40
Solid-Wall Polyethylene Pipe	02415.20
Steel Reinforced Polyethylene Pipe	02415.30

(a) Pipe Anchors - Use pipe anchors conforming to the Standard Drawings and as shown. Metal bands shall conform to the material Specifications for the metal pipe to which they are attached.

(b) Slip Joints - Construct slip joints according to the details shown. The outer sleeve and tapered section shall conform to the material Specifications for the metal pipe with which they are installed.

(c) Safety End Sections - Use safety end sections conforming to 02420.10 and the Standard Drawings. Provide safety bars unless otherwise indicated on the Plans.

(d) Cleanouts - Construct cleanouts of the same materials as the adjacent pipe.

(e) Tracer Wire - Use 12-gauge stranded or solid copper insulated high molecular weight polyethylene (HMW-PE) tracer wire or 12-guage copper clad steel reinforced insulated HMW-PE tracer wire. The HMW-PE insulated cover shall be green and a minimum 45 mil thick. The wire shall be UL rated for 140 °F.

(f) Fittings for Concrete Pipe - Where fittings are fabricated by inserting a stub into a hole cut in the pipe, grout with a non-shrinking grout. Coat surfaces to receive grout with an epoxy bonding agent prior to grouting. Fitting stubs shall not protrude inside of the sewer pipe.

(g) Solid-Wall Polyethylene Pipe - Use solid-wall polyethylene pipe with a minimum SDR of 26.

00445.12 Asphalt Mastic - Furnish the asphalt mastic specified in 00445.47 for aluminum and concrete contact surfaces that consists of a mixture of asphalt, mineral stabilizer, and fillers meeting the requirements of AASHTO M 243 or ASTM D4586. An approved product from the QPL may be used.

00445.15 Quality Control - Provide quality control according to Section 00165.

Labor

00445.30 Quality Control Personnel - Provide technicians having CEBT and CDT technical certifications.

Construction

00445.40 General - Construct culvert, siphon, sanitary sewer, storm sewer, and irrigation pipe according to the following:

(a) Trench Work - Excavate trench, prepare bedding, pipe zone material and trench backfill, and dispose of excavated material according to Section 00405 for pipes 72 inches and less in diameter and Section 00510 for pipes over 72 inches in diameter.

(b) Line and Grade - Centerline and grade control will be established prior to the start of construction. The Special Provisions will indicate whether it will be done by the Agency or the Contractor.

Do not vary from established line and grade by more than 1/32 inch per inch of pipe diameter. Variance shall not exceed 1/2 inch, subject to the following limitations:

- The variation does not result in a level or reverse sloping invert.
- The variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed 1/64 inch per inch of pipe diameter, or 1/2 inch maximum.

(c) Pipe Distribution and Handling - Unload pipe only by approved means.

Inspect the pipe and fittings prior to lowering into the trench to ensure no cracked, broken or otherwise defective materials are used. Clean the ends of the pipe thoroughly, remove foreign matter and dirt from the inside of the pipe, and keep the pipe clean during laying and joining.

(d) Laying Pipe on Curves - Lay pipe on horizontal or vertical curves as shown or approved. When deflecting the pipe from a straight line, either in the vertical or horizontal plane, or when long

radius curves are shown, the amount of deflection allowed shall not exceed that recommended by the pipe manufacturer.

(e) Concrete Closure Collars - Use concrete closure collars only when approved, and only to make connections between dissimilar pipe or where standard rubber gasketed joints or transition couplings are not available. Place the collars using an approved commercial concrete bonding agent applied to all surfaces in contact with the collar. Where concrete closure collars are necessary to join PVC pipe, first prepare the PVC surface for bonding to the concrete by applying a dense coating of clean mortar sand to the pipe using PVC solvent cement. After the cement has cured, apply an approved commercial concrete bonding agent to the sand surface prior to placement of the concrete.

(f) Installation of Sanitary Sewer Service Tees and Wyes - Provide a compacted Base of pipe bedding material under all tees, wyes and branch fittings, extending to the springline of the fittings.

Cap all service lines for sanitary sewers with watertight plugs or caps suitable for resisting the pressures of hydrostatic or air testing.

The maximum line or grade change accomplished with any one fitting shall not exceed 45 degrees and shall be accomplished with long radius curves or bends.

(g) Pipe Anchors - Construct metal or concrete pipe anchors as specified or as shown. Install anchors on runs of pipe located on Slopes 20 percent or greater.

00445.41 Installing Pipe under Railroad - Prior to beginning any under-track Work, submit plans of construction, and details of the methods and Equipment proposed to be used, to the Engineer for submittal to the Railroad. Do not begin under-track Work until Railroad approval is obtained.

Within the limits indicated on the Plans, do not install the pipe under the railroad tracks by the open trench method. Within these limits install the pipe by tunneling, jacking, boring or similar methods, approved by the Railroad, as the Contractor elects, according to Section 00406. Install the pipe to the lines and grades established and backfill completely all voids around the installation with specified material, to the satisfaction of the Railroad.

00445.42 Laying Pipe - Begin pipe laying at the downstream end of the pipeline with the lower segment of the pipe in contact with the shaped bedding throughout its full length and as follows:

- **Elliptical Pipe** - Place with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the pipe.

- **Flexible Pipe** - Place with longitudinal laps or seams at the sides. At circumferential lap joints, place pipe so that the downstream piece is outside.

- **Paved Invert or Partially Lined Pipe** - Place with longitudinal centerline of paved segment coinciding with flow line.

- **Rigid Pipe** - Place with bell or groove ends facing upstream.

- **Round Elliptically Reinforced Concrete Pipe** - Place so that the manufacturer's marks designating the top and bottom of the pipe are within 5 degrees of a vertical plane through the longitudinal axis of the pipe.

00445.43 Placing and Joining Pipe:

(a) General - Lay pipe proceeding upgrade with spigot ends in the direction of flow. Assemble joints according to the recommendations of the manufacturer for the type of joint used. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

Prevent excavated or other foreign material from getting into the pipe. Plug or close off pipes that are stubbed off for future connection. When cutting or machining of the pipe is necessary, use only the tools and methods recommended by the pipe manufacturer. All field joints shall:

- Provide equal or greater strength than the adjoining pipe.
- Fit close and tight.
- Provide a smooth and uniform interior surface.
- Secure and hold adjoining sections to each other.
- Fasten securely to adjoining Structures and special sections.

(b) Concrete Pipe - Lay elliptical reinforced pipe so that the top or bottom marks are not more than 5 degrees from vertical. Provide all rigid pipe entering or leaving manholes with flexible joints within 18 inches of the manhole Structure and placed on firmly compacted bedding.

(c) Polyvinyl Chloride Pipe - Install PVC pipe and fittings according to the manufacturer's recommendations.

Cut the pipe in a neat manner, at right angles to the axis of the pipe, and dress the cut end.

(d) Polyethylene Pipe - Install solid-wall HDPE and corrugated polyethylene pipe and fittings according to the manufacturer's recommendations.

Assemble and join solid-wall HDPE pipe at the site using the thermal butt fusion method to provide a leak-proof joint. Threaded or solvent-cement joints are not allowed. All Equipment and procedures used shall be in strict compliance with the manufacturer's recommendations. Use personnel certified as fusion technicians by the manufacturer of the pipe or fusing Equipment to accomplish the fusing.

Provide joints for corrugated polyethylene pipe made with either bell-and-bell or bell-and-spigot coupling.

(e) Steel Reinforced Polyethylene Pipe - Install steel reinforced polyethylene pipe and fittings according to the manufacturer's recommendations.

(f) Polypropylene Pipe - Install polypropylene pipe and fittings according to the manufacturer's recommendations.

Provide joints made with bell-and-spigot coupling.

When the ambient air temperature is less than 10 °F, do not install, move, cover, bury, or otherwise handle the polypropylene pipe. All polypropylene pipe handled at temperatures below 10 °F will be rejected and not allowed to be used on the Project

(g) Metal Pipe - Install metal pipe and fittings according to the manufacturer's recommendations.

(h) Pipe Joints - Construct field joints, suitable for testing, for siphons, sanitary sewers, irrigation, and other installations as specified.

Construct watertight field joints for storm sewers and culverts with elastomeric joint material. Test joints according to 00445.72.

(i) Inspection - After the pipe is laid and joined, and before any backfilling over it, the installation will be inspected. Take up and relay or replace any pipe found to be out of alignment, unduly settled, or damaged.

00445.44 Strutting Metal Pipe - When the Plans or Special Provisions call for metal pipe to be installed in a tied or strutted condition, place the ties or struts before backfilling, conforming to the details shown. Strutting with timber is not allowed in pipe furnished with paved inverts or with centrifugally applied bituminous inner linings. Remove the ties and struts after the embankment over the pipe is completed and compacted.

00445.45 Backfilling:

(a) General - After the pipe is installed and inspected, backfill pipe zone and trench according to Section 00405 for pipes 72 inches and less in diameter, and according to Section 00510 for pipes over 72 inches in diameter.

(b) Exposed Pipe - When the top 25 percent of the pipe is exposed above the top of the trench, place and compact embankment materials in layers according to the requirements of the Plans for the pipe zone.

Do not cross any pipe with tractors or other heavy Equipment until it has been bedded and backfilled as specified, and is protected by at least a 4-foot cover of compacted fill.

(c) Elliptical Pipe - Where elliptical shaped metal pipe is furnished, place backfill in a manner that will maintain a vertical elongation between 4 and 6 percent greater than the indicated normal diameter, and fill up to the minimum cover above the top of the pipe indicated on the fill height table included with the Plans.

When elliptical shaped metal pipe 48 inches and larger in size is furnished, install and maintain suitable tell-tales throughout the length of the pipe at intervals not exceeding 14 feet. Hang the tell-tales from the crown of the pipe and use as a progressive check on the pipe deflection during backfilling and filling.

Remove tell-tales after the entire fill over the pipe has been completed.

00445.46 Concrete Blocks - When called for by the Plans or directed, construct concrete blocks, with Commercial Grade Concrete according to Section 00440.

00445.47 Contact Surfaces, Aluminum to Concrete - Where uncoated aluminum pipe or aluminum coated steel pipe will be touching portland cement concrete, give the contact surfaces of the pipe a coating of asphalt mastic applied at a rate which will give a minimum dry film thickness of 50 mils.

Do not place concrete on contact surfaces until the mastic coating has dried to practical hardness. The coating is considered to have reached practical hardness when firm pressure between the thumb and fingers shows a slight tacky condition, but the film is not ruptured, and none of the coating adheres to the fingers.

00445.48 Tracer Wire - Install tracer wire in all trenches for sanitary and storm sewers. Place the tracer wire directly over the pipe centerline and on top of the pipe zone material. Place a branch tracer wire over each pipe connected to the main sewer.

Make tracer wire splices using a solderless connection kit that effectively moisture-seals two or more conductors for direct burial and securely join the wires both mechanically and electrically. Insulate splices to be moisture-proof and waterproof. Splices wrapped with tape will not be accepted as waterproof. Have all splice kits approved prior to installation.

Test all tracer wire with locating Equipment prior to acceptance.

Finishing, Cleaning Up, and Testing

00445.70 General:

(a) Storm Sewer and Culvert Installations - Inspect storm sewer systems and culverts to ensure that the lines are free of obstructions and leakage. Perform video and deflection testing.

(b) Siphon, Irrigation and Sanitary Sewer Installations - After laying and joining pipe for siphons, irrigation and sanitary sewers, and backfilling trenches, test the installations for watertightness, including inlet and outlet connections, to the Engineer's satisfaction. Perform video, deflection, hydrostatic, and low-pressure air testing.

00445.71 Requirements Prior to Tests:

(a) General - All sanitary gravity systems, siphon systems and irrigation systems and appurtenances shall successfully pass a hydrostatic or air test prior to acceptance and shall be free of visible infiltration of water. Test manholes as specified in Section 00470.

On pipe 30 inches in diameter and larger, individual joints may be tested by an approved joint testing device. All details of the testing procedure shall meet the approval of the Engineer.

(b) Plugging Tees, Wyes, Stubs and Service Connections (Sanitary Only) - Plug all wyes, tees, stubs and service connections with gasketed caps or plugs securely fastened or blocked to withstand test pressures.

(c) Testing Equipment - Furnish all necessary testing Equipment and perform the tests in a manner that provides observable and accurate measurements of either air or water leakage under the specified conditions. Calibrate and certify gauges at the direction of the Engineer. Provide the certification with the gauge.

(d) Cleaning - Prior to the testing and inspection of the system, flush and clean all parts of the system and remove all debris.

00445.72 Pipe Testing:

(a) General - After completing installation of the system, including all service connections, backfilling and compaction, and prior to wearing surface paving, conduct a low-pressure air test or a hydrostatic test. Provide all Equipment and personnel for the test. Conduct tests during normal working hours. The Engineer may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of the system and allow connections.

The method, Equipment and personnel used in testing shall be subject to approval of the Engineer. The Engineer may, at any time, require a calibration check of the instrumentation used.

(1) Safety Precautions - Only qualified personnel will be allowed to conduct the test. All plugs used to close the system for the testing shall be capable of resisting the expected internal pressures. Securely brace plugs, if necessary.

(2) Groundwater - The presence of groundwater will affect the results of the test. Determine the average height of groundwater over the lines immediately before starting the test, using an approved method.

(b) Hydrostatic Testing - Pipe and joints shall sustain losses not exceeding 0.04 gallons per hour per inch diameter per 100 feet of pipe when field-tested by exfiltration methods, except 0.3 gallons per hour may be used in arid climate zones if approved by the Engineer.

The hydrostatic head for test purposes shall exceed the maximum estimated groundwater level in the section being tested by at least 72 inches of water column and in no case shall be less than 72 inches of water column above the inside top of the highest section of pipe in the test section, including service connections. The Engineer will make the final decisions regarding test height for the water in the pipe section being tested. The length of pipe tested by exfiltration shall be limited so that the pressure on the invert of the lower end of the section shall not exceed 28 feet of water column.

The pipe test section may be filled 24 hours prior to time of exfiltration testing, if desired, to permit normal absorption into the pipe walls to take place.

All service connection footage shall be taken into account in computing allowable leakage.

(c) Air Testing - The pressure gauge used in air testing shall have minimum divisions of 0.1 psi and an accuracy of 0.0625 psi. All air testing shall be by the Time Pressure Drop Method. The test procedure is as follows:

(1) The Contractor may wet the lines prior to testing.

(2) Determine the average height of the groundwater over the line. The test pressures required shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.

(3) Add air slowly to the section of system being tested until the internal air pressure is raised to 4 psi greater than the average back-pressure due to groundwater.

(4) After the test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

(5) After the temperature stabilization period, disconnect the air supply.

(6) Record the time in seconds that is required for the internal air pressure to drop from 3.5 psi to 2.5 psi greater than the average backpressure due to groundwater.

The tested section will be acceptable if the time recorded in paragraph (6) above is not less than the time in seconds (T) computed by the formula:

$$T = K/C$$

Where:

K = the sum of the computations ($0.011\ d^2L$) for each size of pipe and its length in the section
C = the sum of the computations ($0.0003882\ dL$) for each size of pipe and its length in the section, except that the minimum value for C shall be 1
d = inside diameter of the pipe in inches
L = length of pipe in feet

(d) Individual Joint Testing:

(1) General - The Contractor may test each individual joint for leakage using a pneumatic joint testing apparatus. The method, Equipment and personnel used in individual joint testing shall be as approved. The Engineer may, at any time, require a calibration check of the instrumentation used. The pressure gauge used shall have minimum divisions of 0.1 psi and have an accuracy of 0.0625 psi. All air used shall pass through a single control panel.

(2) Method - All air testing shall be by the Time Pressure Drop Method. The test procedure is as follows:

a. Determine the average height of the groundwater over the line. The test pressures required below shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.

b. Add air slowly to the section being tested until the internal air pressure is raised to 4 psi greater than the average backpressure due to groundwater.

(3) Acceptance - The joint shall be considered acceptable if the pressure drops less than 1 psi within 5 seconds.

00445.73 Deflection Testing for Flexible Pipe - Conduct deflection tests of sanitary and storm sewers constructed of flexible pipe prior to wearing surface paving. Conduct the testing by pulling an approved mandrel through the completed pipeline. Use a mandrel having at least 6 vanes and a diameter 95 percent of the pipe's initial inside diameter.

Conduct testing on a manhole-to-manhole basis after the line has been completely flushed out with water. Conduct the tests not less than 30 days after the trench backfill and compaction have been completed. Tests may be conducted sooner if approved by the Engineer. The tests may be conducted concurrently with video inspection. If conducted concurrently, pull the mandrel in front of the camera so that the deflection testing is clearly recorded on the video tape unless approved by the Engineer. Provide a water depth gauge, located on the video camera side of the mandrel with the following characteristics:

- Graduated with marks at 0.50-inch increments clearly visible during video inspection.
- Capable of measuring water depth in 0.50-inch increments from 0.50 inch to 2.50 inches.
- Designed so that it will remain plumb regardless of the rotation of the mandrel or video camera.

00445.74 Video Inspection of Sanitary and Storm Sewers - For all existing culverts being extended, perform preconstruction video pipe inspection of the existing culvert according to Section 00415. For all existing sanitary sewer and storm sewers being altered or repaired, perform preconstruction video pipe inspection, according to Section 00415, between the nearest upstream manhole where Work is not being performed and the nearest downstream manhole where Work is not being performed, including all lateral runs between end manholes.

When constructing a new run, an extension, or a repair of sanitary sewer, storm sewer, or culvert pipe, perform post-construction video pipe inspection, according to Section 00415, of all joints, including the location where new pipe meets existing pipe. Conduct the post-construction video pipe inspection after backfill and compaction are complete, but before any finish Surfacing or final paving is performed.

For pipe sections being replaced, video pipe inspection is not required prior to replacement. Video pipe inspection is not required for pipe sections that are being abandoned.

00445.75 Repairs - Locate and repair any sections failing to pass the required tests and inspections. Repeat the specified tests and inspections on those sections at no additional cost to the Agency.

Following a successful hydrostatic or air test, visible infiltration of groundwater in any section will be considered evidence that the original test was in error or that failure of the section has occurred. Correct such failures and retest the repaired sections, at no additional cost to the Agency.

Measurement

00445.80 Measurement - Pipes and related Work performed under this Section will be measured according to the following:

(a) Pipes - The quantities of pipe of the various kinds, types, and sizes, will be measured on the length basis, and will be determined by the length and depth of installation as follows:

- **Length** - The length will be measured, with no deduction for Structures or fittings, along the pipe flow line from center to center of manholes, inlets, or special sections; or the ends of pipe or end sections, whichever is applicable.

- **Depth** - The depth will be used to determine the maximum depth range and Pay Item for each pipe. The maximum depth range, to the flow line, for each pipe will be "5 feet", "10 feet", "20 feet", and "over 20 feet" as applicable.

  The depth in excavation areas will be the maximum measured vertical distance between the pipe flow line and the surface of the original ground or Subgrade, whichever is less, or the slopes of other areas outside the Subgrade limits.

  The depth in embankment areas will be the maximum measured vertical distance between the pipe flow line and the surface of the constructed embankment as determined in 00330.42(c)(6).

(b) Tee and Wye Fittings - The quantities of tee and wye fittings will be measured on the unit basis. No deduction will be made from measurement of pipe for the length of the fitting.

(c) Slip Joints - The quantities of slip joints will be measured on the unit basis.

(d) Sloped and Skewed Ends - The quantities of sloped ends, skewed ends, or sloped and skewed ends will be measured on the unit basis.

(e) Safety End Sections - The quantities of safety end sections will be measured on the unit basis.

(f) Concrete Pipe Anchors - The quantities of concrete pipe anchors will be measured on the unit basis.

(g) Concrete Closure Collars - The quantities of concrete closure collars will be measured on the unit basis.

(h) Concrete in Blocks - The quantities of concrete used in blocks will be measured on the volume basis, in place.

(i) Reinforcement - The quantities of reinforcement used in blocks will be measured on the lump sum basis or on the weight basis according to 00530.80.

(j) Installation Under Railroad - No measurement will be made for additional Work necessary to install pipe under railroads. Pipe installed under railroads will be separately measured according to 00445.80(a).

Excavation and backfill for pipes greater than 72 inches in diameter will be measured according to Section 00510.

Video pipe inspection will be measured according to 00415.80.

Trench resurfacing will be measured according to 00495.80.

Payment

00445.90 General - The Contract unit price for each Pay Item reflects Plan requirements or the Contractor's choice from the applicable options listed on the Pipe Data Sheets (if shown).

00445.91 Payment - The accepted quantities of pipe and related Work items performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	____ Inch ____ Pipe, ____ Depth	Foot
(b)	____ Inch ____ Pipe	Foot
(c)	Pipe Tees, ____ Inch	Each
(d)	Pipe Wyes, ____ Inch	Each
(e)	Slip Joints, ____ Inch	Each
(f)	Sloped End Sections, ____ Inch	Each
(g)	Safety End Sections, ____ Inch	Each
(h)	Concrete Pipe Anchors	Each
(i)	Concrete Closure Collars	Each
(j)	Concrete in Blocks	Cubic Yard
(k)	Reinforcement in Blocks	Lump Sum or Pound
(l)	Installing ____ Inch Pipe Under Railroad	Lump Sum

In item (a), the nominal pipe diameter will be inserted in the first blank. The type of pipe will be inserted in the second blank. The appropriate flow line depth range will be inserted in the third blank.

Item (a) includes pipe 72 inches and smaller in diameter.

In item (b), the nominal pipe diameter will be inserted in the first blank. For arch type pipe, the nominal diameter of circular metal pipe from which the pipe arch is formed, or reformed, will be inserted in the first blank. The type of pipe will be inserted in the second blank.

Item (b) includes pipe larger than 72 inches in diameter.

In items (c) and (d), the nominal pipe size will be inserted in the blank.

In item (e), the outer sleeve slip joint size will be inserted in the blank. The inner sleeve will be included in payment made for the smaller pipe.

Item (f) includes all sloped end sections, whether manufactured as a sloped unit or cut in the field.

In items (f) and (g), the nominal pipe diameter will be inserted in the blank.

Item (g) includes safety bars when required.

Item (j) includes reinforcement if there is no item listed for reinforcement in blocks in the Contract Schedule of Items.

In item (l), the nominal pipe diameter will be inserted in the blank.

Item (l) includes all additional Work involved in placing pipe under existing railroad tracks as specified within the limits shown.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Excavation and backfill for pipes greater than 72 inches in diameter will be paid for according to Section 00510.

Video pipe inspection will be paid for according to 00415.90.

Trench resurfacing will be paid for according to 00495.90.

No separate or additional payment will be made for:

- trench excavation, bedding, pipe zone Material, and trench backfill for pipes 72 inches and less in diameter
- pipe plugs, stoppers, and other required fittings
- metal pipe anchors
- tracer wire
- hydrostatic, air, joint, and deflection testing

When the Contract Schedule of Items does not indicate payment for pipes or other Work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00446 - Trench Drains

Description

00446.00 Scope - This Work consists of constructing trench drain systems and constructing joints and connections to other drainage Structures at locations shown or directed.

00446.01 Definitions:

Type 1 Trench Drain - A trench drain installation in which any part is constructed in a Traveled Way.

Type 2 Trench Drain - A trench drain installation that is constructed in a paved Shoulder and paved or unpaved Multi-Use Path.

Materials

00446.10 Materials - Furnish Commercial Grade Concrete meeting the requirements of Section 00440.

00446.11 Trench Drains - Furnish trench drains from the QPL or that meet the following requirements:

- Trench drains that have smooth interior surfaces below the level of the frame, grate, and associated connections.
- Trench drain sections, excluding the frame and grate, that are manufactured of monolithic polymer concrete composed of Aggregate and polyester resin or vinylester resin that when complete, meet the following requirements:

Property	ASTM Test Method	Value
Tensile Strength (min. psi)	C 307	1,500
Compressive Strength (min psi)	C 579	12,000
Bending Strength (min psi)	C 580	2,900
Moisture Absorption (max. %)	C 140	0.5
Chemical Resistance	C 267	Pass
Freeze/Thaw (min. number of cycles without weight loss)	C 666	1,600

00446.12 Frames and Grates - Furnish frames and grates from the QPL or that meet the following requirements:

- One piece frames and grates for type 1 trench drains meeting the requirements of AASHTO M 306, H25 loadings. Secure them to the surrounding concrete to provide a minimum pullout resistance of 500 pounds per foot of length of trench drain.
- Either one-piece or removable grate type frames and grates for type 2 trench drains meeting the requirements of AASHTO M 306, H20 loadings. Provide tamper resistant locking devices for removable grates.

Provide Americans with Disabilities Act certified grates that are placed within designated pedestrian paths of travel.

Construction

00446.40 General - Construct trench drains according to the following:

(a) Trench Work - Excavate trench and prepare bedding according to the manufacturer's recommendations. Provide an additional minimum of 4 inches on both sides and the bottom of the trench drain system for the Commercial Grade Concrete.

(b) Line and Grade - Establish the centerline and grade control prior to the start of construction.

Do not vary from established line and grade by more than 1/32 inch per inch of inside trench drain width, subject to the following limitations:

The variation does not result in a level or reverse sloping invert.

The variation in the invert elevation between adjoining sections of trench drain does not exceed 1/64 inch per inch of inside trench drain width.

(c) Trench Drain System Installation - Install trench drain systems according to the following:

- Follow the manufacturer's installation recommendations.
- Locate maintenance access for Type 1 trench drains outside of the Traveled Way.
- Securely support all channel units at the correct line and grade during the concrete pour. Texture the surface of concrete with a broom or burlap drag to produce a skid-resistant surface.

Finishing and Cleaning Up

00446.70 General - Remove all debris from the finished trench drain then flush with water.

Measurement

00446.80 Measurement - The quantities of trench drains will be measured on the length basis. Measurement will be from the beginning of the trench drain to the center of the receiving Structure.

Payment

00446.90 Payment - The accepted quantities of trench drains will be paid for at the Contract unit price, per foot, for the item "Trench Drain, Type ____ ".

The type of trench drain will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00450 - Structural Plate Shaped Structures

Description

00450.00 Scope - This Work consists of constructing structural plate pipe, pipe arches, plate arches, horizontal ellipses, vehicular underpasses and special shaped Structures.

00450.01 Definitions:

Structural Plate Pipe - Built-up pipe with a circular Cross Section of the type, thickness and diameter specified. It is fabricated with the vertical diameter about 5 percent greater than the nominal diameter shown on the Plans.

Structural Plate Pipe Arch - Built-up pipe with a Cross Section made up of a multi-centered shape of four circular arcs, tangent to each other at their junctions, symmetrical about the vertical axis, and of the type, thickness and span specified. The size is designated by span and rise, measured from the inside crests of corrugations.

Structural Plate Arch - Single or multiple radius Structures comprised of a number of curved metal plates that form an arch shape when assembled. The Structure is designed to be supported along its lower edges on separately constructed reinforced concrete foundations, and of the design, type, thickness and span as shown. This size is designated by span and rise measured from the inside crests of corrugations.

Structural Plate Horizontal Ellipse - Built-up pipe in an elliptical shape with the horizontal diameter approximately 20 percent greater than the nominal diameter. The size is designated by span and rise, measured from the inside crests of corrugations.

Structural Plate Vehicular Underpass - Built-up pipe in a high arch shape with large radius sides and invert, and small radius corners between sides and invert. The size is designated by span and rise, measured from the inside crests of corrugations.

Materials

00450.10 Materials - Furnish Materials meeting the following requirements:

Aluminum Alloy Structural Plates 02430.20
Bolts, Nuts, and Washers.....02430.90
Commercial Grade Concrete.....00440
Galvanized Structural Plates 02430.10
Reinforcement.....00530

Construction

00450.40 Trench Work - Excavate trench, prepare bedding, backfill and dispose of excavated material according to Section 00510 and the following:

(a) Trenches In Unstable Areas - Excavate unstable materials under the pipe or pipe arch and to a width of at least one-half the diameter or span width on each side of the Structure, to depths below the established elevation for the bases or foundation of the Structure, as directed. Unless otherwise directed, backfill with granular structure backfill. Bring the backfill material to the moisture content required for compaction and place in 6 inch layers. Compact each layer according to 00330.43. Bring the backfill material to the elevation established.

(b) Trenches in Unyielding Material - When Rock, hardpan or other unyielding material is encountered, remove it below the designated grade, as ordered, to a depth under the pipe or pipe arch equal to at least 1/2 inch per foot of fill height over the top of the pipe, but not less than 8 inches, nor more than three-fourths the vertical dimension of the Structure. Unless otherwise directed, backfill with granular structure backfill.

00450.41 Installation in Paved Areas - If Structures are installed within paved areas to be preserved, resurface according to Section 00495.

00450.42 Erection:

(a) General - Assemble corrugated metal plates at the site of installation to the lines and grades shown or directed. Connect the plates at longitudinal and circumferential seams with bolts. Stagger joints so that no more than three plates come together at any one point. Each plate shall be curved to one or more circular arcs as required, and according to 02430.10, to provide an assembled Structure of specified dimensions and design.

Retain any Camber specified for the invert when assembling and erecting the Structures. Do not create an adverse grade in the Structure.

(b) Plate Thickness - The thickness of the respective top, corner and bottom plates in any one Structure shall be as shown.

(c) Bolts - Use at least 4 bolts per foot of longitudinal seam. Space bolts and bolt holes according to AASHTO M 167. Use additional bolts for special conditions of installation if called for in the Special Provisions or by the Plans. Unless otherwise allowed, place all bolts with nuts on the inside of the Structure.

(d) Assembly - Assemble structural plate Structures according to the manufacturer's assembly instructions and the following:

- Hold the unsupported edges of all plates in position by temporary props.
- Extend each row of side plates far enough to support the plate above until the first complete ring has been assembled.
- Progressively install enough bolts to hold the plates in position. Do not tighten bolts until tightening will not interfere with adjusting and matching of additional plates and sections.
- Do not damage the galvanizing or other protective coating when using drift pins or pry bars. Repair any damage at no additional cost to the Agency.
- After all plates are in place, progressively and uniformly tighten the bolts from one end of the Structure to the other end of the Structure.
- Tighten bolts to at least 100 foot-pounds of torque for plates 0.188-inch thick or less, and 150 foot pounds of torque for plates more than 0.188 inch thick.
- Recheck and retighten as necessary before backfilling.
- Do not torque bolts above 300 foot-pounds during tightening.

(e) Damaged Coating - Repair damaged galvanizing according to 02420.10(d).

00450.44 Arch Substructures and Headwalls - Rest each side of each arch in a groove formed in the concrete, or rest on a galvanized angle or channel securely anchored to or embedded in the Substructure. If the span of the arch is greater than 15 feet or the skew angle is more than 20 degrees, provide a metal bearing surface having a width at least equal to the depth of the corrugation.

Metal bearings may be either rolled, structural, or cold-formed galvanized angles or channels, and shall be at least 3/16 inch thick. Anchor the horizontal leg securely to the Substructure on 24-inch centers or less. When the metal bearing is not embedded in a groove in the Substructure, punch one vertical leg and bolt to the bottom row of plates.

00450.45 Strutting - If strutting is required, place and remove according to 00445.44.

00450.46 Backfilling - Backfill and compact the trench according to 00510.48(d) and the following:

(a) General - Perform backfilling so that a vertical elongation between 4 and 6 percent greater than the indicated normal diameter is maintained. Place backfill material evenly on both sides of the Structure at least up to the three-quarter point of the Structure. Fill above the top of the pipe with minimum cover as indicated on the fill height table included with the Plans.

(b) Exposed Pipe - Place and compact embankment materials at exposed pipes according to Section 00445.

(c) Tell-Tales - Install and remove tell-tales according to Section 00445.

(d) Arches And Horizontal Ellipses - In addition to the other provisions of this Subsection, exercise care as follows:

(1) Before Headwalls Are Placed - If backfilling pipes before headwalls are built, place the first backfill material midway between the ends, forming as narrow a ramp as possible until the top of the pipe is reached. Build the ramp evenly from both sides, and compact the backfill material as it is placed. After the ramps have been built to the top on each side of the pipe, deposit the remainder of the backfill evenly on both sides from the top of the pipe both ways from the center to the ends.

(2) After Headwalls Are Placed - If headwalls are built before the pipe is backfilled, place the first backfill material adjacent to one headwall until the top of the pipe is reached. Then deposit backfill material evenly on both sides from the top of the pipe toward the other headwall.

In multiple installations, follow the above procedures. Use care to place and bring the backfill up evenly on each side of each pipe to avoid unequal pressure.

Compact the backfill material thoroughly, but not excessively. Using water to hydraulically consolidate the backfill by ponding or jetting the backfill material is not allowed.

00450.47 Footings and Headwalls - Construct footings and headwalls for arches according to the design shown and the requirements of Sections 00440 and 00530.

00450.48 Contact Surfaces, Aluminum to Concrete - Where uncoated aluminum pipe will be in contact with portland cement concrete, give the contact surfaces of the aluminum pipe a coating of asphalt mastic according to 00445.47.

00450.49 Work Quality - The following defects constitute poor Work and the presence of any in an individual culvert plate or in a shipment will be cause for rejection:

- Dents or bends in the metal itself
- Illegible brand
- Loose or unevenly lined or spaced bolts
- Ragged edges
- Unrepaired, bruised, scaled or broken spelter coating

- Uneven laps
- Variation from the specified alignment
- Wrong plate location

Measurement

00450.80 Measurement - The quantities of structural plate pipes, pipe arches, arches, horizontal ellipses, and vehicular underpasses will be measured on the length basis, excluding overlaps and the lip of plates at Structure ends. Pipe arches and arches will be measured along the bottom centerline of the Structures. The length of structural plate pipes, horizontal ellipses, and vehicular underpasses will be the average of the top and bottom centerline measurements.

Concrete for footings and headwalls will be measured on the volume basis, and will be the volume within the Neat Lines of the Structure as shown or directed.

Excavation and backfill for pipes greater than 72 inches in diameter will be measured according to Section 00510.

Trench resurfacing will be measured according to 00495.80.

Reinforcement for footings and headwalls will be measured on the weight basis according to 00530.80.

Payment

00450.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	____ Inch Structural Plate Pipe	Foot
(b)	____ Inch x ____ Inch Structural Plate Pipe Arch	Foot
(c)	____ Inch x ____ Inch Structural Plate Arch	Foot
(d)	____ Inch x ____ Inch Structural Plate Ellipse	Foot
(e)	____ Inch x ____ Inch Structural Plate Vehicular Underpass	Foot
(f)	Structural Plate Concrete Footings and Headwalls	Cubic Yard

In item (a), the nominal size diameter of the pipe will be inserted in the blank.

In items (b), (c), (d) and (e), the size of the span and rise of the Structures will be inserted in the applicable blanks.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Excavation and backfill for pipes greater than 72 inches in diameter will be paid for according to Section 00510.

Trench resurfacing will be paid for according to 00495.90.

Reinforcement for footings and headwalls will be paid for according to 00530.90.

No separate or additional payment will be made for trench excavation, bedding, pipe zone Material, or trench backfill for pipes 72 inches and less in diameter.

Section 00460 - Paved Culvert End Slopes

Description

00460.00 Scope - This Work consists of constructing portland cement concrete paved culvert end slopes at locations indicated on the Plans or where designated.

Materials

00460.10 Materials - Furnish Materials meeting the following requirements:

Commercial Grade Concrete.....00440
Curing Compound.....02050
Welded Wire Fabric.....02510.40

Construction

00460.40 General - Construct paved culvert end slopes according to Section 00440 and the following:

- Shape the Base on which the concrete is to be placed to the lines and grades established. Water and compact the areas before placing concrete.
- Finish the surface of the paved culvert end slopes to a smooth, uniform texture by troweling and floating and then brush the surface with a broom or burlap, as directed.

Measurement

00460.80 Measurement - The quantities of paved culvert end slopes will be measured on the area basis. Measurement will be based on the paved end slope area table identified on the Plans. No actual field measurement will be made, except to check the Work, unless changes are ordered. No allowance will be made for paved culvert end slopes which are constructed on a skew.

If changes are ordered and made in the Work, those paved culvert end slopes that are changed will be measured in the field. Measurements will be based on the actual surface area of the paved culvert end slope (not including the culvert opening) plus the face area of the cut-off wall.

Payment

00460.90 Payment - The accepted quantities of paved culvert end slopes will be paid for at the Contract unit price, per square foot, for the item "Paved Culvert End Slopes".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00470 - Manholes, Catch Basins, and Inlets

Description

00470.00 Scope - This Work consists of constructing manholes, catch basins, inlets, siphon boxes, slope protectors, and other similar Structures. Construct the Structures of Commercial Grade Concrete, corrugated metal, or other material, with necessary frames, covers, gratings, and other fittings and hardware.

References to manholes, inlets, siphon boxes, and slope protectors refer to standard Structures of specific design and use, and are identified on the Plans. The term "concrete" refers to Commercial Grade Concrete.

00470.01 Cast-in-Place and Precast Construction - Concrete manholes shall be cast-in-place or precast, as shown or specified. Concrete inlets and siphon boxes may be either cast-in-place or precast.

Materials

00470.10 Materials - Furnish Materials meeting the following requirements:

Commercial Grade Concrete	00440
Concrete Drain Tile	02410.10(i)
Corrugated Metal Pipe	02420.10, 02420.40
Joint Material	02440.40, 02440.50, 02440.60
Metal Frames, Covers, Grates, and Steps	02450.30
Nonreinforced Concrete Pipe	02410.10
Polyethylene Pipe	02415.10
Polyvinyl Chloride Pipe, Schedule 40	02415.50
Precast Concrete Manholes, Catch Basins and Inlets	02450
Reinforcement	02510.10, 02510.40

00470.11 Precast Concrete Manholes and Bases - Furnish cones with the same wall thickness and reinforcement as riser sections.

Prior to delivery of precast manhole sections to the Project Site, yard permeability tests may be required at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material to be supplied to the Project. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C497.

Precast manhole sections shall consist of circular sections in one of the following standard nominal inside diameters:

42 inch	54 inch	72 inch	96 inch	132 inch
48 inch	60 inch	84 inch	120 inch	144 inch

Heights of sections shall be multiples of 6 inches, except heights of manhole sections 72 inches through 96 inches in diameter shall be as required to fit site conditions.

00470.12 Cap Screws - Cap screws and washers for watertight manhole covers shall be stainless steel with 60,000 psi minimum tensile strength conforming to the requirements of ASTM A453.

00470.13 Inside Drop Manhole Connectors - Furnish stainless steel anchor bolts and anchor straps for inside drop pipe connections.

00470.14 Pipe and Fittings - Furnish pipe and fittings as specified and conforming to the applicable portions of Section 00445. Use tees, ells and other fittings for drop manholes made from the same material as the pipe connecting to the manhole.

00470.15 Pipe Stubouts for Future Sanitary Sewer Connections - Pipe stubouts shall be the same type and strength classification as approved for use in the lateral, main or trunk sewer construction. Where there are two different classes of pipe at a manhole, the higher strength pipe will govern strength classification. Furnish watertight plugs with each stubout and adequately brace against hydrostatic or air test pressures.

00470.16 Sanitary Sewer Manhole Carry-Through - All sanitary sewer carry-through pipes and fittings through storm sewer manholes shall be ductile iron conforming to Section 02420.

00470.17 Base Drain Backfill - Furnish Aggregate base or selected granular backfill material that is free from silts or other fines.

Construction

00470.40 General:

(a) Excavation, Backfill and Foundation Stabilization - Excavate and backfill according to Section 00405. When specified, or as directed, remove unstable material that will not support the manhole or other Structure, excavate below grade and backfill with trench foundation stabilization material according to Section 00405.

(b) Pipe Connections - Place connecting pipe at the required alignment and grade. Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall. Ensure that pipe connections to the Structure are completely watertight. Connect all pipe to manholes according to the manufacturer's recommendations.

Grout concrete pipe connections to manholes so they are watertight, using non-shrink grout conforming to 02440.50. When grouted into the manhole section, the pipe section shall not extend more than 18 inches outside the manhole. If an approved flexible connection for concrete pipe is provided at the manhole, full or partial pipe sections may be stubbed into the manhole as required.

Connect flexible pipe to manholes using an adapter specifically manufactured for the intended service. Flexible pipe adapters are required to be watertight after installation. Follow the manufacturer's recommendations. Do not use field-fabricated water stops or improvised adapters. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout conforming to 02440.50.

00470.41 Precast Concrete Manholes - Precast manhole components may be used to construct standard, drop and carry-through manholes.

(a) Bases - If bases are cast in place, consolidate the concrete by mechanical vibration. Screed off the concrete so that the first manhole section to be placed has a level, uniform bearing for the full circumference.

If bases are precast, carefully place the Base section on the prepared bedding so as to be fully and uniformly supported at true grade and alignment.

Construct the invert to match that of the sewer pipe. Where the size of the sewer pipe is changed at the manhole, construct the invert to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, break out the top to the springline of the pipe for the full width of the manhole, and

completely cover the exposed edge of the pipe with mortar. During construction divert existing flows of water or sewage away from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.

(b) Precast Manhole Sections - Thoroughly wet all lift holes, completely fill with non-shrink grout, and smooth and point both inside and out to ensure watertightness.

(1) Sanitary Manholes - Use preformed plastic or rubber gaskets on all joints between manhole sections.

(2) Storm Manholes - Non-shrink grout is allowed on joints, and on extension rings above the cone. In Roadways and other areas intended for traffic, a minimum of one 24-inch diameter precast riser is required between the cone and manhole cover frame.

When grout is used, do the following:

- Clean and wet the surfaces to be joined with water.
- Apply non-shrink grout to the lower portion of the bell or groove of the section already laid and to the upper portion of the spigot or tongue of the section being laid.
- Clean the joint recesses, fill completely with non-shrink grout and wipe to a smooth finish both inside and out.
- Do not allow free water to come in contact with grout joints within 24 hours after the mortared joints are finished.
- Protect the completed joints against rapid drying.

(c) Grates, Frames, Covers and Fittings - Set metal frames for manholes on full non-shrink grout beds to prevent infiltration of surface water or groundwater between the frame and the concrete of the manhole section. If concrete is to be poured around the frames, coat the portion of the frame that will contact the concrete with hot asphalt before placing the concrete. Set frames, covers and grates true to the locations and grades established. Clean bearing surfaces and provide uniform contact. Secure all fastenings. Construct all mortared, sanitary sewer manhole necks and all riser ring joints made with non-shrink grout using an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted.

00470.42 Precast Concrete Catch Basins and Inlets - Install precast catch basins and inlets to the specified line and grade.

00470.43 Cast-in-Place Concrete Construction:

(a) General - Construct cast-in-place manholes, inlets, siphon boxes and concrete slope protectors according to Section 00440. Finish all inside surfaces smooth and free of depressions or protrusions. Form exterior surfaces with steel, plywood or other approved materials. Form other surfaces with matched boards, plywood, or other approved material. Do not cast directly against trench walls, Rock, or earth.

(b) Cast-in-Place Catch Basins and Inlets - Construct forms for both the inside and outside walls of cast-in-place catch basins. Forms shall be tight and well braced, with chamfered corners. Remove all water and debris prior to placing concrete.

Consolidate the concrete immediately after placement with an approved vibrator. Limit vibration time to that necessary to produce satisfactory consolidation without causing segregation. Screed the top surface and trowel exposed surfaces to a smooth finish, free from marks or irregularities. Radius exposed edges with a steel edging tool. After forms are removed, patch any defects in the concrete with an approved mortar mix.

Immediately after removal of forms and final finishing, cure according to 00440.40(e).

00470.45 Steps - Fasten steps to the manhole walls according to the manufacturer's recommendations and as shown.

00470.46 Corrugated Pipe Slope Protectors - Construct corrugated metal slope protectors according to the Plans and the applicable requirements of Section 00445.

00470.47 Concrete Inlet Base Drains - Provide concrete inlets with base drains leading from abutting Aggregate base or selected granular backfill material.

Use nonreinforced concrete pipe, concrete drain tile, polyethylene pipe or polyvinyl chloride (PVC) plastic pipe for basin drains. Place and compact backfill without damaging pipe or inlet.

00470.48 Concrete Manhole Installation Requirements:

(a) Locator Posts - Construct locator posts as shown.

Finishing, Cleaning up, and Testing

00470.70 Cleaning - Upon completion, clean each Structure of accumulated silt, debris or foreign matter of any kind and keep clean until final acceptance of the Work.

00470.71 Sanitary Manhole Acceptance Testing - Field-test all sanitary sewer manholes for acceptance by either hydrostatic or vacuum testing after completion of backfilling, compaction and surface restoration, including paving. If the manhole fails the test, make necessary repairs by an approved method, and retest the manhole. Repair and retest the manhole until a satisfactory test is obtained.

(a) Hydrostatic Testing - Perform hydrostatic testing according to ASTM C497. Plug all inlets and outlets and fill the manhole with water. Fill each manhole to the rim at the start of the test. Leakage in each manhole shall not exceed 0.3 gallons per hour per foot of head above the invert. Determine leakage by refilling to the rim using a calibrated container. Manholes may be filled 24 hours prior to the time of testing to permit normal absorption into the manhole walls.

(b) Vacuum Testing - Perform vacuum testing according to ASTM C1244. Plug and brace all pipes entering the manhole. Place the test head in or on top of the manhole ring. Draw a vacuum of 10 inches of mercury on the manhole, close the valve on the vacuum line of the test head, and shut off the vacuum pump. Measure the time for the vacuum to drop to 9 inches of mercury. The manhole is acceptable if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values in the following table:

Minimum Test Times For Various Manhole Diameters

	Diameter (inches)								
	30 or less	**33**	**36**	**42**	**48**	**54**	**60**	**66**	**72**
Depth * (feet)	**Time ** (s)**								
8 or less	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	35	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

* Depth is measured from the top of the manhole to the lowest invert.
** Test times for manhole depths between those shown in this table may be calculated by interpolation.

Measurement

00470.80 Measurement - The quantities of manholes, inlets, catch basins, siphon boxes, slope protectors, and other Structures will be measured on the unit basis.

Payment

00470.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	**Unit of Measurement**
(a)	Concrete Sanitary Sewer Manholes	Each
(b)	Concrete Storm Sewer Manholes	Each
(c)	Concrete Manholes, ____	Each
(d)	Concrete Inlets, Type ____	Each
(e)	Concrete Siphon Boxes	Each
(f)	Concrete Diversion Boxes	Each
(g)	Concrete Irrigation Boxes	Each
(h)	Concrete Junction Boxes	Each
(i)	Concrete Monument Boxes	Each
(j)	Manhole Slope Protectors	Each
(k)	Catch Basins, ____	Each

In items (c), (d) and (k) the type of Structure will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- earthwork not covered as trench or ditch excavation
- pipe connections
- Rock backfill
- Aggregate base backfill
- drain tile
- acceptance testing
- locator posts

Section 00480 - Drainage Curbs

Description

00480.00 Scope - This Work consists of constructing mechanically extruded curbs using either Commercial Grade Concrete (CGC) or asphalt concrete material.

Construct the curbs at the locations and to the lines, grades and dimensions shown, or as directed.

Materials

00480.10 Materials - Furnish Materials meeting the following requirements:

Commercial Grade Concrete.....00440
Emulsified Asphalt.....00730.11
Epoxy Bonding Agent.....02070.10
Preformed Expansion Joint Filler 02440.10

00480.11 Asphalt Concrete - Furnish commercial asphalt concrete Pavement meeting the requirements of Section 00740. The mixture may be varied when conditions require it, if approved by the Engineer.

Construction

00480.40 Preparation of Base - Clean Pavements upon which drainage curbs are to be constructed so that they are free of dirt, dust, oil, grease or other extraneous matter.

00480.41 Bonding Material Application:

(a) CGC Curbs - Bond CGC curbs to underlying Pavements with an epoxy bonding agent from the QPL or conforming to 00480.10. Apply according to the manufacturer's recommendations and at a rate that provides a thorough coating to the surface with all voids and depressions filled. Place the new curb on the epoxy bonding agent within 15 minutes after spreading, or before it loses its tackiness, whichever is sooner.

(b) Asphalt Concrete Curbs - Bond asphalt concrete curbs to underlying Pavement with either:

- An epoxy bonding agent meeting the requirements of 00480.10 or from the QPL, applied in the manner specified in 00480.41(a), or
- An Emulsified Asphalt of the type designated by the Engineer and conforming to 00480.10. Apply Emulsified Asphalt at a rate of 0.05 to 0.10 gallons per square yard of curb. Place the new curb on the Emulsified Asphalt after the asphalt separates from the water (breaks), but before it loses its tackiness.

00480.42 Commercial Grade Concrete Curbs:

(a) Placing and Finishing - Feed concrete into the extruding machine at a uniform rate and operate the machine under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete. Perform finishing Work as required to present a smooth, dense surface.

Remove and replace honeycombed sections. Repair of honeycombed and other defective sections by plastering will not be allowed.

(b) Transverse Expansion Joints - Space expansion joints as shown. The width of the joint and thickness of the filler shall not be less than 1/2 inch. Construct each expansion joint at right angles to the curb alignment, normal to the surface of the curb and provide complete separation of new concrete.

Firmly support the adjacent portions of the curb with close fitting shields if expansion joints are sawed before the concrete has hardened.

Mortar the joint filler in place if sawing is performed after the concrete has hardened.

(c) Transverse Contraction Joints - Space contraction joints as shown. Form the joints by grooving, by inserting and removing plates or other devices, by inserting and leaving in place preformed expansion joint fillers or by other approved means.

Make joints no wider than 1/4 inch, and deep enough so that at least one-third of the cross-sectional area of the curb is severed. Tool the edges of joints. Clean unfilled grooves and fill with joint filler flush with the surface of the concrete.

(d) Curing - Begin curing curbs immediately after completing machine or hand finishing of the fresh concrete, according to 00440.40(e).

00480.43 Asphalt Concrete Curbs - Construct asphalt concrete curbs by the mechanical extrusion method. Produce a well compacted mass of asphalt concrete with a uniform texture finish.

00480.44 Line and Grade - Place a 12-foot straightedge on the top or face of curb. The curb surface shall not vary more than 1/4 inch from the edge of the straightedge, except at grade changes or curves.

Measurement

00480.80 Measurement - The quantities of drainage curbs will be measured on the length basis, for each continuous run measured along the line and grade of the curb.

Payment

00480.90 Payment - The accepted quantities of drainage curbs will be paid for at the Contract unit price, per foot, for the item "Drainage Curbs".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00490 - Work on Existing Sewers and Structures

Description

00490.00 Scope - This Work consists of joining new Work to existing work, repairing or abandoning of sewer lines and Structures, and adjusting existing manholes, inlets, boxes and other similar Structures. Remove and dispose of pipe, manholes and catch basins that are scheduled for removal according to Section 00310.

00490.01 Descriptive Terms:

Adjust - To raise, lower or reconstruct Structures to a new top elevation flush with the surrounding surface.

Box - Valve box, meter box, monument box or other similar Structure with a removable cover.

Bypass Pumping - The process of pumping sanitary sewer or storm flows around a manhole or pipeline during the construction or rehabilitation of those facilities.

Inlet - Structure designed to receive surface water through a grate or orifice and to discharge water through pipes.

Manhole - Manhole or similar Structure designed to permit entry and working space, usually at intersections of sewer pipes.

Manhole Neck - The upper portion of a manhole, having vertical walls and a uniform diameter or dimension just sufficient to receive and support the metal frame.

Materials

00490.10 Materials - Furnish Materials of either existing materials in a condition suitable for reuse and meeting current design, or new Materials meeting the following requirements:

Commercial Grade Concrete.....00440
Joint Materials 02440.40, 02440.50, 02440.60
Metal Frames, Covers, Grates, and Steps 02450.30
Precast Concrete Sections.....02450
Reinforcement.....02510.10

00490.11 High Early Strength Concrete - Furnish high early strength concrete meeting the requirements of Commercial Grade Concrete, except it shall contain a minimum of 705 pounds per cubic yard of Type III or Type IIIA cement or an approved Type C or Type E admixture with a minimum of 592 pounds per cubic yard of Type I or Type II cement.

Construction

00490.40 General - Excavate and backfill according to Section 00405. Remove and dispose of old concrete and other materials according to Section 00310.

Obtain approval before reusing salvaged metal frames, covers, grates and fittings on Structures to be adjusted.

When concrete is poured around frames, paint the portion of the frame that will contact the concrete with hot asphalt before the concrete is poured.

Provide high early strength concrete when shown on the Plans, or when traffic is required to traverse the Structure due to staging requirements. The Engineer will determine the length of curing time.

New construction shall conform to Section 00470.

Repair, replace or restore to existing condition any manhole or similar structure backfill, inlet base drain, Aggregate Base or Pavement disturbed or fouled by the adjustment Work as directed.

Bypass pump sanitary sewer and stormwater flows around the pipe section or manhole being repaired or replaced by plugging an existing upstream manhole and pumping the flow around the Work to a downstream manhole. Submit a bypass pumping plan to the Engineer at least 48 hours before beginning bypass pumping. Use a pump with adequate capacity to handle existing flows and additional flow due to rain. Pumps shall not exceed a noise level of 86 dB at a distance of 50 feet. Do not operate bypass pumps at night except in an emergency. Do not discharge raw sewage onto private property or city streets, or into storm drain systems.

00490.41 Manholes over Existing Sewers:

(a) General - Construct manholes according to Section 00470. Test all sanitary sewer manholes according to Section 00470.

Prevent material or debris from entering the line.

When required, provide all diversion facilities and perform all Work necessary to maintain flow in existing lines. Obtain the Engineer's approval prior to diverting flows.

(b) Manholes over Existing Rigid Pipe Sewers - Construct manholes over existing rigid sewers after first cleaning and applying an approved commercial concrete bonding agent to all surfaces of the pipe that will be in contact with the manhole.

If the top of the existing rigid pipe is to be cut out, cut it to the springline for the full width of the manhole. Smooth and point the exposed edge of pipe with mortar.

Make rigid sewer pipe connections using an acceptable pipe connection according to Section 00470.

(c) Manholes over Existing Flexible Pipe Sewers - Construct manholes over existing flexible sewers systems with approved water stops, watertight fittings or boots at connections with the existing flexible sewer.

If approved, manholes may be constructed over existing PVC sewers and sealed at the manhole wall using the following method:

- Apply a coating of PVC solvent to the pipe that will be in contact with the manhole.
- Apply a dense coating of clean mortar sand over the PVC solvent cement.
- After the cement has cured, apply a commercial concrete bonding agent to the sand prior to placement of concrete.

(d) Manhole Connections - Core or sawcut openings in the existing manhole base or barrel as required. Construct connections that are watertight and that will provide a smooth flow into and through the manhole. All sanitary sewer pipe connections, including those at invert level as well as penetrations for drop connectors, conduits and carry-throughs, shall conform to the requirements of Section 00470.

00490.42 Service Line Connections to Existing Sanitary Sewers - Make connections of service lines to existing sewers watertight. Make connections, where possible, to existing tees or wyes that have been previously installed and plugged. Remove the plug and make the connection according to Section 00445. Make transition couplings between dissimilar pipe materials using approved commercial adapters with stainless steel bands.

Where tees or wyes for connection are absent or unusable, connect service lines with approved commercial taps. Do not backfill any tap until it is inspected and approved by the Engineer.

Install taps by coring without protrusion into, or damage to, the existing sewer. Support the sewer and replace bedding material, as necessary, to prevent settlement of the sewer grade.

00490.43 Abandoning Pipe in Place - Drain abandoned pipes and plug watertight. Plug abandoned pipes with gasketed mechanical plugs or grout seals, as directed. Where abandoned pipes connect to sewer manholes, install the plugs or seals from the inside of the manhole and reshape the channel to conform to the Standard Drawings.

Fill abandoned pipes greater than 12 inches diameter with sand, controlled low-strength material meeting the requirements of 00442, or other approved material.

00490.44 Filling Abandoned Pipes, Manholes and Catch Basins - Cap or plug all connecting pipes to manholes and catch basins that are scheduled to be abandoned. Remove the manhole cone or flat top and manhole sections, or the catch basin frame, to a minimum depth of 3 feet below finish grade and fill the remaining manhole barrel or catch basin with Granular Material meeting the requirements of Section 02630. Compact the Granular Material to 90 percent of maximum density according to AASHTO T 99. When in landscaped or unimproved roadway sections, backfill with approved materials meeting the requirements of 00330.13. Place Topsoil meeting the requirements of 00330.11 for the last 1 foot of backfill.

00490.45 Salvaging Manhole Frames, Covers and Grates - Remove manhole frames, covers and grates scheduled for salvage and store in an approved location. Frames, grates and covers meeting Specifications may be salvaged from Structures to be adjusted and may be reused in the Work if of suitable size and condition. Replace, at no additional cost to the Agency, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.

Clean salvaged components to be reused of foreign material by methods that will not harm the components.

00490.46 Adjusting Manholes:

(a) Metal Steps - If existing manholes or similar Structures have metal steps, provide new steps in the adjusted Structure, in kind. Construct according to the Standard Drawings.

(b) Concrete and Masonry Manholes - Manholes may be raised or lowered as specified below or as shown.

(1) Minor adjustments of manholes are those that require adding or removing precast grade rings or metal rings as approved.

(2) Major adjustments of manholes are those that infringe into the cone or flat top section. Remove the cone or flat top, add or remove sections, and replace the cone or flat top. Use risers to attain desired grade.

Precast sections removed in the adjusting Work may be reused in other adjusting Work or in new construction provided they are in good condition and otherwise conform to the Specifications. Dispose of precast items, not reused on the Project, according to 00290.20.

(c) Raising Tops of Manholes - The top of the manhole may be raised by the use of riser rings or by reconstructing the neck. Fabricated metal rings and plates may be furnished and used in the adjustment Work, provided that:

- The metal and its fabrication provide at least the strength and support required for covers or grates.
- Uniform bearing of bearing surfaces is assured.
- Positive safeguards are made against displacement when in service.

Do not exceed 24 inches total distance from the top of the metal frame at its new adjusted grade to the top of the cone. Riser rings and repairs shall conform with the requirements of Section 00470. Extend manhole barrels of brick, block or concrete in kind.

(1) Concrete Manholes - Reconstruct the neck of the manhole as follows:

- Remove existing frames, covers and grates.
- Chip away the exposed top surface on which new mortar or concrete is to be placed, to a depth of 1 1/2 inches or until firm concrete is exposed.
- Clean the new surface by brushing, and moisten with water at the time of placing new concrete.
- Place new concrete to the required grade and cure at least 3 days when using Commercial Grade Concrete, and as directed when using high early strength concrete.
- Seat the frame in fresh mortar and bring to the proper grade.

(2) Masonry Manholes - Reconstruct masonry manholes of bricks or concrete blocks as follows:

- Raise with new bricks, blocks, precast components, mortar or combinations thereof, or with concrete, as conditions warrant.
- Do not place mortar for building up existing masonry to a depth of more than 3 inches.
- Do not place concrete to a depth of less than 3 inches.
- To conform to these requirements, cut down as necessary the existing shells or walls of Structures to be adjusted to provide space for the new construction.

(d) Lowering Tops of Manholes (Minor Adjustment) - When the adjustment does not require removal of the cone or flat top, proceed as follows:

- Expose the top of the Structure to the required depth.
- Cut off or remove elements of the Structure to an elevation below that established for the bottom of the metal frame or cover.
- Build up with mortar, concrete, brick or concrete blocks to the required elevation.
- Join new material to old as specified in above under (a) through (c).

(e) Metal Manholes - Adjust metal manholes to grade by resetting the entire Structure on a firm foundation, by adding extensions of like design and material, or by severing the barrel in an acceptable manner. Dispose of salvaged Structures, not reused on the Project, according to 00290.20.

00490.47 Adjusting Catch Basins and Inlets:

(a) Cast-in-Place Concrete Catch Basins and Inlets:

- After existing frames and grates or covers have been removed, chip away the exposed top surface to expose firm concrete. Provide at least 1 inch clearance below the frame to be placed.
- Clean the new surface by brushing and moistening with water at the time of placing new concrete.
- Provide the necessary forms to maintain existing Structure dimensions in the new Work.
- Place new concrete according to Section 00440 to the required grades. The frame may either be preset in the form or placed in the fresh concrete to the required grades.
- Finish the concrete top surfaces as required to match the grades required.
- Grout existing and new inside surfaces as required to attain a uniform surface transition.

(b) Precast Concrete Catch Basins and Inlets - The entire precast Structure may be reset to a new grade when the nature of the Structure and conditions permit.

Precast concrete sections may be added or removed as required to obtain proper grade.

Precast Structures may be raised by using precast sections provided that:

- The material conforms to the general requirements of the existing Structure.
- Sections are set and joined to each other and to existing sections.
- Uniform bearing of bearing surfaces is assured.
- Positive safeguards are made against displacement when in service.

(c) Catch Basin Connections - Adjust as follows:

- Place connecting pipe at the required line and grade.
- Set the connecting pipe through the full thickness of the wall flush with the inner face of the wall.
- Connect to the Structure with a watertight joint.

(d) Capping Concrete Structures - Permanently close openings in concrete inlets, boxes, and Structures as shown and by:

- Removing existing frame and grate.
- Chipping away existing concrete to an elevation below finished grade.
- Reconstructing Structure to accept reinforced concrete cap.
- Installing cap on existing inlet, box, or Structure.

00490.48 Adjusting Boxes, Cleanout Lids and Similar Structures - Raise or lower boxes, lids and similar Structures by one of the following methods:

- Resetting the entire Structure on a firm foundation.
- Adding extensions of like material below the original Structure if raising the Structure to a point where it would not enclose or protect its contents.

- Placing precast box extensions, or cast-in-place concrete.
- Complete replacement of the Structure with a new Structure of adequate design approved by the Engineer.

00490.49 Finish Grade - Center a 12-foot straightedge, as nearly as practicable, over the center of the cover of manholes and boxes. The final grade of the Pavement surface and adjusted manholes and boxes shall not vary more than 1/4 inch from the finish grade and Cross Section at any point along the straightedge.

Measurement

00490.80 Measurement - The quantities of adjusted and reconstructed manholes inlets, boxes, and other similar Structures will be measured on the unit basis.

The quantities of manholes over existing sewers, connections to existing Structures, filling abandoned Structures, and capping existing concrete Structures will be measured on the unit basis.

Payment

00490.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Minor Adjustment Of Manholes	Each
(b)	Major Adjustment Of Manholes	Each
(c)	Adjusting Inlets	Each
(d)	Adjusting Boxes	Each
(e)	Adjusting Catch Basins	Each
(f)	Extra for Manholes Over Existing Sewers	Each
(g)	Connection To Existing Structures	Each
(h)	Filling Abandoned Structures	Each
(i)	Capping Existing Concrete Structures	Each

Item (a) applies to manholes adjusted by adding or removing precast or metal grade rings.

Item (b) applies to manholes adjusted by:

- removing and reconstructing part or all of the cone or flat top
- removing and replacing the entire cone or flat top
- adding precast risers below the cone of precast manholes

Item (f) includes all extra or additional costs associated with installing the manholes over existing sewers. These costs are in addition to those which are included in payment for the manholes.

Manholes will be paid for according to 00470.90.

Item (h) applies to filling abandoned pipes, manholes, inlets, boxes and other similar Structures.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

00490.90

No separate or additional payment will be made for:

- earthwork
- backfill
- protective coatings
- replacement of manhole or similar structure backfill
- base drains
- Aggregate bases
- Pavements
- connections
- Structure abandonment
- removing and disposing of existing Structures and pipe
- bypass pumping

Section 00495 - Trench Resurfacing

Description

00495.00 Scope - This Work consists of resurfacing pipe trenches, including replacement of Pavement, curbs, sidewalks, Rock Surfacing, Topsoil, landscaping and other features removed or damaged during pipe trenching operations.

Materials

00495.10 Materials - Furnish trench resurfacing Materials that either match existing material removed from pipe trenches, or new Materials meeting the following requirements:

Aggregate	00641
Asphalt Concrete Pavement (ACP)	00744 and 00745
Concrete Paving	00756
Concrete Sidewalks, Curbs, and Driveway	00759
Emulsified Asphalt Concrete (EAC)	00735
Emulsified Asphalt Prime Coat	00705
Emulsified Asphalt Surfacing	00710
Emulsified Asphalt Tack Coat	00730
Rock Surfacing	00641
Topsoil, Planting, and Seeding	01040

Furnish sand used for edge sealing that is clean sand with no visible sign of silts or organic materials.

Construction

00495.40 General - The following construction requirements are for resurfacing trenches in various locations. Refer to Section 00405 for trench surface removal requirements.

(a) Asphalt Concrete Paving - Place ACP according to Sections 00744 and 00745, as applicable.

(b) Emulsified Asphalt Concrete Paving - When temporary Surfacing is required prior to placing permanent Surfacing, place EAC paving a minimum of 1 inch thick. The temporary paving shall be smooth with surface variations not greater than 1/2 inch from the Existing Surfacing. Where the temporary patch adjoins existing surfaces the joint shall not be greater than 1/4 inch high. Maintain the temporary Surfacing until the permanent Surfacing is placed. ACP mix may be used if approved.

(c) Emulsified Asphalt Prime Coat - Construct Emulsified Asphalt prime coat according to Section 00705.

(d) Emulsified Asphalt Surfacing - Construct Emulsified Asphalt Surfacing treatment according to Section 00710.

(e) Edge Sealing Tack Coat Application - Seal all adjoining asphalt concrete Pavement surfaces with an edge sealing tack coat. Place sufficient tack coat to seal the adjoining surfaces. After the tack coat has been placed, place clean sand over the tack coat. Reapply additional tack coat and sand cover to any edges that are not completely sealed in the first application.

(f) Aggregate Base - Place Aggregate Base according to Section 00641.

(g) Concrete Sidewalk, Curb and Driveway - Construct concrete sidewalk, curbs and driveways according to Section 00759.

(h) Concrete Paving - Construct concrete paving according to Section 00756.

(i) Rock Surfacing - Construct Rock Surfacing according to Section 00641.

(j) Topsoil - Place Topsoil according to Sections 00405 and 01040.

(k) Landscaping - Place landscaping according to the requirements of Section 01040.

Measurement

00495.80 Measurement - The quantities of trench resurfacing will be measured on the area basis. The length will be measured horizontally along the centerline of the installed pipe from edge to edge of the surface replaced. The width will be the nominal inside diameter of the pipe plus:

- 20 inches for pipes less than 12 inches in diameter
- 24 inches for pipes 12 inches and 15 inches in diameter
- 32 inches for pipes 18 inches and 21 inches in diameter
- 36 inches for pipes 24 inches and 30 inches in diameter
- 48 inches for pipes between 36 inches and 72 inches, inclusive

When the pipe is installed under Pavement by tunneling, boring, or jacking methods, the Work will be measured according to 00406.80.

Payment

00495.90 Payment - The accepted quantities of trench resurfacing will be paid at the Contract unit price, per square yard, for the item "Trench Resurfacing".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for replacement of disturbed landscape items.

When the pipe is installed under Pavement by tunneling, jacking, or boring methods, the Work will be paid for according to 00406.90.

When the Contract Schedule of Items does not indicate payment for trench resurfacing or other Work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

PART 00500 - BRIDGES

Section 00501 - Bridge Removal

Description

00501.00 Scope - This Work consists of removing and disposing of existing Bridges or portions of existing Bridges as shown or specified.

Construction

00501.40 Removal and Disposal - Perform removal and disposal Work according to Section 00290 and Section 00310.

Measurement

00501.80 Measurement - No measurement of quantities will be made for Bridge removal Work performed under this Section.

Payment

00501.90 Payment - The accepted quantities of Bridge removal Work will be paid for at the Contract lump sum amount for the item "Bridge Removal Work".

Payment will be payment in full for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00503 - Bridge Deck Cold Plane Pavement Removal

Description

00503.00 Scope - This Work consists of removing existing Pavement from bridge deck and bridge end panel surfaces.

Equipment

00503.20 Equipment for Grinding on Bridge Decks - To remove Pavement from bridge decks and bridge end panels, use micro-milling Equipment consisting of either cold plane or rotomill grinding machines that have carbide cutting tools on a rotary drum. Provide Equipment with a tooth spacing of not more than 1/4 inch, capable of leaving a smooth, uniform pattern of striations.

Construction

00503.40 Pavement Removal on Bridges - Remove Pavement from Bridges according to the following:

(a) General:

- Do not grind into the existing concrete bridge deck or bridge end panel.
- Before removing the wearing surfaces, do the following:
  - Determine the actual depth of Pavement to be removed.
  - Block all deck drains and all catch basins. Do not allow any grinding, chipping, sweeping, flushing, or shot blasting material to enter them.
- Remove all material that is within 12 inches of joints in a manner acceptable to the Engineer. Do not damage any joints.
- Remove AC, laitance, and residual film by approved hand methods in areas that cannot be reached by grinding machines.
- Repair all damage to abutting concrete surfaces or other surfaces that are damaged by the Contractor's operations at no additional cost to the Agency.

(b) Scheduling - Schedule the Work so the full width and length of travel lane Pavement can be removed during the same shift. Remove the Shoulder area within 24 hours after removing the travel lane Pavement.

If the depth of the existing Pavement to be removed is over 2 inches, then within the same Day construct a wedge of asphalt concrete, at a Slope of 1V:10H or flatter along each exposed longitudinal drop-off, and 1V:50H or flatter along each exposed transverse drop-off. Place wedges completely across the milled area at joints, deck drains, catch basins, and other Structures. Maintain wedges as long as the area remains under traffic or until Pavement is replaced. Remove and dispose of wedges before placing new Surfacings.

00503.41 Surface Tolerance - Test with a 12-foot straightedge furnished and operated by the Contractor, as directed. The variation of the top of the ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed 1/4 inch.

00503.42 Disposal of Materials - Dispose of all materials according to 00290.20.

00503.43 Maintenance Under Traffic - If the cold planed Pavement surface will be exposed to traffic, sweep and clean prior to allowing traffic to use the Roadway.

Measurement

00503.80 Measurement - The quantities of Work performed under this Section will be measured on the area basis.

When the depth of Pavement to be removed is variable, the depth is an estimate and will be considered approximate only. No guarantee is made that the actual depth will be the same as the estimated depth.

Payment

00503.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Bridge Deck Cold Plane Pavement Removal, ____ Deep	Square Yard
(b)	Bridge End Panel Cold Plane Pavement Removal, ____ Deep	Square Yard

In items (a) and (b), the depth will be inserted in the blank. If the depth is variable, the depth range will be inserted in the blank.

Payment will be payment in full for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for constructing, maintaining, and removing temporary wedges or for removal of fabric membranes.

Section 00504 - Concrete Deck Surface Preparation

Description

00504.00 Scope - This Work consists of preparing and patching concrete decks prior to surface treatment, membrane installation, or concrete overlay.

00504.01 Definitions:

Bonded Membrane - A polymer or spray-on waterproofing membrane system that is fully or partially bonded to the concrete deck.

Class 1 Preparation - Deck surface preparation for a membrane or overlay system on an existing bridge deck, where the existing concrete is sound, and minimal concrete removal is required to reach sound concrete.

Class 2 Preparation - Deck surface preparation in areas that are determined by the Engineer to have Unsound Concrete that requires concrete removal beyond the limits of Class 1 Preparation.

Class 3 Preparation - Deck surface preparation in areas where concrete removal extends through the full thickness of the deck.

Fabric Membrane - A rolled or sheet waterproofing membrane system that is installed below or between layers of asphalt pavement.

Unsound Concrete - Delaminated or otherwise deteriorated concrete identified by a deck delamination survey or during surface preparation operations.

00504.02 Submittals - Submit the type of Equipment that will be used for deck preparation to the Engineer for approval at least 21 Calendar Days before the pre-placement conference.

Materials

00504.10 Portland Cement Concrete Repair Material - Furnish PCC repair Material meeting the requirements of Section 02015.

Equipment

00504.20 General - Provide Equipment to perform concrete deck surface preparation. Remove all Equipment that leaks oil or other contaminants from the work area until they are repaired.

00504.21 Surface Preparation Equipment:

(a) Sawing Equipment - Furnish power-driven concrete saws adequate for sawing joints and for surface texture.

(b) Scarifying Equipment - Furnish power-operated diamond grinding, micro-milling, hydroblasting or shot blasting scarifying Equipment capable of uniformly removing the existing surface to depths required.

(1) Diamond Grinding - Furnish power-driven self-propelled machines with the cutting head made up of diamond cutting blades.

(2) Micro-milling - Furnish cold plane or rotomill grinding machines using carbide cutting tools on a rotary drum. Provide Equipment with tooth spacing of not more than 1/4 inch, capable of

leaving a smooth, uniform pattern of striations. Limit machines to a gross operational weight of no more than 35 tons and a forward speed to 2.5 feet per minute. Operate at a drum speed of at least 120 RPM.

(3) Shot-Blasting - Furnish mono-directional or bi directional shot blast machines with single or multiple blast wheels that cover a width of at least 2.5 feet per Pass, and conform to EPA air pollution requirements by containing dust and steel abrasive media. If the Equipment is not equipped for simultaneous bi-directional blasting, make separate passes in opposite directions to ensure equal cleaning on all sides of the exposed aggregate.

(4) Hydroblasting - Furnish hydroblasting Equipment capable of removing concrete at a rate and volume acceptable to the Engineer without leaving a striated surface. Demonstrate the removal rate and accuracy of the Equipment to the Engineer before beginning Work. Hydroblasting may only be used during structural concrete overlay (SCO) installations.

(c) Power-Driven Hand Tools - Furnish power-driven hand tools for removal of Unsound Concrete meeting the following requirements:

- **Class 2 Preparation Equipment** - For Class 2 deck preparation, use chipping hammers equal to or less than a nominal 15 pound class.
- **Class 3 Preparation Equipment** - For Class 3 deck preparation, use jackhammers equal to or less than a nominal 30 pound class.

(d) Hand Tools - Furnish hammers and chisels to remove final particles of Unsound Concrete or to achieve the required depth.

(e) Air Compressor - Furnish air compressors equipped with functioning oil traps. Ensure air used for blow-down of prepared surfaces is free of oil.

Construction

00504.40 General Surface Preparation - Furnish surface preparation Equipment according to 00504.21. Remove surface concrete by approved hand methods that cannot be reached by power-driven Equipment.

Repair all damage to abutting concrete surfaces or other surfaces that are damaged by Contractor's operations at no additional cost to the Agency.

(a) Bridge Deck Drains - Temporarily block all deck drains and catch basins while preparing the surface. Do not allow scarifying, chipping, sawing, sandblasting, shot blasting, water blasting or sweeping Material to enter them.

(b) Asphalt Concrete Wearing Surface Removal - Remove existing asphalt concrete wearing surfaces and Fabric Membranes according to Section 00503.

(c) Bonded Membrane Removal - Remove all existing membrane Material from the deck surface by grinding, micro-milling, or other approved method. Do not exceed 1/4 inch of deck surface removal.

If rutting is present in the existing concrete deck which has resulted in additional thickness of bonded membrane Material, remove all existing bonded membrane Material with Equipment that can sufficiently remove the Material without exceeding 1/4 inch of PCC deck surface removal.

(d) Multi-Layer Polymer Concrete Overlay (MPCO) Removal - Remove all existing MPCO Material from the deck surface by grinding, micro-milling, or other approved method. Do not exceed 1/4 inch of PCC deck surface removal.

If rutting is present in the existing concrete deck which has resulted in additional thickness of MPCO Material, remove all existing MPCO Material with Equipment that can sufficiently remove the Material without exceeding 1/4 inch of PCC deck surface removal.

(e) Premixed Polymer Concrete (PPC) Removal - Remove all existing PPC Material from the deck surface by grinding, micro-milling, or other approved method. Do not exceed 1/4 inch of PCC deck surface removal.

If rutting is present in the existing concrete deck which has resulted in additional thickness of PPC Material, remove all existing PPC Material with Equipment that can sufficiently remove the Material without exceeding 1/4 inch of PCC deck surface removal.

(f) Structural Overlay Removal - Remove the existing Structural Overlay to the parent deck surface. Use Equipment that can sufficiently remove the overlay without exceeding 1/2 inch of parent deck removal. When hydroblasting Equipment is used to remove structural overlays, demonstrate that removal process and selected pressure will not exceed 1/2 inch of parent deck removal. If hydroblasting methods are unable to remove the structural overlay without damaging the parent deck, use scarifying equipment according to 00504.21(b) to remove the structural overlay.

Removal of structural overlay below the top of the top mat of reinforcement is considered Class 2 Preparation.

(g) Sealant Removal - Remove all existing crack sealant from deck surface by grinding, bush hammering, or other approved method. Do not exceed 1/4 inch of deck surface removal.

00504.41 Surface Preparation - Perform surface preparation far enough in advance of resurfacing that all further deck preparation can be satisfactorily completed. Prepare the Bridge deck according to the following:

(a) Delamination Survey - Perform a deck delamination survey, in the presence of the Engineer, using chain drag or other approved methods that locates Unsound Concrete to determine limits of Class 2 Preparation. Class 2 Preparation limits to be verified by the Engineer.

(b) Class 1 Preparation:

- Roughen the existing concrete surface to an exposed aggregate surface texture depth profile of at least 1/16 inch for PPC, MPCO, and membrane applications and 1/8 inch for SCO overlays. Determined profile according to ASTM E965 (standard volumetric test). Perform four tests per 500 square yards of concrete surface prepared, with a minimum of four tests per day.
- Protect visible reinforcing steel and reinforcing steel where the Plans show it to be within 1/2 inch of the surface.
- Hydroblasting may only be used when preparing for SCO overlays.

(c) Class 2 Preparation - In Class 2 areas, remove concrete as follows:

- Remove all Unsound Concrete from the lower limit of Class 1 preparation down to sound concrete.

- Remove a minimum of 3/4 inch of concrete around and below reinforcing steel that is not at least 50 percent embedded in the existing concrete surface.
- If concrete removal extends to the bottom reinforcing mat, notify Engineer to determine further Class 2 preparation or Class 3 preparation limits.
- Sandblast reinforcing steel coated or pitted with rust to a bright finish.

(d) Class 3 Preparation - When Class 3 preparation is required, it will be designated by the Engineer and performed according to 00140.30.

Perform Class 3 preparation as follows:

- Remove the full thickness of deck remaining below the lower limit of Class 2 preparation.
- Sandblast reinforcing bars pitted with rust to remove all rust.

(e) Deck Repair - Where concrete is removed to the limits of Class 2 and Class 3 preparation, repair the deck according to the following:

(1) For a membrane, MPCO, or PPC installation, repair the deck with a PCC repair material that is compatible with the specified membrane or overlay. Cure the repair material according to the manufacturer's recommendations. Place the repair material at least 5 Calendar Days before placing the membrane or overlay or as recommended by the membrane or overlay manufacturer.

(2) For an SCO installation, slope or round the sides of the repair area to avoid vertical edges. Fill repair areas with SCO during the overlay placement.

00504.42 Final Surface Preparation -

(a) PPC, MPCO, and Membrane Installations - Prepare all surfaces that are to be in contact with the membrane or overlay, including vertical contact areas as follows:

- Clean the entire surface by shot-blasting within 24 hours of placing the membrane or overlay.
- Sweep the area magnetically to remove metal residue.
- Blow clean the surfaces with compressed air.
- Immediately after surface preparation is complete cover the prepared deck with clear plastic, overlapping it to prevent contaminants from construction vehicles or other sources from contacting the deck. Maintain the covering until PPC, MPCO, or membrane installation.
- If the prepared surface becomes contaminated by spills, rain, or other contaminant before placing the membrane or overlay, prepare the surface again according to this Subsection.

(b) SCO Overlays - Roughen the surface leaving an exposed aggregate surface texture depth profile of at least 1/8”, determined according to ASTM E965 (standard volumetric test). Perform four tests per 500 square yards of concrete surface prepared, with a minimum of four tests per day.

- Clean the entire surface by shot-blasting. Shot-blasting is not required on final surfaces that were prepared by hydroblasting, chipping, or jack hammering.
- If shot-blasting was performed, sweep the area magnetically to remove metal residue.
- Clean with a power washer and saturate the surface with water for a minimum of 8 hours before resurfacing.
- Remove standing water with compressed air or wet-dry vacuum ahead of concrete placement.

- Repeat cleaning and water saturation on areas that are allowed to dry or become contaminated before resurfacing.
- Immediately after surface preparation is complete cover the prepared deck with clear plastic, overlapping it to prevent contaminants from construction vehicles or other sources from contacting the deck. Maintain the covering until overlay installation.

Measurement

00504.80 Measurement - The quantities of Work performed under this Section will be measured on the area basis with the following exceptions:

- Class 1 preparation will not be measured.
- Removal of existing asphalt wearing surfaces and fabric membranes will be measured according to 00503.80.

Payment

00504.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Class 2 Preparation	Square Yard
(b)	Class 2 Preparation for SCO Installations	Square Yard
(c)	Bonded Membrane Removal	Square Yard
(d)	MPCO Removal	Square Yard
(e)	PPC Removal	Square Yard
(f)	Structural Overlay Removal	Square Yard

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Payment for item (a) includes deck repair within the limits of Class 2 areas, according to 00504.41(e)(1).

Payment of item (b) includes deck repair within the limits of Class 2 areas according to 00504.41(e)(2).

Payment of item (c), (d), and (e) includes material removal from within wheel ruts.

No separate or additional payment will be made for Class 1 preparation Work or final surface preparation. Payment will be included in payment made for the appropriate items under which this Work is required.

No separate or additional payment will be made for sealant removal.

Class 3 preparation and deck repair within the limits of Class 3 areas, will be paid for according to 00195.20.

Removal of existing asphalt wearing surfaces and Fabric Membranes will be paid for according to 00503.90.

Section 00510 - Structure Excavation and Backfill

Description

00510.00 Scope - This Work consists of excavating, backfilling and disposing of materials in connection with the construction of Bridges, grade separation Structures, rigid frame Structures, and other major Structures. Other major Structures under this Section are retaining walls, reinforced concrete box culverts, headwalls, structural plate Structures, and pipe culverts, sewers, siphons and irrigation pipes greater than 72 inches in diameter.

This Work does not include any earthwork covered under any sections of Parts 00300 or 00400, or any earthwork that may be specifically included and provided for as Incidental Work for particular items or parts of the Work. The construction, measurement, and payment of embankment at bridge ends and engineered fills will be according to Section 00330.

00510.01 Lines, Grades, and Cross Sections - Perform the Work to the lines, grades and Cross Sections shown or as established.

00510.02 Definitions:

Shoring - A temporary earth retention and support system that is installed prior to or during excavation using top-down construction techniques.

00510.03 Cofferdam Working Drawings, Calculations, and Design Submittals - Submit stamped cofferdam Working Drawings and design calculations according to 00150.35 except as modified by this Subsection.

Design cofferdams according to the ODOT *Bridge Design Manual*.

Submit a Cofferdam Design Summary and complete a Cofferdam Design Checklist prepared by the cofferdam design engineer, to accompany the Working Drawings and calculations. Include the following in the summary:

- A list of cofferdam members with their capacities and design stresses
- Design loading assumptions for each member
- Design specifications
- Subsurface materials and conditions used in design

Complete the checklist included in the Special Provisions.

Submit five sets (nine sets if Railroad approval is required) of the Working Drawings, and three copies (five copies if Railroad approval is required) of the calculations, summary, and checklist.

00510.04 Shoring Working Drawings, Calculations, and Design Submittals - Submit shoring stamped Working Drawings and design calculations according to 00150.35 except as modified by this Subsection.

Design shoring according to Section 15.3.26 and other applicable sections of the most current version of the ODOT *Geotechnical Design Manual* (GDM) at the time of Advertisement.

Submit a Shoring Design Summary and complete a Shoring Design Checklist prepared by the shoring design engineer, to accompany the Working Drawings and calculations. Include the following in the summary:

- A list of shoring members with their capacities and design stresses
- Design loading assumptions for each member
- Design specifications
- Subsurface materials and conditions used in design

Complete the checklist included in the Special Provisions.

Submit five sets (nine sets if Railroad approval is required) of the Working Drawings, and three copies (five copies if Railroad approval is required) of the design calculations, summary, and checklist.

(a) Defined Shoring Systems - Select shoring systems for construction from the list of defined shoring systems provided in Section 15.3.26 of the ODOT GDM.

(b) Atypical Shoring Systems - Shoring systems that are not on the list of shoring types published in Section 15.2.4.2 of the ODOT GDM are considered atypical shoring systems. If proposing an atypical shoring system, submit stamped Working Drawings according to 00150.35. The review and response time allowed for the Agency to return the Working Drawings will be 120 Calendar Days. The submittal of calculations and other data must satisfy the requirements of the Specifications and include sufficient detail and explanation of the design for the Agency to process and comment on the Working Drawings. If the Engineer requests additional information or explanation related to the review of the atypical shoring system the Engineer may restart the 120-Calendar Day review period.

Include the following additional information in the atypical shoring system submittal:

- If applicable, a list of projects that used the atypical shoring system. Include reference contacts.
- A list of supervisory personnel who will be on-site during construction of the atypical shoring system and documentation of their experience and qualifications to perform the Work.

Design shoring according to the most current versions at the time of Advertisement of one or more of the following design standards:

- ODOT *Geotechnical Design Manual* (GDM)
- AASHTO *Standard and Guide Design Specifications*
- U.S. Department of Transportation Federal Highway Administration (FHWA) design manuals

Geotechnical and structural analysis and design for the shoring shall include but not be limited to the items listed in the Shoring Design Checklist. Submit a completed Shoring Design Checklist and a written Shoring Design Summary, prepared by the shoring design engineer, to accompany the Working Drawings and calculations. Include the following in the Design Summary:

- Identification of the design manuals and specific methodologies used for the analysis and design.
- Identification of the methods of analysis and all computer programs used.
- Soil and material properties used in the shoring design. Include any additional boring logs and laboratory test data performed.
- Design loading assumptions and loading diagrams for each shoring (including all construction staging loads).
- Design performance requirements, including design life, allowable settlement, and alignment tolerance.

- Construction requirements (specifications), including Materials, Equipment, and labor necessary for construction of the atypical shoring system.
- Quality control plan, including required performance and verification tests.
- Performance requirements (actual threshold limits of tolerable differential foundation settlement and/or lateral movement). Indicate how the performance requirements will be monitored during construction.
- If applicable, temporary shoring removal plan.
- All other applicable information for design, detail, sequencing, and construction of the shoring.

Materials

00510.10 Selected General Backfill - Furnish Soil selected from Roadbed, ditch, trench, or structure excavations meeting the requirements of 00330.13.

00510.11 Selected Granular Backfill - Furnish Granular Material selected from Roadbed, ditch, trench or structure excavations meeting the requirements of 00330.14.

00510.12 Granular Wall Backfill - Furnish granular wall backfill meeting the requirements of 02630.11.

00510.13 Granular Structure Backfill - Furnish granular structure backfill meeting the requirements of 02630.10 and the following:

(1) Material Passing No. 200 Sieve - The amount of Materials passing the No. 200 sieve shall not exceed 15 percent by weight. Test according to AASHTO T 11.

(2) Plasticity Index - The plasticity index of the Material passing the No. 40 sieve shall not exceed 6. Test according to AASHTO T 90.

00510.15 Quality Control - Provide quality control according to Section 00165.

Labor

00510.30 Quality Control Personnel - Provide technicians having CEBT and CDT technical certifications.

Construction

00510.40 Clearing, Grubbing, and Removal Work - In the absence of Pay Items under Section 00310 and Section 00320, the provisions of those sections apply when applicable. Perform such Work as Incidental Work for which no separate payment will be made.

Clearing, grubbing, and removal limits shall be at least 10 feet outside of the entire Structure, including the ends of the Structure but within the Right-of-Way.

00510.41 Structure Excavation - Structure excavation includes:

- Removal of all material necessary for the construction of foundations and substructures as shown or specified.
- Placement of all backfill except granular wall backfill and granular structure backfill.
- Disposal of excavated material not required or suitable for backfill according to 00330.41(a)(5).

- Correction, according to recognized practice, of conditions detrimental to the Work, including removal of excess water.

Shore, brace, or use cofferdams to protect excavations unless open excavation would not be detrimental to adjacent Structures, Roadways, or waterways.

Where the Plans show concrete in footings placed against undisturbed material, make excavation for footings as nearly as possible to the limits shown. Fill the space between the footing and remaining undisturbed material to the top of the footing with footing concrete or granular structure backfill material, as directed. Compact the granular structure backfill to 97 percent of maximum density, according to 00330.43.

Concrete placed against steel sheet piles in cofferdams or cribs will be considered placed against undisturbed material, whether or not the steel sheets are later removed.

Where practicable, excavate Rock materials using pavement breakers, rippers, backhoes, other excavation Equipment or non-explosive means that preclude breakage of Rock materials below and outside of the structure excavation limits. If blasting is required, perform such Work in a manner that avoids disturbing Rock outside the structure excavation limits. Use controlled blasting techniques for all structure excavation requiring blasting according to Section 00335. Backfill and repair as directed, at no additional cost to the Agency, any excavation, shattered Rock, void, fault, or unstable condition caused by the Contractor outside the limits of structure excavation. Backfill and repair of voids, faults or unstable condition not caused by the Contractor or covered elsewhere in the Specifications will be paid for according to 00195.20.

Consider the elevations of the bottoms of footings or foundations shown as approximate only. The Engineer may order, in writing, changes in elevations of footings necessary to secure a satisfactory foundation.

Backfill, seal, or otherwise repair excavations beyond the limits shown or as directed by the Engineer with Materials acceptable to the Engineer at no additional cost to the Agency.

00510.42 Structure Excavation and Backfill Below Elevations Shown - Excavate soft, unstable or Unsuitable Material below footings or bases of Structures, including bedding, if any, to elevations as directed.

Perform one of the following as directed:

- Increase the length of columns or walls until the bottom of the footing is at the new established elevation.
- Increase the thickness of footings until the bottom of the footing is at the new established elevation
- Backfill the subexcavated area to the plan elevation according to 00510.46(a).

00510.43 Preservation of Channel - Do not excavate outside of caissons, cribs, cofferdams, sheet piling or sheeting, or disturb the natural streambed unless specified or allowed. Where such excavation is allowed, comply with Section 00405. Do not sidecast any excavated material into the stream.

When allowed, the necessary excavation for placement of riprap outside the perimeter of the footing may be made without the use of cofferdams or cribs, and disposed of according to 00330.41(a)(4).

00510.44 Cofferdams and Shoring - Construct cofferdams and shoring as follows:

(a) Cofferdams and Cribs - Design and construct cofferdams and cribs as shown, specified, or when determined by the Contractor to be necessary for performing the Work:

- Prepare and submit Working Drawings, calculations, summary and checklist for cofferdams or crib designs according to 00510.03.
- Provide interior dimensions for cofferdams and cribs to give sufficient clearance for the inspection of forms.
- When weighted cribs are used to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, provide an appropriate special anchor system such as dowels or keys to transfer the entire weight of the crib into the foundation seal.
- Do not leave cofferdam or crib timber or bracing extending into the Substructure concrete.
- Place and cure seal concrete according to 00540.48(e).
- Vent or port, at low water level, any cofferdam that is to remain in place.
- Unless otherwise directed, remove cofferdams or cribs, including all sheeting and bracing, after the completion of the Substructure. Do not disturb or damage the finished concrete.

Do not begin cofferdam or crib construction Work until all submittals have been approved. Upon completion of the cofferdam construction, and immediately after dewatering, the cofferdam design engineer of record, accompanied by the Engineer, shall field inspect the cofferdam. Do not continue construction until the cofferdam design engineer furnishes the Engineer a written statement that the cofferdam conforms to the design and will serve the intended purpose.

(b) Shoring - Construct shoring in accordance with the approved shoring submittals, the applicable sections of Part 00500 "Bridges" and as specified or determined by the Contractor to be necessary for performing the Work. Do not begin shoring construction Work until all submittals have been approved.

Upon completion of the shoring construction, the shoring design engineer of record, accompanied by the Engineer, shall field inspect the shoring. Do not continue construction until the shoring design engineer furnishes the Engineer a written statement that the shoring conforms to the design and will serve the intended purpose.

(c) Welding - Perform structural steel welding according to 00560.26(a) and steel piling welding according to 00520.43(g). Do not begin welding until all of the following have been approved by the Engineer:

- WPS Welding Procedure Specification
- PQR Procedure Qualification Records
- WQTR Welder Qualification Test Records
- MTR Material Test Report
- CWI AWS Certified Welding Inspector

00510.45 Pumping - No pumping of water from the interior of any foundation enclosure will be allowed during the placing of concrete or for a period of at least 24 hours thereafter unless an effective means of eliminating moving water through fresh concrete is employed. Water may then be pumped, if approved.

Do not pump to dewater a sealed cofferdam until the seal concrete meets the requirements of 00540.48(e).

00510.46 Preparation of Foundations - Do not place concrete on prepared foundations without prior approval. Construct foundations as follows:

(a) Backfilled Foundations - Construct the top surface of the foundation fill at least 3 feet beyond the area to serve as a foundation unless otherwise shown or directed. Use selected granular backfill or granular structure backfill as directed. Place in 6 inch layers and compact to not less than 95 percent of maximum density according to 00330.43.

(b) Undisturbed Soil Foundations - Do not disturb the sides or bottoms of foundation excavations. Place concrete against undisturbed Soil when shown. Concrete may be used as backfill, subject to 00540.45(a). If Soil is disturbed, compact all disturbed material to 95 percent of maximum density according to 00330.43.

(c) Formed Foundations on Soil - Do not disturb the bottoms of foundation excavations. If Soil is disturbed, compact all disturbed material to 95 percent of maximum density according to 00330.43.

(d) Rock Foundations - Before placing concrete:

- Clean all Rock surfaces and remove loose material
- Clean seams and fractures according to 00510.41, and seal with grout
- Level, step or roughen the Rock surface as shown or as directed

Construct formwork, if allowed or required, and place concrete as soon as practicable following the removal of material, to the specified elevation.

00510.47 Embankment Construction at Bridge Ends - Construct embankments at bridge ends according to 00330.42(c)(7) and, when shown, engineered fills according to 00330.42(c)(8).

00510.48 Backfill:

(a) General - Prepare for, place, and compact backfill according to 00330.42 and 00330.43.

Do not place backfill that will cause unbalanced loading on the concrete until the concrete has been in place 7 Calendar Days and test cylinders show the concrete strength to be 100 percent of design strength according to 00540.17(c).

Do not place backfill against any other concrete until the concrete has been in place 3 Calendar Days, and test cylinders show the concrete strength to be 40 percent of design strength according to 00540.17(c).

Place backfill and riprap in a manner that will not damage the concrete footings, drain pipes, and other permanent Work. Do not jet or puddle the backfill unless approved in writing. Prevent large lateral or wedging compaction forces from occurring directly against the concrete; for sloped excavations, step the slope or use other approved means to prevent the wedge action.

Dispose of excess materials according to 00330.41(a)(4).

(b) Bridge Abutments, Wing Walls, Retaining Walls, and End Panels - Backfill, at a minimum, to the pay limits shown. Backfill abutments, wing walls, retaining walls, and end panels with specified backfill to the pay limits shown, and as follows:

(1) Placement at Abutments - Do not place backfill at Bridge abutments until Superstructure elements are set, pinned and tensioned. Place backfill required at the front face of retaining

walls and wing walls before backfilling behind the wall unless shown otherwise. For single span Bridges with abutments, keep the backfill heights within 2 feet of each other.

(2) Placement at Weep Holes - Place granular wall backfill at all weep holes.

(3) Compaction Within 3 Feet Behind Abutments and Walls - Within 3 feet behind abutments, wing walls, and retaining walls, provide walk behind vibratory roller compactor with a single smooth drum, vibratory plate compactor, or rammer/tamper plate compactor; each with a gross static weight of not more than 1,000 pounds and a total compaction static plus dynamic force of not more than 5,000 pounds. Compact backfill to 95 percent of maximum density using the required number of passes determined according to the test pad method, and not less than three compaction Equipment passes.

a. Test Pad Method - Before placing the wall backfill, determine the number of Passes necessary to achieve the specified density by constructing a test pad that is at least 5 feet wide, 15 feet long, and 3 feet in final depth. Construct test pad fill in layers no more than 8 inches thick using the same Equipment and methods that will be used to compact the wall backfill. Perform at least one density test according to AASHTO T 310 on each test pad layer. Construct and test a new test pad when changes in Material occur or different Equipment is used during the construction of the wall backfill.

(4) Compaction More Than 3 Feet Behind Abutments and Walls - Greater than 3 feet behind abutments, wing walls, and retaining walls, provide vibratory roller compactor with a single smooth drum, vibratory plate compactor, or rammer/tamper plate compactor. Compact backfill to 95 percent of maximum density. Unless otherwise specified, test in-place field density according to AASHTO T 310. Test at the frequency required in the MFTP.

(5) End Panels - Place and compact foundation for end panels as shown and according to 00510.46(a).

(c) Pier and Column Footings - Backfill piers and columns as follows:

- Use either selected general backfill, selected granular backfill, riprap or other materials as shown or directed.
- Deposit backfill around piers and columns on all sides to approximately the same elevation at the same time.
- Place backfill up to the original ground surface, the upper limits of pay excavation, or as shown or directed.

(d) Reinforced Concrete Box Culverts, Structural Plate Structures and Pipe Culverts Over 72 Inches in Diameter - Provide bedding, if required, according to 00405.12. Use backfill materials conforming to 00510.12 or 00510.13 unless otherwise specified. Place and compact as shown and according to 00405.46. Place backfill up to the surrounding ground surface, to the top of trench, or the upper backfill pay limits shown or as directed.

Measurement

00510.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Shoring, Cribbing and Cofferdams - No measurement of quantities will be made for shoring, cribbing, and cofferdams.

(b) Structure Excavation - Structure excavation will be measured according to the following:

(1) Lump Sum - Under this method, no measurement will be made. Estimated quantities of structure excavation will be listed in the Special Provisions.

(2) Volume - Under this method, structure excavation will be measured on the volume basis in original position (position before excavating).

Quantities will be limited to the limits shown, or if not shown, will be limited to the following:

a. Lower Limit - The lower limit will be the elevations shown for the bottoms of Structure footings or bases, including bedding, if any.

b. Upper Limits - The upper limit will be determined as follows:

1. Within Embankments - The planes of the new embankment at the elevation specified or established.

2. Within Roadbed or Channel Change Excavations - The planes of the bottoms and side slopes of the excavations.

3. All Other Cases - The ground surface immediately before starting the excavation.

c. Horizontal Limits - The horizontal limits will be the vertical planes parallel to and 1 foot outside the Neat Lines of the footings or bases of all Structures, except for structural plate Structures and pipe culverts over 72 inches in diameter, which will be as shown.

When the Engineer approves or directs, structure excavations less than the specified horizontal limits, the measured limits will be the actual excavation made.

(c) Structure Excavation Below Elevations Shown - Structure excavation below elevations shown will be measured according to the following:

(1) Lump Sum - When structure excavation is lump sum basis and when the Engineer requires structure excavation below the elevations shown, measurement to extend the excavations will be made as follows:

- **0 to 3 Feet Below Elevations** - For excavation 0 to 3 feet below elevations shown, measurement will be determined according to 00190.10(h) and based on a theoretical unit price of the lump sum structure excavation item.

- **More than 3 Feet Below Elevations** - For excavation more than 3 feet below elevations shown, measurement will be determined according to 00195.20.

(2) Volume - When structure excavation is volume basis and when the Engineer requires structure excavation below the elevations shown, measurement to extend the excavations will be made on the volume basis.

Quantity limits will be from the bottom limit described in 00510.80(b)(2)(a) to the new lower limits of the excavation for the footing or base of the Structure, including bedding, if any, established by the Engineer. The horizontal limits will be vertical extensions of the quantity limits established according to 00510.80(b)(2)(c).

(d) Granular Wall /Structure Backfill - Granular wall backfill or granular structure backfill will be measured according to the following:

(1) Lump Sum - Under this method, no measurement will be made. Estimated quantities of granular wall backfill or granular structure backfill will be listed in the Special Provisions.

(2) Volume - Under this method, granular wall backfill or granular structure backfill will be measured on the volume basis in the final position. The quantities will be limited to the quantities placed according to the Plans and Specifications or as directed. When backfilling excavated areas, the quantities will be limited to the pay limits of the excavation for the part of excavated areas backfilled with the specified granular backfill Material.

Payment

00510.90 Payment - The accepted quantities of Work performed under this Section will be paid for as follows:

(a) Shoring, Cribbing and Cofferdams - Shoring, cribbing, and cofferdams will be paid for at the Contract lump sum amount for the item "Shoring, Cribbing, and Cofferdams".

No separate or additional payment will be made for maintaining and removing all materials.

No separate or additional payment will be made for clearing and grubbing, preparing foundations, pumping, or cleaning up.

If the Engineer orders excavations that extend below the elevation shown, the Contractor will be compensated to extend shoring, cribbing, and cofferdams as follows:

Footing Elevation Changes	Compensation
0 to 3 feet below	No extra payment
More than 3 feet below	00195.20

When the Contract Schedule of Items does not indicate payment for shoring, cribbing and cofferdams, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

Payment will be payment in full for designing, furnishing Materials, constructing, inspecting, and for providing all Equipment, labor and Incidentals necessary to complete the Work as specified.

(b) Structure Excavation - Structure excavation will be paid for at the Contract lump sum amount or the Contract unit price, per cubic yard, for the item "Structure Excavation".

Except for granular wall backfill, no separate or additional payment will be made for backfilling and compacting to the elevation specified.

(c) Structure Excavation Below Elevations Shown - Structure excavation below elevations shown will be paid for as follows:

(1) Lump Sum - For excavation 0 to 3 feet below elevations shown, payment will be determined and made according to 00190.10(h). For excavation more than 3 feet below elevations shown, payment will be determined and made according to 00195.20.

(2) Volume - For excavation 0 to 3 feet below elevations shown, payment will be made at the Contract unit price, per cubic yard, for the item "Structure Excavation".

For excavation more than 3 feet below elevations shown, payment will be made at the Contract unit price, per cubic yard, for the item "Structure Excavation Below Elevations Shown". If the

Contract Schedule of Items does not indicate payment for this Work, payment will be determined according to 00195.20.

(d) Granular Wall/Structure Backfill - The accepted quantities of backfill will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Granular Wall Backfill	Lump Sum or Cubic Yard
(b)	Granular Structure Backfill	Lump Sum or Cubic Yard

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- removing material forced up between foundation piles during driving or of material used in backfilling around piles, should subsidence occur during driving
- bedding
- excavations made beyond the limits shown or beyond the limits directed, or below the elevations established for the bottoms of the footings, bases, cofferdams, or walls including bedding.
- water removed from excavations and water used in compaction or other items of Work

Section 00512 - Drilled Shafts

Description

00512.00 Scope - This Work consists of excavating and constructing drilled, cast-in-place, reinforced concrete shafts, according to the Specifications and the Plans.

00512.01 Definitions:

Drilled Shafts - Reinforced concrete sections, cast-in-place against in situ Soil, Rock, or a casing.

Permanent Casing - Casing designed as part of the drilled shaft and intended to remain in place after concrete placement is completed.

Temporary Casing - Casing installed to facilitate drilled shaft construction only and removed during or after concrete placement.

00512.02 Subsurface Investigation - The Soils and Geological Exploration Logs are available for review through the Engineer's office. The data shown for each test boring or test pit applies only to that particular boring or test pit. Subsurface conditions may vary between borings or test pits. Core samples and laboratory test results, if obtained and performed for the Project, are available for review by contacting the Engineer.

The Foundation Data shown in the Plans is a compilation of pertinent information including, but not limited to, the Soils and Geological Exploration Logs.

Materials

00512.10 Materials - Furnish Materials meeting the following requirements:

(a) Reinforcement - Use reinforcement complying with Sections 00530 and 02510.

(b) Concrete - Use Class 4000 drilled shaft concrete according to Section 02001, except as modified in this Section. Water may be added to the concrete mix at the Project Site only if allowed by the approved mix design.

00512.13 Steel Casing - Furnish temporary casing meeting the requirements of ASTM A252 or ASTM A36. Furnish permanent casing meeting the requirements of ASTM A36 with the application of supplemental requirement S5. Test each heat of steel at 40 °F with a minimum absorbed energy requirement of 15 foot pounds. Do not use previously used casing for permanent casing. Use casing of sufficient strength to resist handling, transportation and installation stresses and the external stresses of the subsurface materials. Ensure that the casing is clean and watertight prior to placement in the drilled shaft excavation.

00512.14 Drilling Slurry - Furnish drilling slurry meeting one of the following requirements:

(a) Mineral Slurry - Use mineral slurry conforming to the following requirements:

Property	Test	Requirement
Density	Mud Density API * 13B-1, Section 1	64 - 75 lb./cu. ft.
Viscosity	Marsh Funnel and Cup API * 13B-1, Section 2.2	26 - 50 sec./qt.
pH	Glass Electrode, pH Meter, or pH Paper	8 - 11
Sand Content	Sand API * 13B-1, Section 5	4.0 % max.

Maintain slurry temperature at 40 °F or more during testing.

* American Petroleum Institute

(b) Synthetic Slurries - Select synthetic slurries from the QPL. Use synthetic slurries according to the manufacturer's recommendations and the Contractor's quality control plan. The sand content of synthetic slurry shall be less than 2.0 percent (API 13B-1, Section 5) prior to final cleaning and immediately prior to concrete placement.

(c) Water Slurry - Water may be used as slurry when casing is used for the entire length of the drilled shaft. Use of water slurry without full-length casing will only be allowed with the Engineer's approval. Use water slurry conforming to the following requirements:

Property	Test	Requirement (Maximum)
Density	Mud Weight (Density) API 13B-1, Section 1	70 lb./cu. ft.
Sand Content	Sand API 13B-1, Section 5	2.0 %

Do not use blended slurries.

00512.15 Crosshole Sonic Log Access Tubes - Furnish steel crosshole sonic log (CSL) access tubes meeting the following requirements:

- Steel access tubes shall be at least 1 1/2 inch inside diameter Schedule 40 pipe conforming to ASTM A53, Grade A or B, Type E, F, or S.
- Use access tubes having a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of the source and receiver probes used for the testing. Ensure that access tubes are watertight, free from corrosion with clean internal and external faces to ensure good bonding between the drilled shaft concrete and the access tubes. Fit the access tubes with watertight caps on the top and bottom.
- Access tube acceptance will be based on manufacturer's certification that the furnished material meets the requirements of this Specification.

00512.18 Crosshole Sonic Log Cement Grout - Furnish non-epoxy grout or tendon grout from the QPL or furnish a pumpable CSL cement grout consisting of neat cement and water that has a water-cement ratio between 0.38 and 0.45. The portland cement for the pumpable CSL cement grout shall meet the requirements of Section 02010.

00512.19 Quality Control - Maintain and be responsible for quality control of the drilled shaft Work throughout the construction operation. The Engineer will inspect all drilling operations and verify the

suitability of all drilled shaft construction procedures. Provide lights, mirrors, weighted tape, weighted probe, personnel, and all assistance required for the Engineer to perform inspection during drilled shaft construction.

Labor

00512.30 Personnel Qualifications - Perform the drilled shaft construction Work using a company and personnel experienced in drilled shaft construction Work. Submit a list to the Engineer for approval identifying the on-site supervisors and drill rig operators assigned to the Project and the company's experience relevant to the Project. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, shaft size, depth and any special construction techniques required. Also provide the experience qualifications of the company performing the CSL testing. Before the preconstruction conference, provide the following information to verify the firm's experience and the qualifications of personnel scheduled to perform the drilled shaft construction and CSL testing:

- Submit a project reference list of at least three separate foundation projects, successfully completed in the last 5 years, with drilled shafts of diameters and depths equal to or larger than those shown in the Plans and in ground conditions similar to those indicated. Include a brief description of each project and the owner's contact person's name and current phone number for each project listed.
- On-site supervisors shall have at least 2 years' experience in supervising construction of drilled shaft foundations of similar size (diameter and depth) and scope to those shown in the Plans and in similar geotechnical conditions to those described in the geotechnical report. Experience shall include the direct supervisory responsibility for the on-site construction operations.
- Drill operators shall have at least 1 year experience in the construction of drilled shaft foundations.
- Perform CSL testing using an independent testing organization retained by the Contractor and approved by the Agency. Furnish personnel experienced in operating the CSL testing Equipment. Submit the CSL testing firm qualifications according to 00512.40(a). The CSL testing firm shall have successfully performed CSL testing on a minimum of five projects during the last 3 years. CSL testing personnel shall be trained in the operation of the CSL Equipment and have at least 1 year of experience in operating CSL testing Equipment on a minimum of 10 shafts.

The Engineer will respond within 21 Calendar Days after receipt of the submittal. Do not begin Work on any drilled shafts until the qualifications have been approved. The Engineer may suspend the drilled shaft construction if the Contractor substitutes unapproved personnel during construction. Submit requests for substitution of either on-site supervisors, drill operators, or CSL testing personnel to the Engineer, who will have 7 Calendar Days to respond to each request. Additional costs resulting from the suspension of Work due to the changing of personnel is the Contractor's responsibility, and no adjustment in Contract Time resulting from the suspension of Work will be allowed.

Construction

00512.40 Submittals - Provide the following submittals to the Agency for review and approval:

(a) Drilled Shaft Installation Plan - At least 21 Calendar Days before beginning shaft construction, submit the following:

- The sequence of drilled shaft construction as it relates to the overall construction plan.
- A review of Equipment suitability based on the Contractor's understanding of the site subsurface conditions. Include a project history of the drilling Equipment that demonstrates

the successful use of the Equipment for drilled shafts of equal or greater size in similar subsurface conditions.

- Details of shaft excavation methods, including proposed drilling methods and a disposal plan for excavated material. Include details of methods used to perform final cleaning of the excavation. Include details of the methods and materials used to fill or eliminate all voids between the plan shaft diameter and excavated shaft diameter, or between the casing and surrounding Soil, if permanent casing is specified. Include a disposal plan for any water or contaminated concrete expelled from the top of the shaft (if applicable).
- Details of the proposed methods for ensuring drilled shaft stability during excavation and concrete placement.
- Details for the use of drilling slurry including mix design, slurry head requirements, mixing methods, maintaining, and disposing of the slurry (if applicable). Include a discussion of the suitability of the proposed drilling slurry in relation to the anticipated subsurface conditions.
- A plan for quality control of all drilling slurries, if their use is proposed. In the quality control plan, include property requirements, required tests and test methods to ensure the slurry performs as intended. Submit to the Engineer the name and current phone number of synthetic slurry manufacturer's representatives who will provide technical assistance during construction. Provide the names of the Contractor's personnel assigned to the Project and trained by the synthetic slurry manufacturer in the proper use of synthetics slurries.
- Unstamped reinforcing steel shop drawings and details of reinforcement placement, including bracing, splicing, centering, and lifting methods and the method for supporting the reinforcement according to 00150.35. Include details on the type, number, and placement of spacers and other devices for ensuring the reinforcing cage position is maintained during construction. Include details for attaching the CSL test access tubes to the reinforcing cage (if applicable).
- Evidence that the proposed materials and concrete mix design conform to all applicable Specifications.
- If the concrete mix design allows the addition of water at the Project Site, documentation that specifies the amount of water that may be added and allowable methods for adding the water.
- Documentation that the workability and slump retention properties of Section 02001 are met.
- Details of concrete placement, including proposed operational procedures for pumping and tremie methods. Include details for grout placement in the crosshole sonic logging test access tubes after testing is completed (if applicable).
- Detailed procedures for permanent casing installation and temporary casing installation and removal. Include casing diameters, dimensions, and depths and the methods and Equipment for casing installation and removal.
- CSL testing company performing the CSL testing Work, including documentation demonstrating that the company, and company personnel, meets the required qualifications.
- Confinement methods required to contain drilling fluids, spoils, waste concrete and other products from contacting sensitive environmental areas according to Section 00290 and all applicable regulatory permits.
- Methods for protecting existing Structures according to 00170.82.

The Engineer will approve or reject the drilled shaft installation plan within 21 Calendar Days after receipt of all submissions. Provide any additional information and submit a revised plan, if requested, for review and approval. All procedural approvals given by the Engineer will be subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete the Work. Submit requests for modification of adopted procedures to the Engineer. Allow 21 Calendar Days for approval of modifications. Do not begin drilled shaft construction Work until all drilled shaft submittals have been approved.

(b) Drilled Shaft Repair Plans - For any shaft determined to be unacceptable, submit a repair plan to the Engineer for approval. Furnish all materials and Work, including engineering analysis and design, needed to correct unacceptable drilled shafts, at no additional cost to the Agency. Do not begin repair operations before remedial procedures or designs are approved. Any modifications to the dimensions or material of the drilled shafts shown on the Plans that are proposed in the repair plan will require stamped calculations and Working Drawings according to 00150.35.

(c) Drilled Shaft Inspection Reports - Provide the Engineer with a completed Drilled Shaft Inspection Report for each drilled shaft, detailing the actual location, alignment, elevations, dimensions, and quantities of the shafts.

Submit the report within 21 Calendar Days after the completion and acceptance of each shaft. A "Drilled Shaft Inspection Report" form is available from the Engineer.

(d) Concrete Placement Logs and Volume Curves - Measure and record all concrete placed into drilled shafts using standard ODOT forms designated for this purpose or other forms approved by the Engineer. Provide the Engineer with a completed Drilled Shaft Concrete Placement Log and Concrete Volume Curve Form for each drilled shaft within 24 hours after completion of shaft concrete placement.

00512.41 Drilled Shaft Coordination Meeting - Hold a drilled shaft coordination meeting at least 7 Calendar Days before beginning any shaft construction Work at the site to discuss construction procedures, schedules, staging, personnel, Equipment to be used, and other elements of the approved shaft installation plan as specified in 00512.40. If synthetic slurry is used to construct the shafts, the frequency of scheduled site visits to the Project Site by the synthetic slurry manufacturer's representative will be discussed. Those attending the meeting include:

- **Representing the Contractor** - The superintendent, on-site supervisors, and all supervisors in charge of excavating the shaft, placing the casing, mixing and installing slurry (as applicable), placing the steel reinforcing bars, and placing the concrete. If synthetic slurry is used to construct the shafts, the slurry manufacturer's representative and a Contractor's employee trained in the use of the synthetic slurry shall also attend.

- **Representing the Contracting Agency** - The Project Engineer, key inspection personnel, and designers of record or their appointed representatives.

If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved shaft installation plan, hold an additional meeting before any additional shaft construction operations are performed.

00512.42 Construction Tolerances - Excavate drilled shafts as accurately as possible at the locations shown and within the specified tolerances listed below. Determine the drilled shaft dimensions and alignment with approved methods. The following construction tolerances apply to drilled shafts unless otherwise stated:

- **Horizontal Position (at the Plan Elevation of the Top of Shaft):**

  - **Shaft Diameter Less Than or Equal to 6 Feet** - 3 inch horizontal tolerance from the location shown.

  - **Shaft Diameter Greater Than 6 Feet** - 6 inch horizontal tolerance from the location shown.

- **Top Elevation of Shaft Concrete:**
  - **Top Elevation above Water** - Minus 3 inches to plus 1 inch from the plan top of shaft elevation.
  - **Top Elevation under Water** - Minus 3 inches to plus 6 inches from the plan top of shaft elevation.
- **Vertical Alignment in Soil** - May not vary from the plan alignment by more than 1.5 percent of the shaft length.
- **Vertical Alignment in Rock** - May not vary from the plan alignment by more than 2 percent of the shaft length.
- **Top of Steel Reinforcement** - Plus or minus 6 inches from the plan top of steel reinforcement elevation.

Frequently check the plumbness, alignment, and dimensions of the shaft during construction. Correct all out-of-tolerance shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and Work necessary to complete corrections for out-of-tolerance drilled shafts will be at the Contractor's expense, and no extension of the Project completion date will be granted. Materials and Work necessary to complete corrections for out-of-tolerance drilled shafts resulting from the removal of unexpected drilled shaft obstructions will be paid for according to 00195.20.

00512.43 Drilled Shaft Excavation - Perform drilled shaft excavation according to the following:

(a) General - Excavate drilled shafts to the dimensions and elevations shown or as directed. Provide and maintain stabilized drilled shaft sidewalls and bottoms for the full depth of the excavation, using approved Materials, Equipment and methods. If caving or other unstable conditions occur during any construction procedure, stop further construction, notify the Engineer, and stabilize the shaft excavation by approved methods and submit a revised installation plan which addresses the problem and prevents further instability. Do not continue with shaft construction until any damage which occurred has been repaired according to the Specifications and until receiving the Engineer's approval of the revised shaft installation plan.

If the Engineer has reason to believe that the drilled shaft excavation techniques or workmanship have been deficient, so that the integrity of any excavation is in question, Work on that drilled shaft may be stopped. Drilled shaft excavation will not be allowed to resume until the deficient excavation techniques or workmanship have been changed to the Engineer's satisfaction.

Dispose of materials removed from the shaft excavations according to 00290.20.

Do not leave partially completed shaft excavations open overnight unless they are cased full depth or otherwise stabilized with approved methods. If approved by the Engineer, a partially excavated shaft may be left open overnight, provided that the excavation is:

- Stabilized at the bottom, sides and surface to prevent Soil caving or swelling or a reduction of Soil strength.
- Covered at the surface to protect the public.

Extend the drilled shaft excavation if the Engineer determines that the subsurface materials encountered are not capable of providing the required bearing resistance or differ from those anticipated in the design of the drilled shafts.

(b) Protection of Existing Structures - Control shaft construction operations to prevent damage to existing Structures and utilities. Preventive measures include, but are not limited to, selecting

construction methods and procedures that will prevent caving of the shaft excavation and monitoring and controlling the vibrations from construction activities such as the driving and vibrating of casing or sheeting, drilling of the shaft, or from blasting, if blasting is allowed. Repair all damage caused to existing Structures, utilities or other facilities, resulting from drilled shaft construction activities, at no additional cost to the Agency.

(c) Temporary Casing - Provide temporary casing according to the approved installation plan and of sufficient quantities to meet the needs of the anticipated construction method.

Where the peak horizontal ground acceleration coefficient for the 1,000-year return period used for seismic design of the Structure is less than or equal to 0.16 g (acceleration due to gravity), temporary telescoping casing may be used for the drilled shafts, subject to the following conditions:

- Submit the request to use temporary telescoping casing to the Engineer for approval. Specify the diameters and lengths of the temporary telescoping casing and the shafts where use is requested.
- The minimum diameter of the shaft shall be as shown on the Plans.
- Backfill all voids between the temporary telescoping casing and the plan shaft dimensions with a material that approximates the geotechnical properties of the subsurface Soils, or with concrete as approved.
- Use temporary telescoping casing material conforming to 00512.13.

(d) Unexpected Drilled Shaft Obstructions - Remove any natural or manmade object encountered that was not revealed by the Agency's site investigation, and that would cause a significant decrease in the rate of advancement if removed using the techniques and Equipment used successfully to excavate the shaft. The Engineer will be the sole judge of the significance of any reduced rate of shaft advancement and the classification of any unexpected obstructions. Removal of unexpected obstructions from the shaft excavation will be paid according to 00195.20.

(e) Lost Tools - Promptly remove drilling tools lost in the excavation. Lost tools will not be considered unexpected obstructions and shall be removed without additional compensation. Drilling tools lost during the course of removing unexpected drilled shaft obstructions will be paid according to 00195.20.

(f) Drilling Slurry Installation - If synthetic drilling slurry is selected, provide a manufacturer's representative to provide technical assistance at the site prior to use of the slurry, who shall remain at the site during construction and completion of a minimum of one drilled shaft to adjust the slurry mix for the specific site subsurface conditions. After the manufacturer's representative is no longer at the site, provide the approved personnel trained in the use of the synthetic slurry for the remainder of the shaft slurry operations to supervise the proper slurry mix design and quality control procedures.

All in-hole drilling slurry shall meet the required slurry specifications during excavation and prior to concrete placement. Clean, recirculate, de-sand or replace the slurry to maintain the required slurry properties.

Unless otherwise approved, maintain the level of slurry in the excavation at not less than 5 feet above the groundwater level for mineral slurries or 10 feet above the groundwater level for synthetic or water slurries. Maintain the slurry level a sufficient distance above all unstable zones to prevent bottom heave, caving or sloughing.

Maintain the required slurry properties and levels at all times during shaft construction, including Work stoppages, unless other approved stabilization methods are applied.

Feed slurry continuously into the shaft excavation as drilling progresses so that a stable excavation is maintained. Use a self-priming pump to reclaim the slurry. Keep a standby pump available during the drilling operation.

(g) Drilling Slurry Inspection and Testing - Mix and thoroughly hydrate all drilling slurries in an appropriate storage facility. Collect sample sets from the storage facility and perform tests to ensure the slurry conforms to the specified material properties before introduction into the drilled shaft excavation. A sample set shall be composed of samples taken at mid-depth and within 24 inches of the bottom of the storage facility.

Sample and test all slurry in the presence of the Engineer, unless otherwise directed. The sample sets of slurry within the excavation shall consist of samples taken at mid-depth of the excavation and within 24 inches of the bottom of the excavation. Collect and test sample sets during the drilling operation as necessary to ensure the specified properties of the slurry are maintained. Clean, recirculate, de-sand, or replace the slurry as necessary to maintain the specified slurry properties. Final cleaning of the excavation and placement of concrete will not be allowed until the test results indicate the slurry properties are as specified.

Perform a minimum of two sets of slurry tests per 8 hour work shift, the first test being done at the beginning of the shift. Field conditions may require more frequent testing to ensure acceptable slurry properties.

Make copies of all slurry test results available to the Engineer on request.

(h) Clean Out - Use appropriate means, such as a cleanout bucket, pump or air lift, to clean the bottom of the drilled shaft excavations. No more than 2 inches of loose or disturbed material will be allowed at the bottom of the excavation for end-bearing drilled shafts. No more than 6 inches of loose or disturbed material will be allowed at the bottom of the excavation for side friction drilled shafts. Assume end-bearing shafts unless otherwise shown or specified. Shaft cleanliness will be determined by the Engineer.

Notify the Engineer of completion of each drilled shaft excavation to permit inspection before proceeding with construction. Measure final shaft depths with a suitable weighted tape or other approved method after final cleaning to determine that the shaft bottom meets the requirements in the Contract. Do not proceed with shaft construction until the bottom cleanliness requirements have been met and the bottom (shaft tip) elevation is approved.

00512.45 Reinforcing Steel - Furnish and place reinforcing steel as shown and according to the following:

(a) Placement - Do not place reinforcing steel in the shaft excavation until the Engineer has approved the final elevation of the bottom of the shaft.

In each shaft, place reinforcing steel extending from 6 inches above the bottom of the shaft excavation to the elevation shown. The reinforcing cage may be supported on the bottom of the shaft excavation if approved. Support the reinforcing cage to prevent distortion or settlement during concrete placement. If concrete placement does not immediately follow cage placement, remove the reinforcing cage from the excavation and rectify the integrity of the excavation prior to reinstallation of the cage.

(b) Bracing - Rigidly brace the reinforcing cage to retain its shape for lifting. Lift the cage in a manner that does not cause permanent racking or distortion. Show bracing and any extra reinforcing steel required for fabrication of the cage on the submitted shop drawings. Remove cross bracing during cage placement unless otherwise approved.

(c) Splicing - Splice all drilled shaft reinforcement using approved mechanical splicer's unless otherwise shown or approved.

(d) Concrete Cover - Maintain the required concrete cover shown by placing concentric spacer bars or other approved devices around the reinforcing cage. Place spacing devices on maximum 10 foot vertical spacing the full length of the shaft. At each 10 foot level, place spacers on a maximum 30 inch circumferential spacing with at least three spaces per level. Do not use wood spacers or concrete dobies. Provide details of the proposed centering method on the shop drawings submitted according to 00512.40.

00512.46 Crosshole Sonic Log Test Access Tubes - Furnish and install access tubes for CSL testing as shown. Attach CSL access tubes securely to the interior of the reinforcement cage as near to parallel as possible in each drilled shaft and in the pattern shown. Extend the access tubes from the bottom of the reinforcement cage to at least 24 inches above the top of the shaft. Joints required to achieve full-length access tubes shall be watertight. Do not damage the access tubes during reinforcement cage installation and concrete placement. Fill the tubes with potable water, according to 02020.10(b), as soon as possible, but no more than 1 hour after concrete placement and reinstall the top watertight caps. Check water level and top off as needed.

Replace all access tubes that the test probe cannot pass through to the full depth of the shaft at no additional cost to the Agency. Replace all damaged access tubes with 1.5 inch to 2.0 inch diameter holes cored through the concrete for the entire length of the shaft. Unless otherwise directed, locate replacement core holes approximately 6 inches inside the reinforcement. Do not damage the shaft reinforcement during coring operations.

Fill the access tubes with grout only after all CSL testing has been completed and the shaft has been accepted.

00512.47 Concrete - Furnish and place concrete according to the following:

(a) Concrete Placement - Place concrete immediately after completion of the shaft excavation and with the approval of the Engineer. Prior to concrete placement, ensure the shaft clean-out requirements are met according to 00512.43(h) and the properties of the slurry (if used) conform to the Specifications. Shaft concrete may be placed without mechanical vibration in those areas of the drilled shaft that are not formed or are below the ground line or the water surface.

Place concrete continuously until concrete at the top of the shaft or at the top of the first construction joint, is free of water, Soil, and debris, and uncontaminated concrete extends to the plan top-of-shaft elevation or to the top of the construction joint, as applicable. For shafts with a non-contact splice, clean and roughen the surface of the shaft construction joint according to the applicable portions of 00540.43(a). Dispose of all contaminated concrete expelled from the top of the shaft in an approved manner. Remove waste concrete from the site. If a delay in concrete placement occurs because of a delay in concrete delivery or other factors, reduce the placement rate to maintain a flow of fresh concrete into the shaft excavation.

Allow a maximum of 60 minutes between concrete placements and use no concrete older than 90 minutes from batch time. Use procedures for concrete placement which ensure that the concrete within the shaft becomes a monolithic, homogeneous unit.

Place concrete using hoses or pipes having watertight joints. For concrete placement by gravity tremie, use hose or pipe having an inside diameter of at least 8 inches. For placement by concrete pump, use hose with inside diameter of at least 4 inches. Provide an alternate delivery system that can be used in case of failure of the primary delivery system. Place concrete only against the bottom of the drilled shaft or into fresh concrete.

If caving occurs during concrete placement, the shaft may be rejected.

(b) Dry Shaft Concrete Placement - Concrete may be placed by free-fall if all of the following conditions are met:

- No more than 3 inches of water is present in the bottom of the excavation at the beginning of the pour.
- Groundwater seepage into the excavation is at a rate of no more than 12 inches per hour.
- Shaft diameter is greater than or equal to 3 feet.

Under free-fall placement, deposit concrete through the center of the reinforcement cage by a method which prevents segregation of Aggregates and splashing of concrete on the reinforcement cage. Place concrete so that the free-fall is vertical down the center of the shaft without hitting the sides, the steel reinforcing bars or steel cage bracing.

(c) Wet Shaft Concrete Placement - If the drilled shaft excavation does not meet the requirements for dry concrete placement, stabilize water inflow and place the concrete under water or slurry with a tremie pipe or pump hose according to 00540.48(e). Place concrete continuously from the bottom of the shaft to the top-of-shaft elevation shown. Use a plug in the tremie pipe or pump hose to force water or slurry ahead of the advancing flow of fresh concrete. Dispose of all displaced water, slurry, or waste concrete according to 00290.20. When groundwater, the drilling water or slurry in the shaft excavation is to be removed by pumping during concrete placement, have a standby pump available.

Place concrete in a continuous operation so that the concrete always flows upward within the shaft. Withdraw the delivery hose or pipe slowly as the elevation of the fresh concrete rises in the shaft. Keep the discharge end of the pipe or hose at least 5 feet below the surface of the concrete after the concrete has reached a depth of 5 feet. Maintain sufficient concrete inside the hose or pipe to prevent drilling fluid from entering. During concrete placement, provide and maintain markings on the tremie pipe or pump hose, or a sounding device or other appropriate method to determine the relative elevations of the fresh concrete surface and the bottom end of the pipe or hose. Raise the bottom end of the pipe or hose only when the pipe or hose has a sufficient head of fresh concrete to prevent the formation of a void at the bottom.

(d) Concrete Curing and Cleaning - Allow the exposed top of concrete to cure a minimum of 7 Calendar Days by covering with wet burlap overlain with plastic sheets or by keeping top of concrete under water. Keep the burlap wet during the concrete cure.

Prior to placing any fresh concrete on top of a completed shaft, clean the upper surface of the concrete by removing all scum, laitance, loose gravel, and sediment and chip off any high spots on the upper surface that would prevent the steel reinforcing bar cage from being properly placed in the position shown on the Plans. Remove all loose material and poor quality concrete at the top of the shaft down to sound concrete prior to performing any required CSL testing.

(e) Casing Removal - Remove all temporary casing during or after completion of concrete placement. Do not start temporary casing removal until the level of fresh concrete within the casing has reached a depth of at least 10 feet or the level necessary to adequately counteract the external hydrostatic pressure head. As the temporary casing is withdrawn, maintain a minimum 5 feet head of concrete above the bottom of the casing. A slight downward movement of the casing while exerting downward pressure, or hammering or vibrating the casing will be allowed to facilitate extraction. Extract the casing so that concrete is cast directly against the surrounding in-situ material. Check the elevation of the top of the reinforcing cage before and after temporary casing extraction for conformance with the construction tolerance criteria of 00512.42. Casing that cannot

be extracted during, or immediately after, the concrete placement operation may be cause for rejection of the shaft.

Remove the tops of permanent casing to the top of the drilled shaft or the finished groundline, whichever is lower, unless otherwise shown or directed. Remove the tops of permanent casing for shafts constructed in a permanent body of water to the low water elevation, unless otherwise shown or directed.

00512.48 Drilled Shaft Testing and Acceptance - Acceptance of drilled shafts will be based on the Engineer's review of the results of CSL, or other, integrity testing (if conducted), field inspection reports and visual observations during drilled shaft construction. The Engineer has final authority on the approval of drilled shafts. For shafts that are integrity tested, the Engineer will determine final acceptance of each tested shaft, based on the integrity test results and inspection reports and will provide a response to the Contractor within 5 Calendar Days after receiving the CSL test report.

(a) Crosshole Sonic Log Testing - Provide crosshole sonic log testing Equipment and perform crosshole sonic log testing and analysis on the first drilled shaft completed at each Structure and subsequent shafts as specified or designated for testing by the Engineer. Provide CSL testing Equipment conforming to the requirements of ASTM D6760 and approved by the Engineer. Provide all necessary access and other support to the CSL testing firm necessary to do the CSL testing Work.

Perform one CSL test on each shaft designated for testing. A single CSL test consists of all ultrasonic profile combinations in a given shaft. Test completed drilled shaft foundations using Ultrasonic Crosshole Testing methods (Crosshole Sonic Log (CSL) Testing) according to ASTM D6760. Inform the Engineer of scheduled CSL testing at least 3 Calendar Days prior to the testing. Perform all CSL testing using the Contractor's CSL technician in the presence of the Engineer.

Allow at least 3 Calendar Days of curing time before testing unless otherwise approved. Additional curing time beyond 3 Calendar Days may be required if the shaft concrete contains admixtures such as set retarding admixture or water reducing admixture. Additional CSL testing required due to the CSL testing being conducted on concrete that has not cured sufficiently is at no additional cost to the Agency. Additional curing time required due to concrete admixtures will not be grounds for additional compensation or time extensions.

For drilled shafts constructed using non-contact splice methods, perform CSL testing after the initial pour to the bottom of the splice region and before placement of the column reinforcement and pouring of the splice region.

(b) Contractor's Crosshole Sonic Log Test Reports - Provide a brief summary report of the data, with interpretation of the test results, to the Engineer at the completion of each test. Provide copies (either hardcopies or electronic files) of the raw test data as requested. Mark the test data files to identify, as a minimum, the Structure, bent and shaft number, the date of CSL testing, depths of testing and any other pertinent information.

Submit three copies of a final CSL Test Report for each shaft tested according to ASTM D6760. Provide electronic file copies of the raw CSL data measurements, if requested. The report shall summarize the CSL testing performed, data analysis, and interpretation of CSL data with special attention made to the identification and location of any anomalies or possible defects. Provide interpretation of the CSL test data in terms of overall shaft integrity and acceptance. Submit all reports to the Engineer within 5 Calendar Days of the performance of the tests.

(c) Additional Testing and Investigation - Conduct additional testing or investigation necessary to identify the location, extent and condition of possible shaft defects if requested by the Engineer.

Additional testing and investigation may include, but is not limited to, additional CSL testing, excavation Work or core drilling.

If requested by the Engineer, drill a core hole in any questionable quality shaft to explore the shaft condition. The number, location and depths of the core holes will be determined by the Engineer. Submit the method and Equipment used to drill and remove cores from the shaft to the Engineer for review and approval prior to drilling. Use a coring method that provides complete core recovery and minimizes abrasion and erosion of the core. If a defect is confirmed, as determined by the Engineer, all investigation costs associated with identifying the defect will be at no additional cost to the Agency and no extension of the Project completion date will be granted, regardless of whether the identified defect is repaired or not.

If no defect is identified in the investigation Work, and the CSL tubes were satisfactorily installed according to ASTM D6760 and accepted, the Agency will pay for all coring and excavation costs associated with the additional investigation and grant an appropriate time extension, if required, according to Section 00190 and Section 00195. If it is determined by the Engineer that the CSL tubes were not installed properly thus invalidating the CSL test results, all coring, excavation, and other investigation and evaluation costs will be at no additional cost to the Agency and no extension of the Project completion date will be granted.

Fill all core holes with grout only after the evaluation process is completed and the shaft is accepted and approved.

(d) Drilled Shaft Repair - Repair all defects and rejected shafts according to 00512.40(b). Perform additional CSL testing, or other investigation required, as directed by the Engineer, to confirm the quality of the completed shaft repair Work at no additional cost to the Agency with no time extension granted.

For temporary casing not extracted from the shaft excavation, submit a repair plan or a structural evaluation to the Engineer for approval according to 00512.40. If caving occurs during concrete placement submit a repair plan to the Engineer for approval.

00512.49 Scheduling and Restrictions - Unless otherwise approved, do not proceed with construction of subsequent shafts until the CSL testing has been completed on the first drilled shaft and the results have been approved and accepted, in writing by the Engineer. Approval to proceed with the construction of subsequent shafts, before receiving approval of the first shaft will be based on the Engineer's observations of the Contractor's workmanship during construction of the first shaft and the Engineer's review and assessment of the following:

- The Contractor's conformance with the approved shaft installation plan.
- The Contractor's daily reports and Inspector's daily logs of excavation, rebar, and concrete placement.
- The concrete placement logs and volume curves.

Written notification will be provided to the Contractor on whether or not to proceed with subsequent shaft construction within 24 hours after completion of the first shaft. If the Engineer determines the first shaft to be of questionable quality, discontinue all shaft construction until the CSL test results of the first shaft are received and reviewed and the shaft accepted, in writing, by the Engineer.

Denial of permission to proceed with subsequent shaft construction will not be cause for Contract Time extension.

Do not proceed with the third drilled shaft until the final CSL test results from the first drilled shaft has been received and reviewed and the shaft accepted, in writing, by the Engineer. Allow 5 Calendar Days for the Engineer to review.

After the first drilled shaft on the Project has been accepted, make no significant changes in construction methods, Equipment, or Materials used to construct subsequent shafts, unless otherwise approved.

Measurement

00512.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Furnish Drilling Equipment - No measurement of quantities will be made for furnishing drilling Equipment.

(b) Permanent Casing - Permanent shaft casing will be measured on the length basis.

(c) Drilled Shaft Excavation - Drilled shaft excavation will be measured on the length basis by the vertical excavated length from the bottom of the shaft to the ground surface or to the mudline if under water. If the top of the shaft is located below the original ground surface, measurement will be made to the top of the shaft as shown or directed. If directed to excavate drilled shafts below the elevations shown, the drilled shaft excavation will be measured from the revised bottom of shaft.

(d) Drilled Shaft Concrete - No measurement of quantities will be made for drilled shaft concrete. Estimated quantities of concrete will be listed in the Special Provisions.

(e) Drilled Shaft Reinforcement - No measurement of quantities will be made for drilled shaft reinforcement. Estimated quantities of reinforcement will be listed in the Special Provisions.

(f) Crosshole Sonic Log Test Access Tubes - CSL access tubes will be measured on the length basis of the number of tubes installed in the shafts.

Grout used to fill the access tubes after the completion of CSL testing will not be measured.

(g) Crosshole Sonic Log Tests - CSL tests will be measured on the unit basis for each CSL test completed, reported, and accepted. No measurement will be made for CSL Equipment and operating personnel or for CSL tests performed at the Contractor's option.

Payment

00512.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Furnish Drilling Equipment	Lump Sum
(b)	Permanent Shaft Casings, ____ Inch Diameter	Foot
(c)	Drilled Shaft Excavation, ____ Diameter	Foot
(d)	Drilled Shaft Concrete	Lump Sum
(e)	Drilled Shaft Reinforcement, Grade _____	Lump Sum
(f)	CSL Test Access Tubes	Foot
(g)	CSL Tests	Each

Item (a) includes furnishing and moving the drilling Equipment to the Project, setting up the Equipment at the various locations on the Project and removing the Equipment from the Project.

Partial payments for item (a) will be made as follows:

- When drilling Equipment is on the job, assembled and ready to excavate the shafts..... 60%
- When all shafts have been excavated and shaft concrete has been placed and accepted .. 40%

In item (b), the diameter of the shaft casing will be inserted in the blank.

In item (c), the diameter of the shaft will be inserted in the blank. Item (c) includes excavating the shafts and disposing of the excavated material and for furnishing, placing, splicing, and removing temporary shaft casing and forms.

In item (e), the grade of reinforcement will be inserted in the blank.

Item (e) includes all reinforcement within the drilled shaft plus the reinforcement shown which is to be embedded in the shaft and extends above the top of the drilled shaft including the continuous vertical and spiral reinforcement extending from the bottom of the shaft to the elevation shown. No separate or additional payment will be made for bracing, mechanical splices, centering devices, or support for the bottom of the reinforcement cage.

Item (f) includes filling the tubes with grout after completion of CSL testing.

Item (g) includes mobilization of all CSL testing Equipment and personnel to and from the site, all CSL testing, interpretation, analysis, electronic data, and final report for each tested and accepted shaft.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

If the Contractor chooses to use a larger shaft diameter casing than the shaft diameter shown, no additional payment will be made for the larger casing, or for the additional excavation, concrete, and reinforcement.

Section 00520 - Driven Piles

Description

00520.00 Scope - This Work consists of furnishing and driving piles of the type and dimensions shown or specified, including cutting off or building up piles when required.

Materials

00520.10 Materials - Furnish Materials meeting the following requirements:

Preservative Treatment of Timber	02190
Prestressed Concrete Piles	02520.20
Reinforced Pile Tip	02520.10
Steel Piles	02520.10
Steel Pile Protective Coating	00594
Steel Reinforcement for Concrete	00530
Timber Piles	02120.20
Timber Pile Straps	02120.30

00520.11 Engineer's Estimated Length List - Furnish steel piles of sufficient length to attain the penetration and bearing resistance specified, and to extend into the cap or footing as shown. The Contractor may, at no additional cost to the Agency, drive test piles, make borings, and perform other investigations the Contractor considers necessary. The "Engineer's Estimated Length" of steel piles will be listed in the Special Provisions.

00520.12 Pile Order List - Furnish prestressed concrete and timber piles according to the pile order list in the Special Provisions, which will list the type, number, and length of piles. The pile order length includes an allowance for variation. The Contractor may increase the order lengths as necessary to suit pile driving operations at no additional cost to the Agency.

00520.13 Test Piles - Furnish test piles according to the test pile length list in the Special Provisions. When test piles are required, the production pile lengths shown or specified in the Special Provisions are estimated lengths only. The actual lengths to be furnished for production piles will be determined by the Engineer after the test piles have been driven. This applies for all pile types.

00520.14 Unused Piles - Acceptable full length piles furnished according to the estimated length list, order list, or revised pile order list, but not incorporated in the Work, will be handled according to one of the following:

- Mark and identify piles for the Contractor's own use.
- Return piles to the Supplier with the Agency paying transportation and restocking charges.
- The Agency will purchase from the Contractor piles that are stockpiled at a location on the Project selected by the Engineer according to 00195.80.

Equipment

00520.20 Equipment for Driving Piles - Provide pile driving Equipment meeting the following requirements:

(a) Impact Pile Hammers - Provide a striking part of the hammer not less than one-third the weight of the helmet and pile being driven, but never less than 2,750 pounds.

(1) Air-Steam Hammers - Provide power plant and Equipment for air-steam hammers with sufficient capacity under working conditions to maintain the volume and pressure at the hammer

specified by the manufacturer and with accurate pressure gauges easily accessible to the Engineer.

(2) Open-End Diesel Hammers - Provide open-end (single-acting) diesel hammers equipped with a device which allows the Engineer to visually determine hammer stroke at all times during pile driving operations. Provide the Engineer with the hammer manufacturer's chart equating stroke and blows per minute.

(3) Closed-End Diesel Hammers - Provide closed-end (double-acting) diesel hammers equipped with a bounce chamber pressure gauge, mounted near ground level so the Engineer can easily read it. Before driving, provide the Engineer a chart calibrated within 6 months before first use on the Project to actual hammer performance, equating bounce chamber pressure to either equivalent energy or stroke.

(4) Gravity Hammers - Provide gravity hammers that have a ram weighing between 2,000 pounds and 5,000 pounds and a drop height of not more than 10 feet. The weight of gravity hammers shall not be less than the combined weight of helmet and pile.

(5) Hydraulic Hammers - Provide either single or double acting hydraulic hammers equipped with monitoring systems to measure impact velocity and determine equivalent energy and stroke. Locate monitoring systems for easy access by the Engineer.

(b) Vibratory Hammers - Control installation of production piles with vibratory hammers according to the power consumption, rate of penetration, specified tip elevation, or other acceptable means which assure the pile resistance equals or exceeds the required nominal pile bearing resistance. After driving piles with a vibratory hammer, verify pile resistance (see 00520.42) by driving them with an impact hammer of suitable energy. Do not use vibratory hammers to drive test piles or when preboring or jetting.

(c) Driving Components:

(1) Pile Cushion - Protect the heads of prestressed concrete piles with a pile cushion made of wood or other approved material.

The pile cushion shall be:

- Equal to or greater in cross-sectional contact area than the pile head.
- In full contact with the pile head.
- No less than 4 inches thick, before driving begins, if made of plywood.

Provide a pile cushion for each pile. Replace the pile cushion if, during the driving, the cushion is either compressed to less than one-half the original thickness or begins to burn.

(2) Helmet - Equip piles driven with impact hammers with an adequate metal helmet. The helmet shall:

- Fit around the pile top.
- Be axially aligned with the hammer and pile.
- Distribute the hammer energy to the total Cross Section of the pile head.
- Be guided by leads.

(3) Hammer Cushion - Equip impact pile driving Equipment with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to ensure uniform driving

performance. Provide hammer cushions of durable manufactured materials according to the hammer manufacturer's guidelines. Do not use wood, wire rope, or asbestos hammer cushions.

Place a striker plate, as recommended by the hammer manufacturer, on the hammer cushion to ensure uniform compression of the cushion material.

Inspect the hammer cushion in the presence of the Engineer at the beginning of pile driving at each Structure or after each 100 hours of use during pile driving, whichever is less. Replace the hammer cushion when its thickness becomes less than 75 percent of its original thickness.

(4) Followers - Use a follower between the pile hammer and the pile to transmit energy when the pile head is below the reach of the hammer, if allowed by the Special Provisions or approved in writing. If a follower is allowed, drive the first pile in each bent, and every tenth pile driven after that, full length without a follower. Before additional piles are installed, verify that the first two piles installed with followers in each Substructure unit meet the position and alignment criteria of 00520.41(f).

(5) Leads - Support piles in line and position while driving. Construct pile hammer leads to give the hammer freedom of movement while maintaining alignment of the hammer and the pile to ensure concentric impact for each blow. Leads shall be fixed unless the Engineer approves the use of swinging leads. Fit swinging leads, when used, with a pile gate at the bottom of the leads. To maintain alignment of batter piles, use horizontally braced swinging leads, adequately embedded in the ground, or rigidly attached to prevent movement during pile driving.

(d) Approval of Pile-Driving Equipment:

(1) General - Before beginning test pile or production pile driving, obtain approval in writing of pile driving Equipment.

To obtain approval, complete and submit the Agency's "Pile and Driving Equipment Data" form at least 14 Calendar Days before pile driving begins. This form is available from the Engineer. Within 14 Calendar Days of receiving the form, the Engineer will notify the Contractor of approval or rejection of the pile-driving Equipment.

During pile-driving operations, no changes to the approved Equipment will be allowed without the Engineer's written permission. Submit a request for change on a "Pile and Driving Equipment Data" form. The Engineer will give notification of approval or rejection within 7 Calendar Days of receiving the form. Time required for resubmission and review of a Contractor's Equipment change request is not a basis for a Contract Time extension request unless the Engineer does not respond in 7 Calendar Days.

(2) Standard Evaluation Method - The standard method of evaluating driving Equipment requires that the field-measured hammer energy be within the range of energy levels given in Table 00520-1 corresponding to the nominal pile bearing resistance shown.

Table 00520-1 Pile Hammer Requirements [1]

Nominal Pile Bearing Resistance (kips)	Minimum Field Energy (foot-pounds)
≤ 180	6,500
> 180 and ≤ 300	13,000
> 300 and ≤ 400	20,000
> 400 and ≤ 500	30,000
> 500 and ≤ 600	40,000
over 600	Wave Equation required

[1] Requirements are based on the FHWA Gates equation (see 00520.42(b)), except all driving criteria for double acting and differential hammers both air/steam and diesel will be by the wave equation analysis.

If during the pile-driving operation, the Engineer determines the hammer is not operating properly and is unable to drive the piles to the required resistance, do not use the hammer until repaired to the Engineer's satisfaction.

The required number of hammer blows indicated by the FHWA Gates equation at the nominal pile bearing resistance shall be at a rate between 2 and 10 blows per inch.

(3) Wave Equation Method - Select a suitable hammer for driving piles and perform wave equation analyses. Use the 1987 or newer version of the Wave Equation Analysis Program (WEAP). Conduct the wave equation analyses using personnel qualified by training and experience to perform this type of Work.

Submit the WEAP analysis concurrent with the Pile and Driving Equipment Data Form. The Engineer will approve or reject the pile driving Equipment submittal after a review of the wave equation analysis conducted by the Contractor.

Provide pile hammers meeting the following requirements based on wave equation analysis:

- The energy of the submitted hammer shall produce a wave equation predicted blow count between 2 and 10 blows per inch for the nominal resistances, pile lengths and other conditions specified.
- The pile stresses indicated by the wave equation at the nominal resistance shall not be greater than the stress at the point of impending damage to the pile as follows:
  - **Steel Piles** - Tensile and compressive stresses in the pile of 90 percent of the pile material's yield strength for the grade of steel specified at any time during the pile installation.
  - **Prestressed Concrete Piles:**
    - A tensile stress of ($.095\sqrt{f'_c}$) + effective prestress
    - A compressive stress of ($0.85 f'_c$) - effective prestress

      Where: f'_c = concrete compressive strength (ksi)
  - **Timber Piles** - A compressive driving stress of three times the allowable static design stress.

Hammers not meeting these requirements will be rejected. Replace rejected hammers with suitable hammers.

Use input values for the wave equation analyses provided in the Special Provisions and according to the following:

Use the following settings and default values as input to the wave equation analysis program:

- Output option (IOUT) zero (normal option).

- R_N is the nominal pile bearing resistance.
- Smith damping.
- Do not use residual stress option.
- Default hammer efficiency values. Do not adjust the hammer's efficiency outside of the wave equation program recommended (default) values without prior concurrence of both the pile hammer manufacturer and the Engineer.
- % skin is the percent skin friction.

A Pile Driving Analyzer (PDA) test may be required prior to approval of non-default wave equation input values.

At a minimum, provide the following information and documentation:

- A written summary of how the proposed hammer and associated Equipment meets the Specifications regarding blow count criteria and allowable pile stresses.
- Electronic and paper copies of the wave equation input and output files. Output files shall be in the standard WEAP output format.
- WEAP analysis demonstrating that for the required nominal bearing resistances and conditions provided, the hammer will produce pile stresses less than those described above for the range of hammer strokes expected in the field.
- The *Pile and Driving Equipment Data* form.
- WEAP hammer input files for hammers not in the wave equation default hammer files.

For Agency reviewing and approving of the wave equation analysis submittals, the following will be taken into consideration:

- The pile length for use in the WEAP analysis will be the total pile length at the end of driving, including all pile length above the ground surface. This length may be longer than the Engineers Estimated length depending on the site conditions, Equipment used, pile hammer access limitations and other factors.
- The properties and thicknesses of the hammer and pile cushion materials.
- Various hammer types such as direct-drive diesel, standard diesel, air/steam or hydraulic hammers have major effects on predicted stresses and blow counts.
- Changes in pile type or size will affect the blow count rate and pile stresses.
- Battered piles may effect hammer energy transfer and blow counts.

Failure to address these issues may be cause for rejection of the proposed pile hammer.

The size of the pile hammer selected according to the above specification may have significant impacts on the size and capacity of associated Equipment including the leads and crane. This Equipment, in turn, may have significant impacts on the size and capacity of work Bridges, shoring required for existing Structures or other aspects and elements of construction.

Failure of a previously approved hammer to operate properly during construction will be cause for rejection.

Construction

00520.40 Preparation for Driving:

(a) Excavation - Unless otherwise provided or authorized, do not drive piles until after excavation is complete. Remove to the correct elevation any material forced up by pile driving before concrete for the foundation is placed, at no additional cost to the Agency.

(b) Embankments - Unless otherwise provided or authorized, do not drive piles until the roadway embankment at bridge ends is in place according to 00330.42. Drive piles completely through roadway embankments to the required penetration and bearing in the underlying material.

00520.41 Driving:

(a) General - Drive piles as specified with approved pile driving Equipment to the required penetration depth and to the required nominal pile bearing resistance as shown or specified.

(b) Installation Sequence - Unless otherwise shown or specified, install individual piles in pile groups starting from the center of the group and proceeding outward in either direction, or as approved.

(c) Minimum Penetration - Unless otherwise specified or approved, drive piles at least 12 feet below the footing or pile cap, 12 feet below the groundline at trestle pile locations, and completely through embankments at bridge ends. When shown or specified drive piles to a greater minimum penetration. If the required penetration cannot be attained with a hammer complying with 00520.20(d), provide a larger hammer, prebore or jet holes, or use other approved methods as necessary to attain the required penetration.

(d) Preboring - Use augering, wet-rotary drilling or other methods of preboring only when specified or with written approval. When allowed, prebore holes at pile locations and to the depths shown or directed. Make prebored holes smaller than the diameter or diagonal of the pile Cross Section, but sufficient to allow penetration of the pile to the specified depth. If subsurface obstructions, such as Cobbles, Boulders or Rock layers are encountered, the hole diameter may be increased to the least dimension which is adequate for pile installation. The use of a reinforced section (spud) to loosen the subsurface material at pile locations will not be allowed unless otherwise approved.

Perform preboring in a manner that will not impair the bearing or lateral capacity of the piles already in place or the safety of existing adjacent Structures. When it is determined that preboring has disturbed the load bearing resistances of previously installed piles, restore those piles that have been disturbed to conditions meeting the requirements of this Specification by redriving or by other acceptable methods. The Contractor shall be responsible for the costs of any necessary remedial measures unless the preboring method was specifically included in the Contract Documents and properly executed by the Contractor.

(1) End-Bearing Piles - For end-bearing pile as classified by the Engineer, preboring may be carried to the surface of the end-bearing foundation material. Following that, drive pile with an approved impact pile hammer to the specified blow count.

(2) Other Piles - For other piles, extend preboring to the minimum pile penetration depth and then drive pile with an approved impact pile hammer to the specified blow count.

After completion of driving, fill any void space remaining around the pile with sand or other approved material.

(e) Jetting - Jetting may only be used when allowed in the Contract Documents or if approved in writing. When jetting is not required in the Contract Documents, but approved at the Contractor's request, determine and submit for review the number of jets and the volume and pressure of water at the jet nozzles necessary to freely erode the material adjacent to the pile without affecting the lateral stability of the final in-place pile. The Contractor shall be responsible for all damage caused by unapproved or improper jetting operations, unless the jetting method was specifically included in the Contract Documents and properly executed by the Contractor. Control, treat if necessary, and dispose of all jet water in a satisfactory manner. Drive all jetted pile with an approved impact hammer.

(f) Location and Alignment Tolerance - Place the tops of piles at plan cutoff elevation and horizontally within 6 inches of plan locations. No pile shall be nearer than 4 inches from any edge of the cap. Any increase in cap size to meet this edge distance requirement will be at no additional cost to the Agency.

Install piles so the axial alignment of the top 10 feet of the pile is within 5 inches of the specified alignment. For piles that cannot be inspected after installation, make an alignment check before installing the last 5 feet of pile. The Engineer may require that driving be stopped to check the pile alignment. Pulling laterally on piles to correct misalignment or splicing a properly aligned section onto a misaligned section will not be allowed.

If the specified location or alignment tolerances are exceeded, the effect of the pile misalignment on the Substructure design will be investigated. If the Engineer determines corrective measures are necessary, implement suitable measures and pay all costs and delays associated with the corrective action.

(g) Heaved Piles - Make elevation readings on piles during pile driving operations to check on pile heave. Take elevation readings after each pile has been driven and again after piles within a radius of 15 feet have been driven. Redrive to the required penetration and resistance all piles that have risen more than 1/2 inch, at no additional cost to the Agency. Continue readings until the Engineer determines that such checking is no longer required. If pipe piles which have been filled with concrete subsequently heave, redrive them to original position, after the concrete has attained specified strength, with an approved hammer-pile cushion system.

(h) Test Piles - When specified, furnish and drive test piles at the locations and to the lengths directed. All test piles shall be of the kind and size specified for the permanent foundation piles unless otherwise directed. Drive all test piles with approved pile driving Equipment. The specified length of test piles will be greater than the estimated length of production piles to provide for variation in Soil conditions. Drive test piles using driving Equipment identical to that which the Contractor proposes to use on the production piling. Excavate to the elevation of the bottom of the footing before driving test piles. (See Section 00510.)

Drive test piles to or below the required minimum tip elevation and to a hammer blow count established by the Engineer. Allow test piles which do not attain the hammer blow count specified at the minimum tip elevation shown to "set up" for 24 hours, or less if directed, before being redriven. (See 00520.42(d).) If the tops of test piles reach plan grade without attaining the required pile bearing resistance, splice them and drive until the required bearing resistance is attained.

Remove test piles that are not to be incorporated in the completed Structure to at least 2 feet below the surface of the ground and backfill the remaining hole with acceptable material.

Do not order piling to be used in the permanent Structure until test pile data has been reviewed and the production pile order lengths are determined. The Engineer will provide the Engineer's estimated length list or pile order list within 7 Calendar Days after completion of all test pile driving specified in the Contract.

00520.42 Nominal Pile Bearing Resistance:

(a) General - Drive piles with approved pile driving Equipment to the lengths necessary to attain the required penetration and nominal pile bearing resistance. Adequate pile penetration will be considered reached when the piles are driven to or below the minimum penetration depth and the specified bearing resistance is achieved. If piles do not achieve the specified resistance when driven to order length or estimated length, splice and drive them to penetrations established by the Engineer. The pile blow count shall be at a rate of between 2 and 10 blows per inch at the required nominal pile bearing resistance. The required number of hammer blows per inch at final penetration shall be maintained for 3 consecutive inches unless "refusal" driving is first obtained. "Refusal" driving is defined as 20 blows per 1 inch or as determined by the Engineer.

If water jets are used with the driving, the bearing value shall be determined by the specified equation from the results of driving after the jetting has been completed according to 00520.42(e).

(b) FHWA Gates Equation - Unless otherwise specified, the Engineer will determine nominal pile bearing resistance of the driven pile by the FHWA Gates equation:

$$R_n = 1.75 \left(\sqrt{E} \right) \log_{10}(10N) - 100$$

where:

R_n = Nominal Pile Bearing Resistance (kips)
E = W x H (Hammer energy (foot-pounds) at the ram stroke observed in the field)
W = Weight (pounds) of striking parts of hammer
H = Height of fall (feet) of the ram measured during pile driving in the field
$\text{Log}_{10}(10N)$ = Logarithm to the base 10 of the quantity 10 multiplied by N
N = Number of hammer blows per inch at final penetration to be sustained for 3 consecutive inches

$$N = 10^{\left[\frac{R_n + 100}{1.75\sqrt{E}} - 1 \right]}$$

or N = 10 to the power in brackets

The FHWA Gates equation is applicable only if:

- The hammer is in good condition and operating in a satisfactory manner
- The hammer has a free fall
- A follower is not used
- The head of the pile is not broomed or crushed

If the Engineer determines that the hammer being used may not be attaining the specified bearing resistance when the above equation is applied, the Engineer may order the Contractor, at no additional cost to the Agency, to verify the bearing resistance values obtained by the use of a different hammer.

(c) Wave Equation Analysis - If specified, the Engineer will determine nominal pile bearing resistance based on wave equation analysis.

(d) Set Period and Redriving - If piles do not attain the required nominal bearing resistance when driven to the specified length, and if allowed or required, allow the piles to stand for a "set period"

without driving. The "set period" shall be a minimum of 24 hours. After the set period, perform check driving on either two piles in each bent or on one pile in every 10 piles, whichever is more. The Engineer will designate the piles on which check driving is to be performed. Do not use a cold hammer for redriving. Warm up the hammer before redriving begins by applying at least 20 blows to another pile. Redriving shall consist of driving the pile to the required bearing resistance with a maximum of 15 blows. If the specified hammer blow count is not attained on redriving, the Engineer may direct the Contractor to drive all of the remaining pile length and repeat the set period and redriving procedure. Splice those piles driven to plan grade that do not attain the hammer blow count required, and drive until the required bearing resistance is attained. If the required bearing resistance is attained for each pile that is redriven, then the remaining piles in that bent will be considered satisfactory when driven to at least the same penetration and resistance as the redriven piles.

(e) Jetted Piles - The nominal pile bearing resistance of jetted piles will be based on impact driving blow count after jetting has been completed. Jet pipes may be removed when the pile tip is at the required minimum pile tip elevation and before the pile is driven to the required bearing resistance. For piles that are jetted at the Contractor's request and do not attain the required nominal bearing resistance at the ordered length, splice, as required, and drive with a specified impact pile hammer until the required nominal bearing resistance is achieved according to appropriate criteria in 00520.42. Regardless of Agency approval, the Contractor shall pay all costs of splicing and driving piles beyond the order length if jetting is requested by the Contractor.

(f) Followers - The required nominal pile bearing resistance of piles driven with followers will only be considered acceptable when the follower-driven piles attain the same tip elevation as piles driven without followers. (See 00520.20(c)(4).)

(g) Vibratory Hammers - The nominal bearing resistance of piles driven with vibratory hammers will be based on impact driving blow count after the vibratory Equipment has been removed. When vibratory installation of the piles is approved by the Engineer and the vibrated piles do not attain the required nominal bearing resistance at the specified length, splice them as required, at no additional cost to the Agency, and drive with a specified impact pile hammer until the required nominal bearing resistance is achieved, according to 00520.42.

(h) Load Tests:

(1) Static Load Test - Perform static load tests on foundation or test piles when specified or required. Conduct static load tests according to ASTM D1143 using the quick load test method to plunging failure or the capacity of the loading system. Use testing Equipment and measuring systems capable of applying 150 percent of the nominal pile bearing resistance or 1,000 tons, whichever is less.

(2) Dynamic Load Tests - Take dynamic load test measurements during the driving of piles designated as dynamic load test piles as specified. Perform dynamic testing according to ASTM D4945.

Drive the pile to such depth that the dynamic load test Equipment indicates that the nominal pile bearing resistance shown has been achieved, unless otherwise directed. Monitor the stresses in the piles during driving with the dynamic test Equipment to ensure the values do not exceed the values in 00520.20(d)(3). If necessary, reduce the driving energy by using additional cushions or reduce the energy output of the hammer to stay below the values in 00520.20(d)(3). If non-axial driving is indicated by dynamic test Equipment measurements, immediately realign the driving system.

00520.43 Steel Piles:

(a) General - Unless otherwise specified, furnish standard steel piles in the longest practical lengths.

(b) Storage and Handling - Store and handle steel piles in ways that protect them from damage. Bent or kinked piles will be rejected.

(c) End Treatment - Cut pile ends square.

(d) Reinforced Pile Tips - Install pile points, shoes, or other tip reinforcement according to the manufacturer's recommendations and Section 02520.

(e) Driving - During driving, protect the pile head with a fitted metal helmet.

(f) Splices - Where splices are unavoidable, submit for approval their number, location and details.

(1) Welded Splices - Make welded splices using a full penetration butt weld, as shown. Comply with the welding procedures of AWS D1.1.

(2) Mechanical Splices - Mechanical splices may be used if the splice transfers the full pile strength in compression, tension, and bending, according to unstamped Working Drawings submitted according to 00150.35 and approved by the Engineer.

(g) Welding - Weld pile splices, pile tips, pile anchors, and other welded attachments to steel piles according to AWS D1.1.

(1) Splices - Splice joints for pipe piles shall conform to Joint B-U4a or B-U4a-GF (Single-Bevel Groove Weld) in D1.1 Figure 3.4. Weld back-up rings with a full penetration groove weld. Pipe pile splices that include a steel plate for Soil plug formation shall conform to Joint TC-U4a or TC-U4a-GF.

Splice joints for H-piles shall conform to Joint B-U3b or B-U3-GF (Double V-Groove Weld) in D1.1 Figure 3.4 for both the web and flange sections. Joint B-U4a or B-U4a-GF may be substituted on the flange weld. Provide access holes at the ends of the web according to D1.1 Section 5.17.

(2) Submittals - Prior to welding, submit the following for approval:

- A Welding Procedure Specification (WPS) for all pile welds, conforming to the limitations of D1.1 Table 4.5. Both ASTM A36 and ASTM A252 Grade 1 and 2 may be treated as prequalified base metals under Group 1. ASTM A252 Grade 3 will not be considered a prequalified base metal unless the steel has a Carbon Equivalent (CE) of 0.30 percent or less. Develop a Procedure Qualification Record (PQR) for all welding using Grade 3 steel or present proof that the chemistry of the steel meets the CE requirements.
- Qualification documents for each welder. Use welders qualified according to D1.1 Section 4 for the position, process and pile diameter used on the job.

Do not begin welding without approval.

Following completion of all welding, submit the following:

- An inspection report stating that the welding under the Contract was performed according to D1.1. The report shall include a review of the WPS, a review of welder qualifications

and a report on visual inspection of the welds on the Project Site. The inspection shall be signed by a Certified Welding Inspector (CWI) holding QC1 certification as defined in D1.1 Section 6.

- If the Plans or Specifications call for additional inspection other than visual, include reports in the submittal.

(3) Additional Testing - The Engineer may request additional nondestructive testing (NDT), such as radiography or ultrasonic testing of any or all welds. If the additional testing identifies defects warranting rejection, perform repair and additional inspection at no additional cost to the Agency. If the additional NDT does not identify defects warranting rejection, the Agency will pay the cost of the additional testing. Radiographic and ultrasonic defect indications will be evaluated according to the statically loaded criteria of D1.1.

(h) Cutoff Lengths - Cut off the tops of all permanent piles square and smooth at the elevation shown or as directed. All cut-off pile becomes the property of the Contractor. Dispose of according to 00290.20. With approval, undamaged cutoffs may be used as pile extensions or welded together to form full length piles. Steel pile cutoffs welded together, whether pile extensions or full length piles, shall not vary from a straight line more than 1/4 inch in 20 feet measured along any edge of the pile.

All acceptable cutoffs and unused pile lengths remaining at completion of pile driving will be marked for identification by the Engineer as acceptable for use on other or future Agency projects if requested by the Contractor.

(i) Capping - If required by the Plans, cap steel piles with a steel plate of the size and shape shown. Connect this cap to the pile according to the details shown.

(j) Steel Pile Protective Coating - Apply steel pile protective coating according to Section 00594 and to the elevations specified in 00520.11.

00520.44 Prestressed Concrete Piles:

(a) General - Furnish full-length prestressed concrete piles according to the Special Provisions and Section 00550.

(b) Lifting, Storing, and Transporting - Lift, store and transport prestressed concrete piles according to 00550.49.

(c) Strength Before Driving - Do not drive precast, prestressed concrete piles until the conditions of 00550.12(c) are met, and the Engineer gives consent to proceed.

(d) Extensions or "Build-ups" - If additional driving is required beyond the order length, splice on pile extensions or build-ups as specified and directed. Prestressed concrete pile cutoffs may be used as extensions if additional driving is not required. Do not use pile cutoffs as extensions exceeding 5 feet in length unless approved.

(1) Epoxy-Dowel Method - Make splices of prestressed concrete piles to prestressed concrete piles and poured-in-place extensions or build-ups with the epoxy-dowel method, as shown or approved.

(2) Mechanical Splices - Mechanical splices may be used subject to limitations of 00520.43(f).

(e) Cutoffs - Cut off permanent prestressed concrete piles at the elevations shown or directed. All cut-off lengths become the property of the Contractor. Dispose of according to 00290.20. Take

care to prevent spalling of the concrete below the footing or pile cap. Repair damage to the piles at no additional cost to the Agency.

(f) Finishing - Finish all exposed prestressed concrete pile surfaces to 1 foot below ground surface according to 00550.47.

00520.45 Timber Piles:

(a) General - Furnish full length treated timber piles according to the Special Provisions and 02120.20. Cut the heads of piles back square to untreated wood before driving. Provide a length of pile above the elevation of cutoff sufficient to permit the complete removal of all pile damaged by driving. Splicing of timber piles will not be allowed.

(b) Storage and Handling - Store and handle piles to avoid damage. Avoid breaking the surface of treated piles. Do not use cant hooks, dogs or pike poles on portions of the piles remaining in the completed Work. Give cuts or breaks in the surface of treated piles three brush coats of pentachlorophenol, hot creosote oil or other preservative from the QPL. Pour pentachlorophenol, hot creosote oil or preservative from the QPL into all bolt holes. If the treatment is damaged so the integrity of the pile is in jeopardy, the pile will be rejected. Furnish a replacement pile at no additional cost to the Agency.

(c) Strapping - Strap timber piles with at least three straps as follows:

- One approximately 18 inches from the butt
- One approximately 24 inches from the butt
- One approximately 12 inches from the tip

Use straps manufactured according to 02120.30. Wrap the strap around the pile once and fasten with a clip so crimped that the joint will have a tensile strength of at least 4,100 pounds. Install the straps after pressure treating the pile.

(d) Reinforced Pile Tips - Provide metal tips and fasten securely to the pile when shown or specified. Carefully shape the pile tip to secure an even, uniform bearing on the pile tip reinforcement.

(e) Cutoffs - Saw timber piling to a plane parallel to the bottom of the Structure at the elevation shown or as directed. All cut-off materials become the property of the Contractor. Dispose of according to 00290.20.

(f) Capping - Cover timber pile heads not encased in concrete with alternate layers of hot asphalt and loosely woven fabric, using four applications of asphalt and three layers of fabric. Make the cover at least 6 inches more in dimension than the diameter of the pile head. Neatly fold down over the pile and secure by binding with not less than seven complete turns of commercial corrosion resistant wire (13.5 gauge minimum diameter) held in place by large headed commercial corrosion resistant nails or staples. Hot-dipped galvanized or stainless steel straps and clips conforming to 02120.30 may be used instead of commercial corrosion resistant wire. Neatly trim the edges of the fabric projecting below the binding.

00520.46 Damaged or Defective Piles - In addition to other specified requirements:

- Approval of a pile hammer shall not relieve the Contractor of responsibility for piles damaged from misalignment of the leads, failure of capblock or cushion materials, failure of splices, malfunctioning of the pile hammer or other improper construction methods.

- Piles damaged during installation will be considered unsatisfactory unless the nominal bearing resistance is proved by load tests performed by the Contractor. If such tests indicate inadequate resistance, take corrective measures, such as the use of damaged piles at reduced resistance, installation of additional piles, strengthening of damaged piles, or replacement of damaged piles.
- A concrete pile will be considered defective if a visible crack appears around the entire periphery of the pile, or any other crack or defect is observed which is determined to affect the strength or performance of the pile.
- Do not place footing concrete until all piles within a footing are inspected by the Engineer.

Measurement

00520.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Furnish Pile Driving Equipment - No measurement of quantities will be made for furnishing Equipment for driving piles.

(b) Furnish Piles - The quantities of furnishing steel, prestressed concrete, timber, and test piles will be measured on the length basis, as follows:

(1) Steel Piles - Steel piles will be the length of each pile remaining in the completed Work, from the pile tip to the cutoff plane.

(2) Prestressed Concrete and Timber Piles - Prestressed concrete and timber piles will be the sum of the lengths of piles of the types and lengths ordered, furnished according to the Specifications, and stockpiled in good condition at the Project Site.

(3) Test Piles - Test piles, including test piles remaining in the completed Work, will be measured according to (b)(1) and (b)(2) above as applicable.

No allowance will be made for that length of pieces furnished by the Contractor to replace piles previously accepted by the Engineer, but that are subsequently damaged before completion of the Project

(c) Drive Piles - The quantities of driving steel, prestressed concrete, timber, and test piles will be measured on the unit basis. Driving test piles includes test piles remaining in the completed Work.

Preboring will be measured on the length basis.

Jetting will be measured on the unit basis, for each pile driven with the aid of jetting.

(d) Load Tests - Load tests will be measured on the unit basis, for the number of specified load tests completed and accepted. Load tests made at the option of the Contractor will not be measured.

(e) Reinforced Pile Tips - The quantities of reinforced pile tips will be measured on the unit basis.

(f) Pile Splices - Pile splices will be determined as follows:

(1) Steel Piles - Splices incorporated in the finished Structure that were made to increase the length of the pile 5 feet or more for estimated pile lengths of 60 feet or less and 10 feet or more for estimated pile lengths of over 60 feet beyond the estimated pile length will be measured on the unit basis. Only one splice will be measured per pile.

No measurement will be made for splices to steel piles within the estimated lengths listed in 00520.11 of the Special Provisions.

(2) Prestressed Concrete Piles - No measurement of quantities will be made for prestressed concrete pile splices shown or specified. Additional splices required to complete the Work will be paid according to 00195.20.

(g) Steel Pile Protective Coatings - No measurement of quantities will be made for steel pile protective coatings. The estimated quantities of steel pile protective coatings is listed in the Special Provisions.

Payment

00520.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Furnish Pile Driving Equipment	Lump Sum
(b)	Furnish ____ Piles	Foot
(c)	Furnish ____ Test Piles	Foot
(d)	Drive ____ Piles	Each
(e)	Drive Test Piles	Each
(f)	Preboring Piles	Foot
(g)	Jetting Piles	Each
(h)	Pile Load Test (static)	Each
(i)	Pile Load Test (dynamic)	Each
(j)	Reinforced Pile Tips	Each
(k)	____ Steel Pile Splices	Each
(l)	Steel Pile Protective Coating	Lump Sum

Partial payments for Item (a) will be made as follows:

- When Equipment for driving piles is furnished and is satisfactorily driving piles 75%
- When driving piles is complete and Equipment has been removed from site 25%

Item (a) includes:

- furnishing all Materials, Equipment, and labor necessary for transporting, erecting, maintaining, replacing any ordered Equipment, dismantling and removing the entire pile driving Equipment
- resubmittal of wave equation analysis data if original data is rejected
- replacing previously approved hammers if hammer operates improperly
- all considerations when selecting the pile hammer size

The cost of all Materials and labor, including the manipulation of the pile driving Equipment in connection with driving piles will be included in the unit price each for driven piles. Furnishing Equipment for driving sheet piling is not included in this Work.

In items (b), (c), (d) and (k) the type and size of pile will be inserted in the blank.

Item (d) includes cutting off piles, treating and capping pile heads, attaching anchor brackets, lugs or other attachments, and finishing concrete piles.

Items (d) and (e) include all expenses involved in driving piles which have not attained the required bearing resistance and are required to stand for a "set period".

Item (j) includes attaching the tips to the piles.

Item (k) includes steel pile splices required to increase pile length beyond the estimated length listed in 00520.11 of the Special Provisions. No payment will be made for splices to steel piles that are within the estimated lengths listed in 00520.11 of the Special Provisions.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- Work needed to drive piles to minimum tip elevation as shown or specified
- welding inspection performed according to 00520.43(g)(2)
- preboring and jetting of piles if not included in the Contract Schedule of Items but requested by the Contractor

Preboring and jetting, if not included in the Contract Schedule of Items, larger hammers, and construction of concrete pile extensions, build-ups, and splices ordered by the Engineer, as a result of differing site conditions (see 00140.40) will be made according to 00195.30.

Section 00530 - Steel Reinforcement for Concrete

Description

00530.00 Scope - This Work consists of furnishing and placing steel reinforcement of the grade, type and size shown or specified.

Materials

00530.10 Materials - Furnish Materials meeting the following requirements:

Deformed Bar Reinforcement	02510.10
Dowels	02510.50
Epoxy Coated Reinforcement	02510.11
Headed Bar Reinforcement	02510.25
Galvanized Coating	02510.30
Mechanical Splices	02510.20
Stainless Steel Chairs and Supports	02513.30
Stainless Steel Concrete Inserts	02513.35
Stainless Steel Dowels	02513.50
Stainless Steel Mechanical Splices	02513.20
Stainless Steel Reinforcement Bar	02513.10
Stainless Steel Tie Wire	02513.60
Welded Wire Fabric	02510.40
Wire Reinforcement	02510.60

00530.11 Order Lists and Bending Diagrams - Before ordering material, submit all order lists according to 00150.37 and unstamped bending diagrams according to 00150.35 for approval. Do not order material until such lists and bending diagrams have been approved. The review of order lists and bending diagrams by the Engineer will not relieve the Contractor of responsibility for the correctness of such lists and diagrams. Revise lists and diagrams as required to make them comply with the design drawings at no additional cost to the Agency.

Order lists and bending diagrams for reinforcement affected by stressing system in prestressing beams or post-tensioning systems such as anchorage design and duct placement will not be reviewed before the stressing system is reviewed.

00530.12 Fabrication - Cold bend reinforcement bars to the shapes shown. Make bends, tag, mark and ship reinforcement bars according to the current edition of the CRSI *Manual of Standard Practice*.

00530.13 Miscellaneous Metal - Minor metal parts such as drains, bolts, concrete anchors, spacer blocks, expansion and bearing devices, access hole covers and frames, anchor bolts, inserts and similar miscellaneous metal, unless otherwise provided, will be classified as reinforcement.

Pipe attached to or used in conjunction with bridge deck drains or catch basins will be classified as reinforcement.

00530.14 Concrete Inserts - Furnish hot-dip galvanized expanded coil concrete inserts with closed-back ferrule threaded to receive UNC threaded bolts or rods of the size shown. Provide concrete inserts with the following minimum lengths and capacities:

Bolt or Rod Diameter (Inches)	Minimum insert Length (Inches)	Minimum Safe Working Load in Shear or Tension (Pounds)
3/4	4 1/2	4,000
1	5 1/2	6,000
1 1/4	7 1/2	10,000
1 1/2	9 1/2	16,000

Where stainless steel inserts are specified, furnish inserts meeting the requirements of 02513.35.

Labor

00530.30 Mechanical Splice Installers - Provide qualified mechanical splice installers to construct mechanical splices. To qualify an installer, provide the Engineer with three completed mechanical splice samples of each type and size to be installed on the Project for each mechanical splice installer, at no additional cost to the Agency. Prepare the splice samples as follows:

- Make splice samples in the presence of the Engineer using the same materials, Equipment, and procedures that will be used on the Project.
- Construct each splice sample according to the manufacturer's recommendations.
- Construct each splice sample with two equal lengths of straight reinforcing bar so the total length of the assembled splice sample is at least 96 inches.
- Mark each splice sample with the heat treatment lot number.

Provide splice samples that meet the requirements of 02510.20. For stainless steel reinforcement, provide splice samples that meet the requirements of 02513.20. Do not begin mechanical splice installation until the Engineer confirms, in writing, the qualification of each mechanical splice installer. The Engineer may suspend mechanical splice installation if the Contractor substitutes unapproved personnel during construction.

00530.35 Headed Bar Reinforcement Installers - Provide qualified headed bar reinforcement installers to construct headed bar reinforcement. To qualify an installer, provide the Engineer with three complete headed bar reinforcement samples of each type and size to be installed on the Project for each installer, at no additional cost to the Agency. Prepare the headed bar reinforcement samples as follows:

- Make samples in the presence of the Engineer using the same Materials, Equipment, and procedures that will be used on the Project.
- Construct each sample according to the manufacturer's recommendations.
- Construct each sample so the total length of the assembly is at least 48 inches.
- Mark each sample with the heat treatment lot number.

Provide headed bar reinforcement samples that meet the requirements of 02510.25. Do not begin headed bar reinforcement installation until the Engineer confirms, in writing, the qualification of each headed bar reinforcement installer. The Engineer may suspend headed bar reinforcement installation if the Contractor substitutes unapproved personnel during construction.

Construction

00530.40 Protection of Material - Store reinforcement above the surface of the ground on dunnage. Protect reinforcement from damage at all times. Ensure reinforcement is free of dirt, detrimental rust or scale, paint, oil and other foreign substances when placed in the Work.

In addition to the requirements above, store epoxy coated bars with supports close enough to prevent sagging in the bundles. Provide protective padding when bundles are stacked or when supported on metal. Store bars as close as practicable to where they will be placed in the Structure. Cover bars with an opaque material during storage to protect them from exposure to sunlight and saline mist. Move bars to or from storage according to 02510.11(b) to minimize damage to the coating. Do not allow the total exposure time from bar delivery to concrete placement, while in storage or in place, to exceed 2 months.

00530.41 Placing and Fastening - Place all reinforcement within the tolerances recommended in the CRSI *Manual of Standard Practice* unless otherwise specified. Hold reinforcement firmly during the placing and setting of concrete.

(a) Fabric - If fabric reinforcement is shipped in rolls, straighten it into flat sheets before placing.

(b) Ties and Supports - Keep reinforcement properly positioned during placement of concrete according to the following:

- In top mats of footings and deck slabs, tie bars at all intersections except where bar spacing is less than 6 inches, tie bars at alternate intersections.
- Tie all other bars at all intersections except where bar spacing is less than 1 foot in each direction, tie bars at alternate intersections.
- Use precast concrete bar supports with approved shape and dimensions, and equal or greater compressive strength as the concrete to be placed.
- When precast concrete bar supports are used, provide Wired Blocks. Provide tie wires meeting the requirements of 02510.60. Combination Blocks may be used in horizontal applications. Provide tie wires meeting the requirements of 02513.60 for blocks supporting stainless steel reinforcement.
- Where at least one of the bars to be tied or supported is epoxy coated, provide tie wires that are either plastic or epoxy coated.
- For bridge decks, support the bottom mat with precast concrete Wired Blocks or Combination Blocks. The wire ties need not be coated. Plastic bar supports are not allowed.
- For bridge decks, support the top mat of reinforcing steel from the bottom mat with reinforcing bar supports according to Chapter 3 of the CRSI *Manual of Standard Practice* (SBU, BBU or CHCU) at 24 inch maximum centers. Plastic bar supports are not allowed.
- When stainless steel rebar is specified, use stainless steel wire bar supports conforming to the requirements of ASTM A493, Type 430, stainless steel rebar Standees, or Class 1A epoxy coated wire bar supports.
- Use plastic tipped feet or Class 2, Type A stainless steel tips if the feet of the support will be on an exposed surface.
- Turn up the legs of steel wire bar supports a minimum of 1/8 inch.
- Separate layers of bars with precast concrete bar supports or by other approved bar support devices.
- Do not use pebbles, broken stone or brick, metal pipe or wooden blocks as bar supports.
- Tie stainless steel reinforcement only with stainless steel tie wire meeting the requirements of 02513.60.

- Support stainless steel reinforcement with stainless steel metal chairs and continuous supports meeting the requirements of 02513.30.
- Do not allow direct contact between stainless steel reinforcement and steel reinforcement. When stainless steel reinforcing or dowels is located near steel reinforcing, use nylon or polyethylene spacers to maintain a minimum 1 inch clearance between the two metals and bind them with nylon cable ties. Where insufficient space exists to maintain this minimum, either bar may be sleeved with a continuous polyethylene or nylon tube extending at least 1 inch in each direction past the point of closest contact between the two dissimilar bars.

(c) Clearances:

- Provide the same surface clearance for ties and splices that is shown or specified for the reinforcement.
- Maintain clearance distance from the forms with stays, precast concrete blocks, ties, hangers, or other approved supports.
- Remove all precast member lifting devices prior to placing concrete deck reinforcement.
- Ensure bridge deck clearances meet the requirements of 00540.48(g).

(d) Approval - After placing reinforcement in any member have it inspected and approved before placing concrete. Concrete placed in violation of this provision may be rejected and removal required.

00530.42 Splicing:

(a) General - Furnish full length reinforcing bars the specific length shown or the calculated length for those designated "full length".

If specific locations are designated for splices, make splices only at those locations, or use full-length bars.

In the absence of other directions, including bars designated "continuous," furnish reinforcing bars to provide the minimum practical number of bars.

Where splicing is allowed, unless shown otherwise:

- Splice No. 11 bars and smaller by lapping, or with an approved mechanical splice.
- Splice No. 14 bars and larger with an approved mechanical butt splice.

(b) Lapped Splices - In lapped splices, place the bars in contact and fasten together according to 00530.41 with at least three ties per splice.

Where coated reinforcement is spliced to uncoated reinforcement, provide the required splice lap for the coated reinforcement unless shown otherwise.

(c) Mechanical Splices:

(1) General - Construct mechanical splices according to 02510.20 and the manufacturer's recommended procedures. Use devices that join bars end-to-end if a butt splice is specified; otherwise bars may be lapped or joined end-to-end. All requirements for mechanical splices apply to mechanical butt splices.

Ensure mechanical butt-spliced reinforcing bars do not deviate from the layout line by more than 1/4 inch over a 3 foot length of bar.

For staged construction, dowels may be replaced by reinforcing bars with threaded sleeve mechanical splice couplers embedded in the portion of concrete placed first and threaded reinforcing bars inserted in the couplers after forms are removed. Approval by the Engineer is required for the substitution. Construct assemblies that develop 125 percent of the specified minimum yield strength of the dowels shown or specified. Construct reinforcing bars that have effective splice or development lengths equal to the replaced dowels.

When grout sleeve mechanical splices are allowed, submit a written installation plan at least 14 Calendar Days before splice installation. Include splice installation details including grouting operations, Equipment, Material, and testing requirements. Submit an installation plan that conforms to the Manufacturer's testing and installation recommendations.

Provide written documentation, signed by the qualified mechanical splice installer verifying the splices were tested and installed according to manufacturer's recommendations and the Specifications. Also, submit copies of all test results.

Construct the three qualifying splice samples in the same orientation as the production splices.

(2) Sampling and Testing:

a. General - Furnish labor, Material and Equipment for fabricating sample mechanical splices at no additional cost to the Agency. All sample splices will be tested by the Agency at the Agency's expense.

b. Samples - Provide all samples meeting the requirements of 02510.20 and this Subsection.

c. Testing - Construct test splices in the presence of the Engineer. Construct test splices with two equal lengths of straight reinforcing bar so that the total length of the assembled sample is not less than 96 inches. Mark each splice sleeve with the heat treatment lot number.

d. Project Site Quality Control - During the installation of mechanical splices:

- Submit one quality control sample for each 100 splices performed up to 500 splices, and then submit one sample for each 500 splices. Successful installer qualification according to 00530.30 satisfies quality control for the first 100 splices being installed. This sequence of testing will be required for each heat treatment lot used.
- Make non-threaded mechanical splice quality control samples at the Project Site in a manner similar to that used for the production splices.
- Fabricate threaded sleeve mechanical splice quality control samples on a random basis during the cutting of threads on the reinforcing bars and deliver to the Engineer at the Project Site with the material they represent.
- Complete the splice according to the manufacturer's recommendations.
- Quality control samples will be tested according to this Section. If any sample fails to meet the test criteria, the lot which it represents will be rejected until the cause of failure has been determined. Materials from a rejected lot may be accepted if they are shown to be free of the condition which caused the failure.

(3) Installation - Install splices in the presence of the Engineer. Splices made without the Engineer present will be rejected.

Do not place stirrups and other reinforcing bars between a mechanical splice sleeve and the surface of the concrete where it would impair the specified clearance. Instead, place additional reinforcement as necessary at no additional cost to the Agency.

When using epoxy coated reinforcing bars, coat mechanical splices prior to installation according to ASTM A775. After the splices are attached to the rebar, coat exposed areas of bare steel and seal the rebar to splice interface with a manufacturer recommended patching material according to ASTM A775.

(d) Welded Splices - Perform welded splices of steel reinforcing according to AWS D1.4. Submit welder certification, Welding Procedure Specifications and Procedure Qualification Records to the Engineer for approval.

Provide a Certified Welding Inspector according to AWS D1.4 who:

- Performs visual inspection of Work performed by the certified welder.
- Prepares, signs, and submits a signed report confirming the Work was performed according to AWS D1.4.

00530.43 Splicing Welded Wire Fabric - Overlap sheets of welded wire fabric as shown or provide edge and end laps not less than one mesh in width. Securely fasten sheets at the ends and edges according to 00530.41.

00530.44 Substitutions - Substitute different size bars only if approved.

00530.45 Inspection and Repair of Epoxy Coated Rebar - Inspect coated bars before placement for damage to coating. Before installation, patch all visual defects in the coating with a manufacturer recommended patching material according to ASTM A775. Repair damaged coated areas as follows:

- Remove all surface contaminants and damaged coating.
- Promptly repair prepared areas according to the resin manufacturer's recommendations and before detrimental oxidation occurs.
- If rust is present, remove it by blast cleaning or power tool cleaning methods immediately before applying the patching material.
- Feather the patching material 2 to 3 inches, or as recommended by the manufacturer, into undamaged coated areas.
- Apply patching material to a thickness greater than 8 mils.

Repair damage found after placement as specified above. Coating damage exceeding 2 percent of the surface area in any lineal foot section of a bar may be cause for rejection of that bar.

00530.46 Marine Environment - On projects within 3 aerial miles of the Pacific Ocean, clean bars with a high pressure washer (1,500 pounds per square inch minimum pressure, with a fan pattern, 4.5 gallons per minute capacity) just prior to placing concrete.

00530.47 Headed Bar Reinforcement:

(a) General - Construct headed bar reinforcement according to 02510.25 and the manufacturer's recommended procedures.

(b) Sampling and Testing:

(1) General - Furnish labor, material and Equipment for fabricating sample headed bar reinforcement at no additional cost to the Agency. All sample headed bar reinforcement will be tested by the Agency at the Agency's expense.

(2) Samples - Provide all samples meeting the requirements of 02510.25 and this Subsection.

(3) Testing - Construct test headed bar reinforcement in the presence of the Engineer. Construct test headed bar reinforcement with straight reinforcing bar not less than 48 inches in length. Mark each headed bar with the heat treatment lot number.

(4) Project Site Quality Control - During the installation of headed bar reinforcement:

- Submit one quality control sample for each 100 headed bars installed up to 500 headed bars, and then submit one sample for each 500 headed bars. Successful installer qualification according to 00530.35 satisfies quality control for the first 100 headed bars being installed. This sequence of testing will be required for each heat treatment lot used.
- Complete the headed bar reinforcement according to the manufacturer's recommendations.
- Quality control samples will be tested according to this Section. If any sample fails to meet the test criteria, the lot which it represents will be rejected until the cause of failure has been determined.

(c) Installation - Install headed bar reinforcement in the presence of the Engineer. Headed bar reinforcement installed without the Engineer present will be rejected.

When using epoxy coated reinforcing bars, coat heads prior to installation according to ASTM A775. After the heads are attached to the rebar, coat exposed areas of bare steel and seal the rebar to head interface with a manufacturer recommended patching material according to ASTM A775.

Measurement

00530.80 Measurement - The quantities of reinforcement will be measured by one of the following methods:

(a) Lump Sum - Under this method, no measurement will be made. Estimated quantities of reinforcement will be listed in the Special Provisions. The weight of reinforcement in prestressed beams, slabs, piles and other items where the reinforcement is included in those items will not be included in the listed estimated quantities.

(b) Weight - Under this method, reinforcement will be measured on the weight basis, of reinforcement incorporated into the concrete based on the total computed weight for the sizes and lengths of bars as shown or authorized.

The following assumed densities will be used as a basis for computing the theoretical weight of miscellaneous metal:

Steel	-	490 pounds/cubic foot
Copper	-	555 pounds/cubic foot
Cast Iron	-	450 pounds/cubic foot
Stainless Steel	-	500 pounds/cubic foot

The weight of mesh will be computed from the theoretical weight of plain wire. If the weight per square foot is shown, that weight will be used.

For the purpose of computing weight of reinforcement, weights published in the CRSI *Manual of Standard Practice* will be used.

The weight of reinforcement in prestressed beams, slabs, piles and other items where the reinforcement is included in those items will not be included in the listed quantities.

If bars are substituted at the Contractor's request, and as a result, more steel is used than specified, only the amount specified will be included in the pay quantities. When laps are made for splices for the convenience of the Contractor, the extra reinforcement will not be included in the pay quantities.

Payment

00530.90 Payment - The accepted quantities of reinforcement will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Reinforcement, Grade _____	Lump Sum or Pound
(b)	Coated Reinforcement, Grade ____	Lump Sum or Pound
(c)	Stainless Steel Reinforcement, Grade ____	Lump Sum or Pound

The grade of reinforcement will be inserted in the blank.

Item (a) includes fabricating and placing uncoated reinforcement as specified.

Item (b) includes placing epoxy coated reinforcement as specified.

Item (c) includes fabricating and placing stainless steel reinforcement as specified.

Payment for reinforcement will be made when the reinforcement is incorporated into the concrete.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for clips, wire, separators, wire chairs, or other Material used in fastening the reinforcement in place.

Section 00535 - Resin Bonded Anchor Systems

Description

00535.00 Scope - This Work consists of drilling and preparing holes in hardened concrete and providing and installing anchor bolts and/or reinforcement using a resin bonded anchor system as shown.

00535.01 Required Submittals - For anchor installation horizontally or upwardly inclined submit personnel qualifications according to 00535.30 at least 21 Calendar Days before starting Work.

Materials

00535.10 Materials - Furnish anchor bolts meeting the requirements of 02560.30 and reinforcing steel meeting the requirements of Section 02510 as shown. High-strength anchor bolts meeting the requirements of ASTM A193, Grade B7 may be substituted in place of these specified in 02560.30(b).

Furnish a polyester, vinyl ester, or epoxy resin bonding system from the QPL that sustains minimum pullout forces shown. Resin used for installation of the anchor system as shown shall be the same lot used for testing according to 00535.45.

Unless shown otherwise, do not install anchors larger than 1 inch in diameter using a resin-bonded anchor system.

Unless shown otherwise, select a resin from the QPL as follows:

- For Grade 36 and Grade 55 anchors, use either low strength or high strength resin.
- For Grade 105 anchors and Grade 60 rebar, use high strength resin only.

Provide the Engineer with:

- Certification, according to 00165.35, that the anchor system meets all requirements for the Project.
- Mill test certificates verifying the strengths of material used in the manufacture of the anchors.

Unless shown otherwise, galvanize all anchors which have any portion of the anchor exposed. Galvanize according to AASHTO M 232 (ASTM A153) or AASHTO M 298 (ASTM B695), Class 50. When within 25 aerial miles of the Pacific Ocean, galvanize according to AASHTO M 232 (ASTM A153) only. Unless otherwise shown, anchors that become completely encased in concrete will not require galvanizing.

Provide thread lengths as shown. If thread lengths are not shown and the anchor is not rebar, provide threads on the resin-bonded end of the anchor for at least 80 percent of the embedment depth shown.

Labor

00535.30 Qualified Personnel - Provide ACI/CRSI adhesive anchor certified personnel for installation of resin bonded anchors horizontally or upwardly inclined (including vertically overhead). Contact Oregon Chapter of ACI, (503) 753-3075, www.oregonaci.org

Construction

00535.40 Construction - Install the anchor system according to the Manufacturer's Printed Installation Instructions (MPII) and to the embedment depths shown. Unless stated otherwise in the

manufacturer's instructions, use a drill bit diameter 1/8 inch larger than the nominal anchor diameter for AASHTO M 314 anchors and 5/64 inch larger than the out-to-out diameter for rebar. Unless shown otherwise, drill holes for anchor bolts as follows:

- Locate existing reinforcing bars. If existing reinforcement is encountered, adjust the hole location to avoid conflicts as directed.
- When the center of the hole is more than 6 inches from a concrete edge, use either a 9 pound air hammer weight, or a carbide bit rotary hammer with two cutting edges on the diameter.
- When the center of the hole is 6 inches or less from a concrete edge, use either a diamond bit core drill or a carbide bit rotary hammer with four cutting edges on the diameter.

Clean holes with a nonmetallic brush, compressed air, and water. Remove excess water from the hole. The cleaned hole may be damp, but shall be free of concrete dust, foreign matter, and standing water.

Install horizontally inclined, upwardly inclined, or vertically overhead resin bonded anchors using piston plug method.

Do not install resin bonded anchors when the concrete temperature is below 50 °F, unless otherwise advised by the resin manufacturer’s recommendations.

For anchors resisting sustained tension loads do not load or torque anchors until 24 hours after the manufacturer’s minimum full cure time.

Do not install resin bonded anchors until concrete has cured for 21 Calendar Days.

For resin bonded anchor system with anchor bolts and nuts, after the resin is fully cured, tighten no more than one quarter turn past snug-tight, unless shown otherwise, to avoid unintended damage.

00535.45 Testing - Perform demonstration tests and production tests on anchors as specified in the anchor test summary at the frequency in the MFTP.

Perform demonstration tests before installing the anchor system and perform production tests during anchor installation work at agreed upon locations.

(a) Demonstration Tests - Demonstrate the installation process for each lot of resin and each anchor type:

- Install three test anchors using the same materials and methods that will be used for installing the anchor system. One demonstration test includes 3 test anchors.
- Test the anchors according to ASTM E488 as confined tension tests up to the minimum pullout force shown. When the pullout force and embedment depth are not shown, install the anchors to the embedment depth and test the anchors using the minimum pullout forces in Table 00535-1.

TABLE 00535-1

Minimum Pullout Force							
	Anchor Bolts				Rebar		
	Grade 36	Grade 55	Grade 105		Grade 60		
Dia. (inch)	Force (Pounds)			Embed. Depth (inch)*	Size	Force (Pounds)	Embed. Depth (inch)
1/2	7,400	9,700	15,300	4.50	3	7,900	3.25
5/8	11,700	16,900	24,300	6.00	4	14,400	5.25
3/4	17,300	22,500	36,000	7.50	5	22,300	6.50
7/8	24,000	31,200	49,900	9.25	6	31,700	7.50
1	31,700	40,900	65,400	11.00	7	43,800	8.75
					8	56,700	10.25

*± 1/8 inch

Do not incorporate demonstration test anchors into the work.

Do not begin installing the anchor system until the installation process is approved. Test results with the average load meeting or exceeding the minimum pullout force will be acceptable. If any test anchor has a capacity less than 95 percent of the minimum pullout force, the resin lot will be rejected.

(b) Production Tests - Use resin for each anchor type from the same lot used for the demonstration tests. During installation of the anchor system and after the resin has cured according to the Manufacturer's recommendations:

- Test anchors according to ASTM E488 as confined tension tests to 50 percent of the minimum pullout forces shown. One production test includes 1 test anchor.
- For bent rebar anchors (#5 or smaller), furnish and test a straight bar at the required location. After the Engineer accepts test results, cold bend the bar to dimensions as shown. For epoxy coated rebar, inspect for damage to coating and repair damaged coated areas according to 00530.45. For threaded rods and larger reinforcing bars, furnish and install a sacrificial straight test anchor at a minimum distance of 1.5 times embedment depth away from the required location.

Maintain the test load at the required load level for a minimum of 10 seconds. Test anchors shall not have measurable displacement. If the Engineer suspects improper installations, more testing may be required.

Measurement

00535.80 Measurement - No measurement of quantities will be made for resin bonded anchor systems.

Payment

00535.90 Payment - No separate or additional payment will be made for resin bonded anchor systems. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00536 - Internal Shear Anchors

Description

00536.00 Scope - This Work consists of constructing internal shear anchors in existing concrete beams that includes drilling and preparing holes, inserting epoxy resin, inserting steel rods, and repairing, patching, and finishing the concrete surface.

00536.02 Plans - Plans of the existing Structure are available from the Engineer. Prints of these plans are available upon request.

00536.03 Submittals - Submit the following for approval at least 12 Calendar Days before beginning internal shear anchor Work:

- The manufacturer's recommended materials.
- Describe the materials to be used including the properties of each material and the Specifications to which the materials comply. Published manufacturer data is acceptable.
- Proposed changes to the required installation procedure.

Materials

00536.10 Epoxy Resin - Furnish crack injection epoxy products from the QPL.

00536.11 Threaded Shear Anchors - Furnish fully threaded shear anchor rods meeting the requirements of ASTM A449 or ASTM A193 (Grade B7). Furnish one extra anchor rod from each separate lot for check testing.

00536.12 Concrete Repair - Furnish PCC repair Material meeting the requirements of Section 02015 that is compatible with the epoxy resin.

00536.13 Epoxy Resin Manufacturer's Recommendations - Submit the following manufacturer's recommendations to the Engineer before beginning installation:

- Confirmation that the proposed products are suitable for the internal shear anchor application.
- Confirmation that the proposed products can be installed according to 00536.41 and 00536.42 or, if not, the manufacturer's recommended changes to the installation procedures.
- The estimated time it will take the epoxy resin to reach a minimum compressive strength of 3,000 psi at the anticipated installation temperatures.

Construction

00536.40 General - Mark anchor locations on the bridge member for each entire span before drilling anchor holes for that span. Obtain the Engineer's approval of each span, before drilling the holes.

Install the epoxy resin according to the manufacturer's recommendations and the following:

- Install epoxy resin and anchors when the ambient air temperature is above 50 ºF.
- Complete installation of the internal shear anchors within 12 Calendar Days of drilling the holes.

00536.41 Internal Shear Anchors - Bottom:

(a) Demonstration - Demonstrate the installation of the internal shear anchors that will be installed from the bottom in the presence of the Engineer using the same materials, Equipment, and installation methods that will be used for the final installation. Perform the demonstration according to the following:

- Construct a frame that can support and orient a PVC pipe at the angles and the lengths of the finished installed anchors.

  For variable angles and non-variable lengths perform the demonstration using the closest to vertical angle.

  For variable angles and variable lengths, perform either two demonstrations or one demonstration as follows:

  - For two demonstrations, perform the first demonstration using the longest anchor length at that anchor's corresponding angle. Perform the second demonstration using the closest to vertical angle at that anchor's corresponding length.
  - For one demonstration, perform the demonstration using the longest anchor length at the closest to vertical angle.
- Use clear Schedule 40 PVC pipe that has an internal diameter that matches the internal diameter of the specified anchor hole within a tolerance of ± 1/4 inch. Cap the top of the PVC pipe.
- Insert the anchor rod into the PVC pipe then inject the epoxy resin. Simulate the anchor rod placement conditions including temperature, humidity, geometry, injection pressure, and the method that will be used to prevent the epoxy resin from escaping. Measure the quantity of resin injected.
- After curing, cut the demonstration specimen into three separate sections, as directed.
- If required, perform additional demonstrations until the Engineer is satisfied that the epoxy resin has been fully distributed throughout the PVC pipe.

Do not begin drilling holes in the Bridge until the Engineer has provided written approval of the demonstration.

(b) Construction - Unless otherwise approved, use the following procedure to install internal shear anchors from below:

- Lay out and mark proposed anchor locations.
- Locate existing reinforcement by using an electronic rebar mapping device or by removing a 6 inch maximum diameter plug of concrete, as required, to expose the existing bottom layer of longitudinal reinforcement at the locations shown. If locations are not shown, perform concrete removal at enough locations to determine the location of the existing bottom longitudinal reinforcement.
- After locating the reinforcement, drill an 8 inch deep hole using a carbide bit rotary hammer. If existing reinforcement is encountered, stop drilling and adjust the hole location. Unless shown or approved, adjust the hole location up to 3 inches in any direction. If existing reinforcement is not encountered, drill the hole to the required depth using a diamond bit core drill.
- Clean and scarify the hole with a high-pressure water system that has a rotating tipped wand and can deliver water at a water pressure of approximately 17,000 psi.
- Brush the hole with a nonmetallic brush.
- Flush the hole with water and compressed air.

- Tie a sponge or rag to a section of scrap rebar. Test the drilled hole for concrete dust and debris by touching the tip and sides of the hole with the sponge or rag. Repeat water flush and compressed air procedure until no evidence of concrete dust and debris is observed on the sponge or rag.
- Measure and record the length and diameter of the drilled hole.
- Let all water drip from the hole before proceeding.
- Insert the anchor rod into the hole and inject the epoxy resin. Measure and record the volume of epoxy resin used.
- Patch the beam bottom surface using a PCC repair material.
- Submit the measured depth, diameter, and volume of epoxy resin of each hole and the total recorded volume of epoxy after installation is complete.

00536.42 Internal Shear Anchors - Top - Unless otherwise approved, use the following procedure to install internal shear anchors from above:

- Lay out and mark proposed anchor locations.
- Locate existing reinforcement by using an electronic rebar mapping device or drill an 8 inch deep hole using a carbide bit rotary hammer. If existing reinforcement is encountered, stop drilling and adjust the hole location. Unless shown of approved, adjust the hole location up to 3 inches in any direction. If existing reinforcement is not encountered, drill hole to the required depth using a diamond bit core drill.
- Clean and scarify the hole with a high-pressure water system that has a rotating tipped wand and can deliver water at a water pressure of approximately 17,000 psi.
- Vacuum the hole with a minimum 30 hp vacuum. Attach a PVC pipe or other type of extension to the end of the vacuum hose to reach the bottom of the hole.
- Tie a sponge or rag to a section of scrap rebar. Test the drilled hole for standing water and debris by touch the bottom of hole with the sponge or rag. Repeat vacuuming until no evidence of water or debris is observed on the sponge or rag.
- Plug the hole until epoxy resin is installed.
- Before installing the anchor rod and epoxy resin, remove the plug and perform testing and cleaning described above.
- Inject the epoxy resin into the hole to cover the top of the anchor rod.
- Insert the anchor rod and twist it at least 360 degrees during the insertion process.
- Remove excess liquid epoxy resin from the top of the hole.
- Repair the deck with a PCC repair material. Remove all loose material according to the manufacturer's recommendations for patch preparation. Provide a patched surface finish that matches the appearance of adjacent deck sections.
- Cure the epoxy resin to the manufacturer's recommended time to reach 3,000 psi compressive strength and cure the PCC repair material as recommended by the manufacturer before opening the section to traffic.

Measurement

00536.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Lump Sum Basis - No measurement of quantities will be made for lump sum items.

(b) Unit Basis - Measurement will be by actual count.

Payment

00536.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Internal Shear Anchors, Top	Each
(b) Internal Shear Anchors, Bottom	Each
(c) Anchor Demonstration	Lump Sum

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for anchor rods used for check testing, for adjusting and redrilling holes, repairing, patching, or surface finish Work.

Section 00538 - Crack Injecting Existing Bridges

Description

00538.00 Scope - This Work consists of cleaning, sealing, and injecting cracks that are 1/64 inch and greater in width in existing concrete bridge members as shown.

00538.01 Submittals - Submit the following for approval at least 6 Calendar Days before beginning Work:

- Personnel qualifications.
- The manufacturer's recommended materials.
- Describe the materials to be used including the properties of each material and the Specifications to which the materials comply. Published manufacturer data is acceptable.
- An injection procedure for performing the Work.

Materials

00538.10 Epoxy Resin - Furnish crack injection epoxy from the QPL.

00538.11 Surface Seal - Furnish epoxy paste surface seal that is compatible with the epoxy resin.

00538.12 Portland Cement Concrete Patching Material - Furnish PCC patching Material meeting the requirements of Section 02015.

00538.13 Epoxy Resin Manufacturer's Recommendations - Submit the following manufacturer's recommendations to the Engineer before beginning Work:

- The range of crack width over which the product is effective.
- The horizontal, vertical, and overhead orientation of cracked surfaces that the epoxy resin can be used.
- The cleaning requirements for epoxy resin.
- The estimated time it will take for the epoxy resin to reach a minimum compressive strength of 1,500 psi at the anticipated installation temperatures.

Labor

00538.30 Personnel Qualifications - Provide personnel skilled in the application of epoxy crack injection. Experience shall be relevant to anticipated conditions, materials, and construction techniques for epoxy crack injection. The on-site epoxy crack injection supervisor shall have successfully completed at least three projects within the past 5 years.

Submit personnel experience documentation and, for the on-site supervisor a brief description of each of the three projects the on-site supervisor supervised. For each project, include the project name, location, year of construction, owner's contact name, and current phone number.

The Engineer will respond within 7 Calendar Days after receipt of the submittal. If, after checking references, the Engineer determines that the proposed personnel are not qualified, they will not be allowed to Work on the Project. Do not begin crack injection Work until the Engineer has approved, in writing, the proposed personnel.

The Engineer may suspend the epoxy crack injection Work if the Contractor substitutes unapproved personnel during construction. Submit requests to substitute the on-site supervisor or other

personnel. The Engineer will respond to the substitute request 7 Calendar Days after receiving each request. Additional costs resulting from the suspension of Work due to the changing of personnel is the Contractor's responsibility, and no adjustment in Contract Time resulting from the suspension of Work will be made.

Construction

00538.40 General - Remove dirt, dust, grease, oil, efflorescence, and other foreign material from surfaces adjacent to the cracks to be injected. Clean the crack with compressed air. Test the compressed air for oil and water according to ASTM D4285. Perform other cleaning requirements that are recommended by the epoxy resin manufacturer.

Provide entry ports along the crack at intervals of not more than the thickness of the concrete at that location. Apply epoxy paste surface seal along the entire exposed face of the crack between entry ports. Allow the epoxy paste surface seal to cure before beginning epoxy crack injection Work.

Perform crack injection Work when the ambient girder temperature is above 40 °F or the manufacturer's recommended temperature, whichever is higher.

Begin injection Work at the lowest entry port. Continue injection Work until the crack is filled and epoxy resin appears at the next entry port. If port to port travel of epoxy resin is not apparent, stop Work and notify the Engineer. Do not restart Work until allowed by the Engineer.

After the injected epoxy resin has cured, remove the epoxy paste surface seal and all epoxy resin runs and spills by grinding or by abrasive blasting.

00538.42 Acceptance - Crack injection Work will be accepted visually by determining that the epoxy resin has set and cured and that all cracks are sealed. If visual inspection reveals suspected failures, the Engineer will require cores samples. When required, provide 2 inch minimum diameter by 6 inch minimum depth core samples. The Engineer will determine the number of core samples and the locations to take the core samples. Take core samples at least 24 hours after the crack injection Work. When the crack injection Work is performed on only one side of the girder, take the core sample from the opposite side of the girder. When obtaining core samples do not cut or damage existing steel reinforcement. Fill core holes with a PCC repair material.

If core samples show fully hardened epoxy resin and at least 90 percent of the crack is filled, the crack injection Work for that crack will be accepted. If core samples show inadequately hardened or inadequately filled cracks, stop all crack injection Work. Submit a revised crack injection procedure to the Engineer. Do not resume crack injection Work until the revised crack injection procedure has been approved by the Engineer.

After approval of the revised crack injection procedure, re-inject all failed cracks to fill at least 75 percent of the crack volume.

Temporary

00538.50 Traffic Control - In addition to the requirements of Section 00221, provide traffic control beginning with the application of epoxy paste surface seal and continue for 6 hours after completion of the crack injection Work or until the injected epoxy resin has reached a compressive strength of at least 1,500 psi whichever is less.

Unless otherwise shown, stage traffic so that the edge of the nearest travel lane is no closer than the center of the adjacent girder.

Measurement

00538.80 Measurement - The quantities of epoxy injected cracks will be measured on the length basis. The length will be determined by measuring the straight line distance between the beginning point and ending point of each filled crack.

Payment

00538.90 Payment - The accepted quantities of epoxy injected cracks will be paid for at the Contract unit price, per foot, for the item "Inject and Seal Cracks".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for providing core samples, patching core holes, or re-injecting cracks.

Section 00540 - Structural Concrete

Description

00540.00 Scope - This Work consists of furnishing, placing, and finishing portland cement concrete, throughout this Specification referred to as structural concrete or concrete, for Bridges and other Structures according to the Specifications and in close conformity to the lines, grades and dimensions shown or established.

00540.01 Abbreviations and Definitions:

Falsework - Structural system to support the vertical and horizontal loads from forms, reinforcing steel, plastic concrete, structural steel, loads from placement operations and other related loads.

Forms - Structural system to contain the horizontal pressures exerted by plastic concrete.

HPC - High Performance Concrete - See 02001.02 for definition.

Post-Tensioned - Tensioning of prestressing steel after concrete has reached specified strength.

Surrounding Temperature - The air temperature measured in the shade. When placement and curing of concrete is enclosed, it is the lowest temperature within the enclosure.

Tolerance:

- The permitted variation from a given dimension or quantity, or
- The range of variation permitted in maintaining a specified dimension, or
- A permitted variation from location or alignment.

00540.02 Deck Pre-Placement Conferences:

(a) Supervisory Personnel - Hold a pre-placement conference with all supervisory personnel who are to be involved in the concrete Work at a mutually agreed time approximately 3 weeks in advance of placing concrete for bridge decks. Ensure the Engineer, concrete Supplier, and any other Subcontractor is represented. Present and discuss all phases of the concrete deck placement Work.

(b) Placement Crew - Hold a second pre-placement conference with the Engineer and the entire concrete placement crew at the Project Site 1/2 hour before the first placement begins to discuss placement duties and procedures.

Materials

00540.10 Materials - Furnish Materials meeting the following requirements:

Concrete	02001
Concrete and Crack Sealers	02060
Concrete Coating	02210
Curing Materials	02050
Concrete Surface Retarder	02055
Epoxy and Non-Epoxy Bonding Agents	02070
Epoxy and Non-Epoxy Grouts	02080
Epoxy Cement	02060
Portland Cement Concrete Repair Material	02015

Hot Applied Joint Sealant 02440.30
Preformed Expansion Joint Filler 02440.10

00540.11 Classes of Concrete - Furnish concrete meeting the requirements of Section 02001 and the requirements of Table 02001-1 for the classes of concrete to be used in various Structures and concrete paving mixtures. The Plans or Special Provisions will show the class of concrete required for the component parts of the Structure. Use the specified class of concrete, or a higher class. Where the class is not specified, use Class 3300.

00540.14 Concrete Mix Tolerances and Limits - Furnish a workable concrete mixture, uniform in composition and consistency and meeting the properties and limits requirements of 02001.20.

00540.15 Form Materials - Furnish wood, minimum nominal 5/8 inch thick APA exterior grade plywood, minimum nominal 5/8 inch thick APA plyform, metal, or other suitable form material. For round concrete columns, provide either metal or other approved form material that produces a smooth and true surface free from fins, joints and other irregularities. Use APA plyform for all decks and slabs.

00540.16 Quality Control - Provide quality control according to Section 00165 and the following:

- Sample and test according to the MFTP.
- For all structural concrete, provide personnel according to 00540.30 to sample and test the mix for temperature, air content, slump, water-cementitious ratio, density and yield, from the first load of each placement, whenever there is a visible change in the slump of the concrete, and when a set of cylinders is obtained.
- If the results of any test are outside of the Specification limits, stop placement of the load. Correct the load or, if the load cannot be corrected, do not incorporate it into the Work. Test subsequent loads before any further concrete placement. Correct subsequent loads if any of the tests are still outside the Specification limits. Return to the specified test frequency when the test results from two consecutive loads are shown to meet the Specification limits.

00540.17 Acceptance of Concrete - Acceptance of concrete will be according to Section 00165 and the following:

(a) Aggregate - Acceptance of aggregate will be according to 02690.12.

(b) Plastic Concrete - Acceptance of plastic concrete will be based on tests performed by the Contractor's QCT, according to the tolerances and limits of 02001.20.

(c) Hardened Concrete - Cast and cure test specimens according to AASHTO T 23 in 6 inch x 12 inch or 4 inch x 8 inch, single-use plastic molds and test at 28 days according to AASHTO T 22.

(1) General - For all classes of concrete, acceptance of hardened concrete will be based on an analysis of compressive strength tests of cylinders cast by the QCT. Test cylinders at an ODOT certified laboratory.

(2) Acceptance - Hardened concrete with an ASTV meeting or exceeding the specified design strength, $f'c$ will be accepted for strength. If the ASTV is less than $f'c$ but at least 85 percent of $f'c$, the Engineer may review the results to determine if the concrete represented by the cylinders is suitable for the intended purpose. Remove concrete that has an ASTV less than 85 percent of $f'c$ unless otherwise authorized, in writing, by the Engineer. If the concrete is removed, the cost of removal, replacement and all related Work is the Contractor's responsibility. If the Engineer determines that the concrete is suitable for the intended purpose, the concrete may be allowed to remain in place, subject to a price adjustment according to 00150.25.

If an ASTV falls below $f'c$, the Contractor may submit a written plan outlining a proposed alternate method of evaluating compressive strength. Submit the plan for review by the Engineer within 3 days of the test. Provide evidence that a reasonable $f'cr$ (over-design) was maintained and that there is credible evidence (besides low strength) which warrants consideration of this option. The Engineer may allow an alternate method of acceptance if the compressive strength test results are determined to be suspect from definable external factors.

Equipment

00540.22 Concrete Conveying Equipment - Use clean, non-aluminum conveying Equipment capable of supplying concrete to the point of placement without segregation.

(a) Concrete Pumping Equipment - Provide a discharge line for the pump made of steel or rubber pipe and having the following minimum size:

Nominal Maximum Size of Concrete Aggregate	Minimum Pipe Size, Inside Diameter
1 inch	4 inches
1 1/2 inches	5 inches

(b) Chutes - Use steel or steel-lined chutes. Where steep slopes are required, equip the chutes with baffles or provide short lengths that reverse the direction of movement.

(c) Pipes or Trunks - Other than tremie seal pipe, provide rubber or steel pipes, and plastic trunks.

(d) Tremie Seal Pipe - Provide a tremie seal pipe that:

- Is rigid pipe with minimum diameter of 10 inches and sufficient length to reach from the bottom of the excavation to above the waterline, with an attached receptacle or hopper for receiving concrete.
- If jointed, is the flange-and-gasket type and waterproof.
- Has means to close the discharge end.
- Is supported to permit free movement of the discharge end throughout the seal.
- Is equipped with a device to permit rapid lowering when necessary to retard or stop the flow of concrete.

00540.23 Vibrators - Provide vibrators that:

- Are an internal type unless other methods are approved by the Engineer.
- Are capable of transmitting vibration to the concrete at frequencies of not less than 4,500 impulses per minute.
- Are in working condition to meet manufacturer's rating.
- Are fitted with a manufactured rubber sleeve to prevent damage to epoxy coated reinforcement.

00540.24 Deck Finishing Machine - Provide a deck finishing machine that is:

- Capable of finishing the entire Roadway surface or the specified stage construction width.
- Self-propelled with positive control in both forward and reverse directions.
- Capable of raising rolls or screed to clear the screeded surface with positive control to the specified grade.

- Equipped with augers.
- Equipped with rollers or vibrating screeds.

(a) Deck Finishing Machine Support System - Furnish calculations and detailed drawings of the proposed deck finishing machine support system according to 00540.41.

(b) Other Deck Finishing Equipment - In narrow Bridge widenings where a deck finishing machine is not practicable, a mechanical vibrating screed may be used.

00540.25 Straightedge - Furnish a 12 foot metal straightedge for checking bridge deck roadway and sidewalk surface tolerances.

00540.26 Concrete Saws - Provide power-driven concrete saws for sawing joints and as required for surface texture.

00540.28 Power Washers - Provide power washers that produce a minimum 2,500 psi pressure at the nozzle, with a fan pattern, and a minimum 4.5 gallons per minute capacity. For bridge decks, provide at least one power washer for each side of the deck section to be placed. When using power washers to produce a fog spray for curing, match the flow rates and pressures of the power washers with the fogging nozzles to produce an average droplet size of 3 mils, according to the nozzle manufacturer's recommendation.

00540.29 Work Bridges - Provide at least two transverse work Bridges when placing concrete on a bridge deck. Use the transverse work Bridges to facilitate placement of the cure.

Labor

00540.30 Quality Control Personnel - In addition to the certified technicians required in 02001.50 provide and designate an individual to be present at the placement site at all times during concrete placements for projects with more than 100 cubic yards of structural concrete and for all high performance concrete, and who is authorized and responsible for acceptance and rejection of materials.

Construction

00540.40 Tolerances - The following tolerances apply to cast-in-place Structures:

(a) Foundation Footings:

(1) Lateral Alignment:

- Actual (as cast) location of the center of gravity: 0.02 times width of footing in the direction of misplacement, but not more than 2 inches
- Supporting masonry: 1/2 inch

(2) Level or Vertical Alignment:

- Top of footing supporting masonry: 1/2 inch
- Top of other footings: minus 2 inches to plus 1/2 inch

(3) Cross-Sectional Dimensions:

a. Horizontal dimension of formed members: minus 1/2 inch to plus 2 inches

b. Horizontal dimension of unformed members cast against Soil:

- Less than and equal to 2 feet: minus 1/2 inch to plus 3 inches
- Over 2 feet and less than and equal to 6 feet: minus 1 1/2 inch to plus 6 inches
- Over 6 feet: minus 1/2 inch to plus 12 inches

c. Vertical dimension (thickness): 0 to plus 6 inches

(4) Relative Alignment - Footing side and top surfaces may slope with respect to the specified plane at a rate not to exceed 1 inch in 10 feet.

(b) All Other Structural Members:

(1) Vertical Alignment:

- Exposed surfaces: ± 3/4 inch
- Concealed surfaces: ± 1 1/2 inches
- Construction joints: 0 to minus 3 inches

(2) Lateral Alignment - Centerline alignment: 1 inch

(3) Level Alignment:

a. Profile grade: ± 1 inch

b. Top of other concrete surfaces and horizontal grooves:

- Exposed: ± 3/4 inch
- Concealed: ± 1 1/2 inches

c. On ramps, sidewalks and intersections, in any direction, the gap below a 12 foot unleveled straightedge resting on high spots shall not exceed 1/4 inch.

d. On bridge decks, in any direction the gap below a 12 foot unleveled straightedge does not vary from the testing edge by more than 1/8 inch.

(4) Cross-Sectional Dimensions:

- Bridge slabs and decks vertical dimension (thickness): minus 1/8 inch to plus 1/4 inch
- Members such as columns, beams, piers, walls and others (slab thickness only): minus 1/4 inch to plus 1/2 inch
- Openings through members: 1/2 inch

(5) Relative Alignment:

a. Location of openings through members: 1/2 inch

b. Formed surfaces may slope with respect to the specified plane at a rate not to exceed the following amounts in 10 feet:

- Watertight joints: 1/8 inch
- Other exposed surfaces: 1/2 inch

- Concealed surfaces: 1 inch

c. Unformed exposed surfaces, other than Pavements and sidewalks, may slope with respect to the specified plane at a rate not to exceed the following amounts:

- In 10 feet: 1/4 inch
- In 20 feet: 3/8 inch

00540.41 Design of Falsework for Vertical Pressures:

(a) Submittal of Working Drawings and Calculations - Submit stamped falsework Plans and design calculations according to 00150.35, except as modified below.

Ensure the falsework designer prepares a Falsework Design Summary and completes a Falsework Design Checklist to accompany the Plans and calculations. Include in the summary a list of each falsework member with its:

- Assumed dead and live loads
- Allowable and design stresses
- Allowable and calculated deflections
- Design references and derivations for design formulas
- Documentation for computer-generated calculations

The Falsework Design Checklist is included in the Special Provisions.

Submit five sets (nine sets if Railroad approval is required) of the Plans and three copies (five copies if Railroad approval is required) of the calculations, summary, and checklist.

Design falsework according to the current edition of AASHTO *Guide Design Specifications for Bridge Temporary Works* except where in conflict with the Specifications.

(b) General Design Loads - Design and construct falsework to support the total applied loads and provide enough redundancy in the design to prevent a failure of the entire system.

Ensure design loads used are the maximum loadings. Ensure deflections used on manufactured devices and assemblies do not exceed the manufacturer's recommendations. Furnish catalog data that lists the manufacturer's recommendations.

(c) Falsework Foundation:

(1) On Soils - Consider anticipated construction and Soil conditions in determining the Soil's support capacity, including draining water away from the supports. For falsework supported on Soils, show the following in the calculations:

- Assumptions and methods used to determine the Soil's capacity to support the footing loads.
- Anticipated falsework footing settlement based on the allowable Soil bearing values.

(2) On Piles - For falsework supported on piles, show on the Working Drawings the pile type, size and spacing. Accompany these drawings with calculations which show the assumptions and methods used to design the piles and the bearing values to which the piles need to be driven to support the calculated loads.

(d) Requirements at Highway and Railroad Traffic Openings - For falsework adjacent to or spanning a Highway or railroad traffic opening, do the following:

- Design the posts using a minimum elastic section modulus, about each axis, of:
  - 12.2 cubic inches for structural steel
  - 244 cubic inches for timber
- Increase the vertical post load 150 percent. If the load on the falsework will be increased by load transfer due to prestressing, increase the vertical post load by the additional load due to prestressing or by 150 percent, whichever is greater.
- Provide mechanical connections for posts to supporting footing with capacity to resist a minimum lateral force of 2,000 pounds applied in any direction at the base of the post.
- Provide mechanical connections between top of posts and the cap or stringer capable of resisting a lateral force of 1,000 pounds from any direction.
- Tie down all beams or stringers spanning traffic so that each will resist a 500 pound force from any direction.
- Use 5/8 inch diameter or larger bolts at connections for timber bracing.
- Show temporary erection/removal bracing on the falsework Plans.

(e) Additional Requirements at Railroad Traffic Openings - For falsework bents within 20 feet of the track centerline:

- Design bracing so that the bent will resist the required horizontal load or 500 pounds, whichever is greater.
- Provide solid sheathing of 5/8 inch thick plywood between 3 feet and 16 feet above the top of the rail, properly blocked at the edges.
- On falsework Plans, show:
  - Collision posts if they are required
  - Soffit and deck overhang forming details

00540.42 Falsework Construction - Construct falsework according to the current edition of AASHTO *Construction Handbook for Bridge Temporary Works*, except where in conflict with the Specifications. Assure that falsework is constructed according to the falsework design and on Soils equal to or exceeding design assumptions. Within 2 days of notice of the falsework design engineer's pending inspection, the Engineer will provide a list of construction concerns. Do not place concrete until the falsework design engineer of record, accompanied by the Engineer, field inspects that portion of the falsework proposed for use. Do not place concrete until all construction concerns have been addressed, the falsework design engineer furnishes the Engineer a written statement that the falsework conforms to the design and will serve the intended use, and the Engineer agrees in writing that the falsework will serve the intended use.

Set falsework to give the finished Structure the Camber shown or specified.

Install telltales on falsework at locations as directed and use jacks, hardwood wedges or other methods approved, to take up settlement in the formwork.

When used, provide sand jacks consisting of a metal piston and metal frame filled with compacted, clean, dry sand. Ensure the annular space between the top bearing plate or piston and the frame does not exceed 1/4 inch.

Use temporary barriers according to 00226.11(a) to protect falsework from damage from adjacent traffic. Make provisions to prevent damage by debris in streams.

Upon completion of the Structure, remove all falsework to at least 24 inches below ground line or streambed.

Limit the height of timber blocking and wedging to 24 inches, or to less than 1 1/2 times the least horizontal dimension of the blocking or wedges, whichever is smaller. Limit post, shim pack and wedging assemblies supporting beams to six faying (interface or contact) surfaces. Ensure adjacent beam support assemblies do not have a difference of more than two faying surfaces. Ensure timber blocks loaded perpendicular to the grain are free of splits.

For post-tensioned Structures, do not remove falsework until post-tensioning is complete.

00540.43 Joints - Construct joints in concrete Bridges according to details shown or directed.

(a) Construction Joints - Make construction joints between concrete placements only where shown or specified unless otherwise approved.

Do not form construction joints in concrete exposed to salt water between levels of extreme low and high water. Where concrete may be exposed to the action of alkaline water or Soil, place concrete continuous until completion of the section, or until the concrete is at least 18 inches above the ground or high water level.

Unless otherwise shown, provide construction joints with a roughened surface. Do not smooth or trowel Aggregate into the cement paste. Provide a minimum deviation from a plane surface or 1/4 inch and a maximum deviation from a plane surface equal to the maximum size of Aggregate in the specified class of concrete.

Apply a concrete surface retarder according to the manufacturer's recommendations. Remove surface mortar within the time period recommended by the manufacturer and clean the joint surface and reinforcing steel by removing loosened particles of Aggregate, damaged concrete, unconsolidated concrete and surface laitance with a high pressure washer conforming to 00540.28 to the extent that clean Aggregate (free of surface mortar) is exposed on 50 percent of the surface. Clean the joint surface again immediately prior to the concrete placement to remove any subsequent deposits of dirt, debris or other foreign materials. Saturate the joint surface with potable water immediately before resuming concrete placement. Remove standing water in depressions or hollows of the joint surface.

Saw cut the top 1 inch of the deck joints with a straight vertical cut before subsequent concrete placement and before saturating the surface with water. Where joints are straight and without spalls, the Engineer may waive this saw cut requirement.

Hand rub or brush fresh concrete paste onto the existing surface of vertical deck joints down to the top mat of reinforcing steel at the beginning of subsequent concrete placement.

Stay in place joint forms are not allowed in bridge deck construction joints.

(b) Open Joints - Locate open joints as shown. Construct the form so the form support system may be released as soon as the concrete takes its initial set. Do not chip or break the corners of the concrete when removing forms. Do not extend reinforcing bars across an open joint unless shown.

(c) Joints with Fillers - Construct joints with preformed expansion joint fillers or poured fillers as shown and according to the manufacturer's recommendations for the filler used. Provide a 3/4 inch chamfer on each edge of the joint unless otherwise noted.

(d) Bridge Deck Expansion Joints - Construct expansion joints for bridge decks as shown and according to Section 00585.

00540.44 Foundations - Place concrete foundations for Structures on suitable Soil or Rock bearing surfaces, concrete seals or piles as shown. Excavate and backfill according to Section 00510.

00540.45 Construction of Forms - Construct forms that:

- Conform to ACI 347 and ACI SP-4.
- Are mortar-tight and sufficiently rigid to conform to and maintain the specified dimensions and tolerances.
- Provide a 3/4 inch chamfer on all exposed concrete edges unless otherwise noted.
- Provide a smooth concrete surface unless otherwise specified.
- Are constructed so portions may be removed without disturbing forms that are to remain.
- Are treated with a release agent that is not detrimental to the concrete.
- Are cleaned of dirt, sawdust, excess water and other foreign material before placing concrete in the forms.
- Are saturated with water immediately before placing concrete and kept damp during placement.
- Are retightened before depositing new concrete on or against concrete which has hardened.

On Structures located within 25 aerial miles of the Pacific Ocean, remove metal ties and anchorages to a depth of 2 inches from accessible surfaces. Remove fiberglass form ties and anchorages to a depth of 1 inch from accessible surfaces.

On Structures located more than 25 aerial miles from the Pacific Ocean, construct ties or anchorages within the forms so they can be removed to a depth of at least 1 inch from accessible surfaces.

Install embedded conduit 2 inches clear of the nearest face of concrete.

Secure in place expanded polystyrene forms and spacers between adjacent concrete placements to prevent floating or displacement during concrete placement. Carefully cut joints in expanded polystyrene and fill with a suitable filler or mastic to prevent intrusion of concrete mortar. After the concrete has hardened, completely remove expanded polystyrene unless otherwise stated.

Permanent stay-in-place bridge deck forms are not allowed unless shown otherwise.

(a) Footings - When footings are not founded in firm Rock, concrete may be placed without forms if the excavation does not exceed the tolerances of 00540.40(a)(3)(b).

Do not form portions of footings founded in firm Rock. Place concrete against undisturbed Rock, filling the overbreak to the top of Rock or top of footing.

(b) Accessible Box Girder Cells - Falsework and deck forms for accessible box girder cells may be supported by girder stems or bottom slab provided the bottom slab is fully supported and designed to take additional loading from deck forms and falsework, deck concrete, and concrete placement forces.

(c) Inaccessible Box Girder Cells - Falsework and deck forms for inaccessible box girder cells may be left in place provided:

- Falsework and deck forms left in place are not supported off the bottom slab. Falsework and deck forms supported by girder stems are allowed.

- 1/2 inch preformed expansion joint filler are placed between the end of deck forms and transverse beams and at 25 foot spacing in the deck forms.
- Box girder cells are cleared of materials and forms except as necessary to support the deck slab before the deck forming is complete.

(d) Form Maintenance - Set forms and maintain them true to designated line and grade until the concrete hardens. When forms appear to be unsatisfactory, either before or during the placing of concrete, the Engineer may order the Work stopped until the defects have been corrected. Leave forms in place for periods specified in 00540.52.

00540.47 Delivering Concrete - Schedule delivery of concrete to ensure continuous delivery during placement. For all placements except seal and deck placements, ensure the interval between the end of one load and the start of the next load does not exceed 20 minutes. See 00540.48 for seal and deck placements.

If the requirements of the previous paragraph are not met, the Engineer will determine whether the concrete has taken its initial set and may order a bulkhead installed or removal of concrete in the affected placement.

00540.48 Handling and Placing Concrete:

(a) General - Do not place concrete under water or in flowing water unless specifically authorized. Place concrete:

- In the sequence shown or as approved.
- In its final position in the forms within 1 1/2 hours after the addition of the cement to the Aggregate. A retarder may be used or required. Use a retarder from the QPL and furnish at no additional cost to the Agency.
- As close as possible to its final position and consolidated to:
  - Avoid segregation of the materials and displacement of the reinforcement
  - Produce a dense, homogeneous concrete, free of voids and Rock pockets
- Through pumps, chutes or trunks conforming to 00540.22, when placement requires dropping concrete more than 5 feet. Place the bottom of pump hose, chutes, pipes or trunks as close to final placement position as practicable.
- In layers not more than 18 inches thick, except for seal concrete placement, and unless shown otherwise. Place and consolidate each layer before the preceding layer has taken initial set to avoid surfaces of separation between the layers.

Do not place concrete prior to complete approval of:

- The excavation and the bearing material in a foundation
- Installed piling
- The falsework and forms
- Placed reinforcing steel

After initial set of the concrete, do not disturb the forms or place loads on the ends of reinforcing bars projecting from the concrete placement until allowed by 00540.52.

(b) Pumping Concrete - Pump concrete with pumping Equipment conforming to 00540.22. Pump a cement-water slurry through the lines before starting the mix through the pump. Operate the pump in a manner that produces a continuous stream of concrete without air pockets or

segregation. When a placement nears completion, if concrete remaining in the pipeline is to be used, remove it in a manner that will not cause contamination of the concrete already in place.

There will be no extra payment for additional cement or additives required to ensure a mix is pumpable.

(c) Vibrating Concrete - Except for seal concrete, thoroughly consolidate fresh concrete according to the following:

- Vibrate concrete internally using mechanical vibrating Equipment.
- Provide an extra vibrator for emergency use.
- Re-vibration of concrete may be required as directed.

Apply vibration at the point of freshly deposited concrete. Apply vertically at points uniformly spaced not farther apart than 1 1/2 the radius over which the vibration is visibly effective. Penetrate into previously placed plastic layers.

Do not use vibrators to make concrete flow or to move concrete from one point to another in the forms. Do not apply directly on or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration.

Supplement vibration by spading as necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners or other locations impossible to reach with vibrators.

Continue vibration until the concrete is thoroughly consolidated. Discontinue vibration if segregation occurs or localized areas of grout form.

(d) Concrete Exposed to Salt Water, Alkaline Water, or Soil - For concrete exposed to salt water, see 00540.43(a) for location of construction joints, and 00540.53 for surface finish requirements.

Do not allow alkaline water or Soil to contact the concrete during placement or for a period of at least 72 hours after placement. See 00540.43(a) for location of construction joints.

(e) Seal Concrete - Deposit seal concrete in still water near its final position, by means of a tremie seal pipe meeting the requirements of 00540.22(d) or a concrete pump with a rigidly held discharge line to prevent unwanted vertical movement. Place seal concrete continuously from start to finish, at a rate of at least 50 cubic yards per hour, keeping the surface of the concrete nearly horizontal at all times. Place each increase in height before the preceding concrete has taken its initial set.

Do not use vibrators.

At the start of the Work and on any withdrawal of the pipe, close the discharge end to prevent water entering the pipe. During the progress of the Work, keep the pipe full of concrete to the bottom of the hopper. When concrete is dumped into the hopper, start the flow of concrete by slightly raising the discharge end, always keeping it in the deposited concrete. Control the elevation of water inside the cofferdam to prevent any flow through the seal.

Dewatering may proceed when the concrete seal has achieved a compressive strength of 2,200 psi. Remove high spots, laitance and other unsatisfactory material from the exposed surface.

(f) Walls, Abutments, Bents, Piers, Columns, Beams, Girders, and Slabs - Place concrete following the sequences shown and the delay period specified in 00540.52.

Delay placement for the Superstructure until the column forms have been stripped sufficiently to determine the character of the column concrete. Ensure Superstructure loads are not carried by the bents or piers until the concrete has been in place and has attained the strength specified in 00540.52.

Stop placement for the bottom slab of box girder Structures at the bottom of beam stems or bottom of stem fillets. Before placing concrete in the stems, wait for a period not less than that specified in 00540.52.

Stop placement for T-beams and box girder stems at the bottom of the deck fillet. Before placing deck concrete, wait for a period not less than that specified in 00540.52.

(g) Bridge Decks - Use deck finishing machines conforming to 00540.24 and set to run parallel to the skew of the bent lines. Place screed rails outside the finishing area. Extend screed rails beyond both ends of the scheduled placement length for a distance that allows the finishing machine to reach all of the concrete.

For Bridges with continuous spans, ensure reinforcing steel is in place and tied in any adjacent span in the continuous Bridge segment before placing concrete.

Before placing concrete, operate the finishing machine the length of the proposed placement, and check the deck thickness and clearance from the screed to the reinforcing steel in the presence of the Engineer, by an approved method. The permissible variation from the clearance indicated will be plus or minus 1/4 inch. Make necessary corrections before beginning the placement.

Furnish transverse work Bridges according to 00540.29. Extend the screed rails beyond the start end to allow placement of all transverse work Bridges on the screed rails before placement of concrete begins.

Do not place bridge deck concrete until the Engineer is satisfied that the Contractor:

- Meets the requirements of 00540.41, 00540.45 through 00540.49, and 00540.52.
- Has the finishing machine and transverse work Bridges placed and ready on the screed rails.
- Is able to deliver concrete for decks so deck placement progresses at a rate of not less than 20 feet per hour.
- Proceeds up grade from the lowest deck elevation, unless otherwise shown.
- Is able to produce and place concrete at a rate sufficient to complete proposed placement and finishing operations within the specified time.
- Illuminates the work area during hours of darkness.
- Has experienced concrete finishers and necessary finishing tools and Equipment at the Project Site.
- Provides wind breaks, fog spray, or other approved methods when the concrete surface is exposed to conditions which may cause premature drying during placement operations.
- Has saturated the tops of precast prestressed concrete members and formwork by applying continuous water for a minimum of 2 hours immediately prior to beginning deck placement.

If delays occur lasting longer than 30 minutes, the Engineer may order construction of a bulkhead. If a bulkhead is constructed, do not begin further placement in that span or the adjacent falsework

span, if any, for at least 24 hours. Construct bulkheads only where shown or when directed by the Engineer.

00540.49 Weather Conditions for Concreting:

(a) All Concrete Placement:

(1) Hot Weather - Maintain the concrete temperature during hot weather as specified. When concrete temperatures approach the maximum allowable temperature according to 02001.20(d), take appropriate action to lower the concrete temperature.

Do not place concrete on or in forms if surface temperature of forms or reinforcing steel is 90 °F or above.

(2) Cold Weather:

a. General - Do not place concrete if the air temperature is, or is forecast to be, below 40 °F the Day of placement or is forecast to be below 40 °F on any of the next 7 Calendar Days (14 Calendar Days for decks) after placement, unless a Cold Weather Plan has been approved by the Engineer.

To place concrete when the temperature is below 40 °F, submit a Cold Weather Plan that identifies the methods that will be used to prevent the concrete temperature from falling below 50 °F. Methods include heated enclosures and insulated forms. Also include in the plan measures that will be taken if the concrete temperature falls below 50 °F. Provide a 24 hour continuous recording thermometer to verify the concrete temperature.

Keep the foundation, form surfaces and reinforcing steel free of frost and ice.

Ensure the temperature of the concrete is not less than 60 °F when placed in the forms. If air temperature is below 40 °F, heat mixing water to a temperature of at least 70 °F, but not more than 150 °F, or heat the Aggregates with either steam or dry heat. Ensure the temperature of concrete produced with heated Aggregate, heated water, or both does not exceed 80 °F before placing.

b. Enclosures - If enclosures are used, do the following:

- Furnish and use, within the enclosure, a 24-hour continuous temperature/humidity recorder to record the air temperature and relative humidity every hour during the cure period.
- Supply and maintain curing moisture and heat in the enclosure for 7 Calendar Days (14 Calendar Days for bridge decks) after placing concrete as follows:
  - Relative humidity of at least 40 percent.
  - Air temperature between 60 °F and 80 °F.

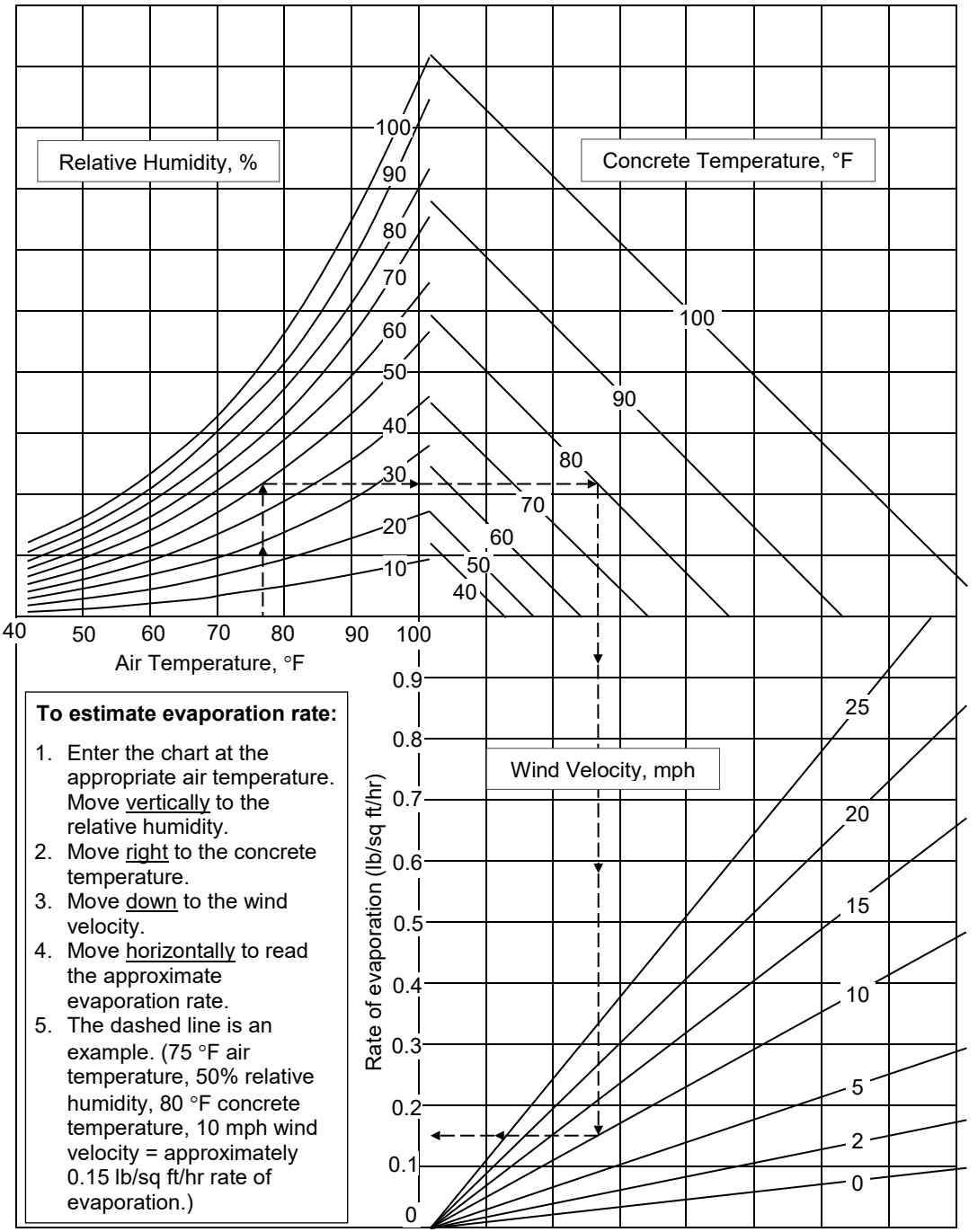
c. Insulated Forms - When approved by the Engineer, insulated forms, capable of maintaining the surface of the concrete at not less than 50 °F for a period of 7 Calendar Days (14 Calendar Days for bridge decks), may be used instead of enclosures and heating. If forms are insulated, protect exposed horizontal surfaces with a similar layer of insulating material securely fastened in place. If the insulated forms do not maintain the proper temperature at the concrete surface, use auxiliary protection, and provide additional heat and thermometer, as described in (b) above.

(b) Bridge Deck Placement - Place concrete for bridge decks:

- Only if precipitation is not forecast between 2 hours before and 2 hours after the scheduled placement duration. An acceptable forecast will have less than 30 percent chance of precipitation for the entire placement window. Provide, from an agreed upon weather forecast service, a forecast to the Engineer 1 hour before placement.

- Only if not raining and the combination of air temperature, relative humidity, concrete temperature and wind velocity produces an evaporation rate of less than 0.10 pounds per square foot of surface area per hour, according to Figure 00540-1, or
- Within an enclosure, according to 00540.49(a)(2)(b).

FIGURE 00540-1 SURFACE EVAPORATION FROM CONCRETE [1]



To estimate evaporation rate:

1. Enter the chart at the appropriate air temperature. Move vertically to the relative humidity.
2. Move right to the concrete temperature.
3. Move down to the wind velocity.
4. Move horizontally to read the approximate evaporation rate.
5. The dashed line is an example. (75 °F air temperature, 50% relative humidity, 80 °F concrete temperature, 10 mph wind velocity = approximately 0.15 lb/sq ft/hr rate of evaporation.)

[1] Based on ACI 305 R, "Hot Weathering Concreting"

00540.50 Bridge Deck Roadway and Sidewalk Finish:

(a) General - After the bridge deck roadway and sidewalk concrete is placed and consolidated, strike it off to lines, grades and Cross Sections shown.

(b) Deck Roadway Finish - After the deck roadway concrete has been screeded with a finishing machine conforming to 00540.24, float, if necessary, to produce a uniform surface, according to 00540.55. If the Work does not conform to the prescribed limits, stop the operation until revised methods, changes in Equipment, or correction of procedures are approved for trial. Also stop the revised operation if it does not produce a specified surface.

(c) Deck Roadway Texturing - After correcting any non-specification surface tolerance according to 00540.55, texture the deck roadway surface with a saw that cuts grooves into the bridge deck as follows:

- Cut grooves 1/8 inch wide and 1/8 inch to 3/16 inches deep.
- Space grooves randomly from 3/4 inch to 1 1/2 inches apart with a minimum of 12 grooves for every foot of deck surface. Measure groove spacing parallel to the roadway centerline.
- Orient the grooves perpendicular to the roadway centerline and full width of the Roadway except leave smooth strips 16 inches wide along each curb face. Do not overlap grooves.
- Do not groove within 6 inches of joint blockouts and bridge ends. For skewed Bridges, additional ungrooved portions at joint blockouts and bridge ends are allowed to accommodate the width of the gang saw.
- Continuously remove saw slurry and laitance from the sawing operation while cutting grooves.
- Cut grooves after the bridge deck has been checked for non-specification surface tolerances as required by 00540.55 and after the water cure is complete.
- Cut grooves no sooner than 14 days after the deck is cast. Cut grooves before opening the Roadway to traffic. For Structures constructed in stages, the Roadway may be opened to traffic before cutting grooves provided the time period from opening to actual construction of grooves is between June 1 and October 1.

(d) Deck Sidewalk Finish - After the deck sidewalk surface has been struck off with a strike board, float it with a wooden or cork float. Use an edging tool on edges and at expansion joints. Remove edging tool marks prior to final finishing. Apply a light broom texture to the surface.

00540.51 Curing Concrete:

(a) General Requirements - Cure cast-in-place concrete surfaces with water, wet burlap, and a layer of 4 mil polyethylene film, except polypropylene fabric may be used in place of wet burlap on horizontal surfaces. Begin curing as soon after placement as possible without damaging the freshly placed concrete. Continue curing for 7 Calendar Days (14 Calendar Days for bridge decks) after placement.

Keep surfaces not covered by waterproof forms damp by applying water with a fog nozzle until the surface has set sufficiently to allow sprinkling with water or covering with wet burlap or an approved wet or dry material.

Do not interrupt curing for more than 1 hour during the curing period.

If the ambient temperature falls below 50 °F, or is forecasted to be below 50 °F, provide a 24-hour continuous recording thermometer and place it directly on the surface of the concrete. Once placed, the thermometer shall remain in place for the duration of the cure period. Use methods

approved by the Engineer to maintain a concrete temperature of at least 50 °F during the cure period.

(b) Curing Concrete Bridge Decks - In addition to requirements of 00540.49, cure cast-in-place concrete bridge deck surfaces by doing the following:

- Provide wind breaks or other approved methods when exposed to conditions which may cause premature drying during placement operations. Premature drying is defined as an evaporation rate equal to or greater than 0.10 pounds per square foot per hour, as determined from Figure 00540-1, or as the loss of surface sheen when the evaporation rate at the surface exceeds the bleed rate.
- Provide high pressure washers, according to 00540.28, fitted with fog nozzles during all deck placements to prevent and control premature drying. Apply fog spray upwind of the concrete placement during finishing. The purpose of fogging is to maintain a layer of high humidity above the concrete surface in order to minimize water loss in the mix after placement and before application of cure. Do not allow larger water droplets that drip from nozzles to fall onto the freshly finished plastic concrete.
- Cover the concrete with a single layer of clean initial covering immediately after finishing. Apply initial covering no later than 20 minutes after final Pass of the finishing machine and no greater than 20 feet from the back of the finishing machine. Provide an initial covering with a minimum length sufficient to cover the bridge deck from side to side of the concrete placement. Use one of the following:
  - Saturated wet burlap having a minimum dry weight of 10 ounces per yard for material 40 inches wide. Presoak the burlap by immersing it completely in water for 72 hours prior to the deck placement and presoak new burlap with a wetting agent. Overlap the edges at least 6 inches.
  - Nonwoven, needle punched polypropylene fabric curing blanket from the QPL. Thoroughly wet fabric within 15 minutes of fabric placement. Overlap the edges at least 12 inches.
- Provide soaker hoses for additional soaking of the initial covering. Place over the full width of the concrete placement, at a maximum of 10 foot intervals. Do not allow initial wetting of burlap or fabric to dry before soaker hoses are in place and operational. Operate soaker hoses continuously to keep the initial covering saturated.
- Place a layer of 4 mil polyethylene film over the initial covering and soaker hoses. Provide clear or white polyethylene film if the air temperature is forecasted to be above 65 °F within 24 hours of the concrete placement, and black at other times, as determined by the Engineer. Overlap the edges of polyethylene film by 12 inches. Keep the film in place by taping and weighting the edges where they overlap or are vulnerable to movement by wind. Once a particular type of film has been placed, do not change it during the curing period.
- Maintain a continuous water cure of the concrete surface for 14 days.

(c) Additional Cure Time - If, during the cure time, the surrounding temperature falls below 45 °F, extend the cure for the number of hours the temperature is below 45 °F.

00540.52 Removal of Forms and Falsework, and Subsequent Loading - Do not remove forms and falsework or place subsequent loads without approval.

In determining when to remove forms and falsework, and when to place subsequent loads, the Engineer will consider the Contractor's proposed schedule, the location and character of the Structure, the weather, and other conditions influencing the setting of the concrete. If appropriate, these operations will be controlled by compressive strength tests of cylinders cast by the Contractor and witnessed by the Engineer. Test the cylinders at a recognized testing laboratory at no additional cost

to the Agency. Cast and cure cylinders according to AASHTO T 23 (field cured) which is equivalent to the most unfavorable field conditions for the portions of the concrete which the cylinders represent.

Forms and falsework may be removed and subsequent loads may be placed when both conditions of Table 00540-1 are met.

Table 00540-1

Part 1:

Form and Falsework Removal for:	**Percent of Specified Strength**	**Counting Days [1]**
Side form for footings, walls, stems, abutments, caps, traffic and pedestrian barriers, and any other side forms not supporting the concrete weight	–	1
Columns	–	3
Cantilevered bridge deck sidewalks	–	7
Bridge decks supported on steel beams or precast, prestressed concrete members; top slabs of concrete box culverts	80	7
Crossbeams, caps, box girders, T-beam girders, and flat slab Superstructures [2]	80	7
Arches [2]	80	7

Part 2:

Subsequent Loading [3] of:	**Percent of Specified Strength**	**Counting Days [1]**
Footings for signal, luminaire and sign supports	100	7
Footings [4]	–	3
Walls, wall-type abutments, columns, vertical girder stems, and box culvert stems over 4 feet in height [4]	–	3
Bottom slabs of box girders	66	5
Members and falsework designed integrally to carry the additional loads	100	7
Pile caps, bents, and other members designed as moment-carrying members	100	7
All other members	100	7

[1] From the time of the last placement in the forms or falsework supports and excluding days when the surrounding temperature is below 40 °F for a total of 4 hours or more.

[2] Where continuous spans are involved, the time for all spans will be determined by the last concrete placed affecting any span.

[3] Except loads from forms and reinforcing steel of further concrete placements.

[4] Mass type or other type members where subsequent loading will not induce flexural bending and flexural stresses.

Early removal of forms does not eliminate the curing requirement of 00540.51.

Remove forms and falsework:

- With methods not likely to deface, damage, or cause overstressing of the concrete.
- In a manner that permits the concrete to uniformly and gradually take the stresses due to its own weight.
- From the interior of structural steel box girders.
- From accessible concrete box girder cells before any loading, post-tensioning or removal of the supporting falsework.
- From all decks after subsequent loading is authorized, except those necessary to support the deck slab in inaccessible cells.

Dispose of forms and falsework according to 00290.20(c).

00540.53 Surface Finish Other Than Bridge Decks - Provide concrete surfaces with a general surface finish unless otherwise shown or specified. See 00540.50 for bridge deck and sidewalk surface finishing. Leave concrete surfaces unfinished as they come from the forms when exposed to salt water between the levels of extreme low and high water, except for needed repairs.

If a Class 1 or Class 2 surface finish is required, it will not include the interior sides of girders and the underside of decks between girders. Finish Class 1 and Class 2 surfaces to a point 1 foot below finished ground line.

(a) General Surface Finish - Give all concrete surfaces a general surface finish prior to the higher class finish specified for a particular item of Work. A general surface finish consists of the following:

(1) On All Surfaces:

- Remove form bolts and metal to a depth of 1 inch, 2 inches on Structures within 25 aerial miles of the Pacific Ocean.
- Remove Rock pockets and unsound concrete.
- Fill holes and depressions at least 1/4 inch in depth or diameter with an approved PCC repair material.

(2) On All Exposed Surfaces:

- Correct bulges, fins, depressions, stains, discolorations and other imperfections.
- Slope formed surfaces with respect to the specified plane at a rate not to exceed the following amounts in 10 feet, if required:
  - Watertight joints: 1/8 inch
  - Other exposed surfaces: 1 1/2 inch
  - Concealed surfaces: 1 inch
- Slope unformed, exposed surfaces, other than Pavements and sidewalks, with respect to the specified plane at a rate not to exceed the following, if required:

- In 10 feet: 1/4 inch
- In 20 feet: 3/8 inch

The Engineer will determine the extent of the required repairs.

(b) Class 1 Surface Finish (Ground, Sacked, and Coated) - After completion of the general surface finish, grind the surface with a power grinder or an equivalent method to remove laitance and surface film. Sack the surface to fill all holes using a paste of fine mortar sand, cement, water, and bonding agent. The ratio of bonding agent to water shall be one part bonding agent to two parts water, or as recommended by the manufacturer. Apply coating according to 00540.53(d).

(c) Class 2 Surface Finish (Ground, Floated and Coated or Uncoated) - After completion of the general surface finish, grind the surface with a power grinder or an equivalent method to remove laitance and surface film. Float the surface with a rubber or sponge float, using a paste of fine mortar sand, cement, water, and bonding agent to fill air holes or voids and to bring the surface to a uniform texture. Keep the retextured surface damp a minimum of 12 hours or until the paste has set, whichever is longer. If dusting occurs after the retextured surface sets and is rubbed, refinish the surface.

After the paste has set for a minimum of 24 hours, apply coating according to (d) below.

(d) Concrete Coating - Apply either a concrete paint or a concrete stain or sealer as shown or specified. Where a Class 1 or Class 2 surface finish is shown, apply a concrete paint unless specified or shown otherwise.

(1) Concrete Paint - Thoroughly saturate the surface with water and coat it, while damp, with a coating material conforming to 02210.30. Apply a minimum of two coats of coating material. Apply coating according to the manufacturer's instructions. The second coat may be applied any time after the previous coat, when touched lightly, does not adhere to the finger. Additional coats may be required to provide uniformity in coverage and color. Mortar sand may be added to the coating material to help achieve a uniform surface.

(2) Penetrating Concrete Stain or Sealer - Select a penetrating concrete stain or sealer from the QPL. Apply stain or sealer to a dry concrete surface and according to the manufacturer's instructions. Ensure the concrete has cured sufficiently. Apply a minimum of two coats of stain or sealer. Additional coats may be required to provide uniformity in coverage and color.

00540.54 Crack Inspection and Deck Sealing - Before allowing Public Traffic across the Bridge, the Engineer will inspect the deck and end panels for cracks.

After correcting non-specification surface tolerance according to 00540.55 and after texturing the deck surface according to 00540.50(c), seal all visible cracks as follows:

- In areas where cracks are 10 feet or more apart, seal each crack separately.
- In areas where the cracks are numerous or are less than 10 feet apart, seal the entire area where the cracks occur.

Seal with a low modulus concrete and crack sealer.

Perform crack sealing Work at no additional cost to the Agency. Complete all crack sealing Work before opening to traffic. If the Bridge is opened to traffic at the Contractor's request before completing crack sealing, all additional traffic control to complete crack sealing will be at no additional cost to the Agency.

00540.55 Final Acceptance of Bridge Deck Surface - Ensure the finished bridge deck roadway surface meets the tolerance specified in 00540.40(b)(3)(d) at every point. Furnish a 12-foot straightedge and use it under the Engineer's direction.

Correct non-specification surface tolerances by complete removal and replacement or with a diamond grinder. If the surface is ground, take care not to unnecessarily sacrifice concrete cover over the reinforcing bars. Restore transverse texture to specification tolerance. Perform correction Work, including required traffic control, at no additional cost to the Agency.

Measurement

00540.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Concrete - Concrete will be measured by one of the following methods:

(1) Lump Sum - Under this method, no measurement will be made. Estimated quantities of concrete will be listed in the Special Provisions.

Concrete quantities listed for cast-in-place deck is based on the nominal deck thickness shown.

Concrete quantities for prestressed, precast members, piling, bridge rail, slope paving, tremie seals and other similar items will not be included in the listed quantities.

(2) Volume - Under this method, concrete will be measured on the volume basis within the Neat Lines of the Structure as shown.

No deductions will be made for the volume of pile heads, metal reinforcement, scoring, chamfer strips or structural steel embedded in the concrete.

(b) Saw Cut Texturing - The quantities of surface texturing will be measured on the area basis and will be the area of each bridge deck or end panel shown less 16 inches along each curb. Field measurement of surface texturing will not be made.

Payment

00540.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Foundation Concrete, Class ____	Lump Sum or Cubic Yard
(b)	Deck Concrete, Class ____	Lump Sum or Cubic Yard
(c)	General Structural Concrete, Class ____	Lump Sum or Cubic Yard
(d)	Saw Cut Texturing	Square Yard

In items (a), (b), and (c), the class of concrete will be inserted in the blank.

Item (a) includes footings, pile caps, and all other elements so designated.

Item (b) includes bridge decks and all other elements so designated.

Item (c) includes columns, crossbeams, diaphragms, wing walls, backwalls, abutments, and all elements that are not designated as either (a) or (b) above.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Reinforcing steel, metal expansion joints, or other metal incorporated in the Work will be paid for according to the appropriate Section in which the Work is required.

No separate or additional payment will be made for:

- surface finish, fogging, curing, joint filler, admixtures and other similar items, and for all other items required to complete the concrete Work
- portland cement and fly ash used in excess of the minimum specified
- extra concrete required to fill footings cast directly against Rock or Soil or where forms are omitted
- additional concrete placed in deck buildups on top of beams to achieve the desired deck elevations

Section 00545 - Reinforced Concrete Bridge End Panels

Description

00545.00 Scope - This Work consists of constructing reinforced portland cement concrete bridge end panels at the locations shown or as directed, and in close conformity to the lines, grades and dimensions shown or established.

Materials

00545.10 Materials - Furnish Materials meeting the requirements of Section 00530 and Section 02001, modified as follows:

- Furnish Class HPC4500 concrete for end panels, unless shown otherwise.
- When pipe under end panels are shown, provide one of following types:
  - Class V reinforced concrete pipe meeting the requirements of 02410.10(g)
  - Schedule 80 polyvinyl chloride (PVC) pipe meeting the requirements of ASTM D1785
  - Type PSM polyvinyl chloride (PVC) sewer pipe meeting the requirements of ASTM D3034 SDR 26
  - Grade A or B galvanized steel pipe, STD weight class minimum, meeting the requirements of ASTM A53, hot-dip galvanized according to AASHTO M 111 (ASTM A123)
- For pipe under end panels, provide pipe bedding, pipe zone material, and backfill meeting the requirements of 00405.12, 00405.13, and 00405.14.
- Provide granular structure backfill meeting the requirements of 00510.13.

00545.15 Quality Control - Provide quality control according to Section 00165.

Labor

00545.30 Quality Control Personnel - Provide technicians having CEBT, CDT, and CSTT technical certifications.

Construction

00545.40 General - Perform Work according to Section 00530 and Section 00540 except as modified by this Section.

00545.41 Earthwork - Remove Pavement and Subgrade according to Section 00310 and Section 00330.

00545.42 Surface Finish - For end panels with an asphalt concrete wearing surface, a finishing machine and roadway texturing are not required. For end panels without an asphalt concrete wearing surface, texture the end panel roadway surface by saw cutting according to 00540.50(c). Perform saw cutting on end panels no sooner than 14 days after the end panels are cast.

00545.43 Curing - Cure concrete according to 00540.51(a).

00545.44 Expansion Joints - Construct expansion joints as shown, according to Section 00585, and as follows:

- Install armored corners for strip seal joints in preformed blockouts a minimum of 14 days after the bridge deck and end panels are cast. Set the joint opening as shown. Support the armored corners securely in position before placing concrete in the joint blockout.
- Place compression joint seals or poured sealant joint seals a minimum of 14 days after the bridge deck and end panels are cast.
- Place asphaltic plug joints a minimum of 14 days after the end panels are cast and after final paving is complete.

00545.45 Pipes under End Panels - Install pipes under end panels for future utilities as shown and according to Section 00445.

00545.46 AC Paving - Compact AC abutting end panels according to Section 00744 and Section 00745, as applicable.

00545.47 Bridge Rails - Construct bridge rails on end panels as shown and according to Section 00587.

Measurement

00545.80 Measurement - The quantities of reinforced concrete bridge end panels will be measured on the area basis. The area will be determined by surface measurement of the width and length of each separately constructed end panel.

Surface texturing by saw cutting will be measured according to 00540.80.

Expansion joints at panel ends will be measured according to 00585.80.

Bridge rails on end panels will be measured according to 00587.80.

Payment

00545.90 Payment - The accepted quantities of reinforced concrete bridge end panels will be paid for at the Contract unit price, per square yard, for the item "Reinforced Concrete Bridge End Panels".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Surface texturing by saw cutting will be paid for according to 00540.90.

Expansion joints at panel ends will be paid for according to 00585.90

Bridge rails on end panels will be paid for according to 00587.90.

No separate or additional payment will be made for:

- saw cutting and filling the joint in the wearing surface at the roadway end
- furnishing and placing pipe under the end panels for future utilities
- extra thickness of panels as shown at the panel ends
- required stage construction, including splices

Section 00550 - Precast Prestressed Concrete Members

Description

00550.00 Scope - This Work consists of the manufacture, storage, transportation and installation of precast prestressed concrete girders, box girders, slabs or other concrete members. Precast prestressed concrete members in this Specification will be referred to as members.

00550.02 Design - Essential elements of design and section dimensions for members are as shown. Submit unstamped Working Drawings, stressing calculations, and detensioning sequence for all members for approval according to 00150.35.

00550.03 Alternate Designs - Agency design specifications will be furnished by the Agency upon request. The Contractor may propose another type of prestressing system or different member dimensions provided the following requirements are met:

- Before manufacturing the members, submit stamped design calculations, Working Drawings, and specifications for all modified members according to 00150.35.
- With the calculations, show that the member meets all applicable service and strength limit states used for the Agency design.
- Do not increase member dimensions by more than 1 inch, except that bulb width and overall depth may be increased up to 2 inches from the dimensions shown. Where overall depth is increased, verify that the required minimum vertical roadway clearance has been maintained.
- Do not incorporate alternate materials or members into the Work until the proposal has been accepted by the Engineer.
- Make any structural changes required to accommodate an approved alternate prestressing system or section at no additional cost to the Agency.

00550.04 Member Tolerances:

(a) General - Fabricate members to the dimensional tolerances in the PCI *Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products* and as specified below. Acceptance or rejection of members outside these tolerances will depend on how the Structure's strength, rideability and appearance are affected.

(b) Twist - Provide members with a relative twist of member bearing surfaces between member ends of less than or equal to 1/16 inch per foot of bearing width measured at right angles to the centerline of the member.

00550.05 Fabricator Certification and Qualification - Certification under the PCI Plant Certification Program is required for all plants producing precast prestressed concrete bridge members. Certification in Bridge Group B3 or Bridge Group B4 is mandatory for the fabrication of prestressed straight strand bridge members. Certification in Bridge Group B4 is mandatory for the fabrication of prestressed draped strand bridge members.

Materials

00550.11 Materials - Furnish Materials meeting the following requirements:

Backer Rod	02440.14
Concrete Coating	02210
Concrete	02001
Deformed Bar Reinforcement	02510.10
Epoxy and Non-Epoxy Grouts	02080
Epoxy Coating	02510.11
Keyway Grout	02080.30
Portland Cement Concrete Repair Material	02015
Hot Applied Joint Sealant	02440.30
Prestressing Reinforcement	02515
Tie Rods	02560.30

00550.12 Acceptance of Concrete - Acceptance of concrete will be according to Section 00165 and the following:

(a) Aggregate - Acceptance of Aggregate will be based on the Contractor's quality control testing, if verified, according to Section 00165.

(b) Plastic Concrete - Acceptance of plastic concrete will be based on tests performed by the QCT, according to Section 02001.

(c) Hardened Concrete:

(1) General - Acceptance of hardened concrete will be based on analysis of compressive strength test results of cylinders cast and cured by the Contractor and tested according to AASHTO T 22 by a CSTT at an ODOT certified laboratory and verified according to Section 00165.

(2) Sampling and Testing - Obtain a sample from a delivery vehicle, selected at random, during placement in each bed. Test the sample for temperature, slump, density and air content and cast at least three cylinders for testing at 28 days. Cure the cylinders in a manner similar to the members they represent. Alternately, the cylinders may be cured in a curing chamber correlated in temperature with the concrete in the beds. Leave the cylinders in the bed with the member or in the curing chamber until the member is stripped. After the member is stripped, place the acceptance cylinders in storage in a moist condition according to AASHTO T 23.

(3) Acceptance - Hardened concrete members with an ASTV meeting or exceeding the specified design strength, f'_c, will be acceptable for strength.

If the ASTV is less than f'_c but at least 85 percent of f'_c, the Engineer may review the results to determine if the member is suitable for the intended purpose. If suitable, the concrete represented by an ASTV less than f'_c may be accepted subject to a price adjustment according to 00150.25.

Concrete that has an ASTV less than 85 percent of f'_c will not be accepted. All costs of removal, replacement, and all related Work are the Contractor's responsibility.

Equipment

00550.20 Prestressing Equipment - Provide hydraulic jacks equipped with calibrated pressure gauges. Calibrate the jack and gauge combination and furnish a graph or table showing the calibration to the Engineer.

If other types of jacks are used, furnish calibrated proving rings or other devices that accurately indicate the jacking forces.

Recalibrate the jack and gauge combination annually or at any time the results are in question.

00550.25 Vibrators - Provide either internal or external vibrators in working condition meeting the manufacturer's rating.

When epoxy coated reinforcement is used, use internal vibrators fitted with a manufactured rubber head to minimize damage to the epoxy coating.

Construction

00550.40 Forming - Provide forms that are mortar-tight and sufficiently rigid to conform to the specified dimensions without appreciable distortion, warping or opening of joints.

Before placing concrete in the forms, remove all dirt, sawdust, excess water and other foreign material.

Tighten forms before depositing new concrete on or against hardened concrete.

00550.41 Placing Reinforcement - Place reinforcement according to the Plans, Section 00530, and the Specifications.

00550.42 Pretensioning:

- Do not proceed with stressing prior to receiving the Engineer's approval of stressing calculations submitted according to 00550.02.
- Provide a person, skilled in the use of the system of prestressing to be used, to supervise the Work and assist the Engineer.
- Hold the prestressing strands accurately in position and stress by jacks meeting the requirements of 00550.20.
- Determine the force induced in the strands by measurement of elongation and, independently, by direct measurement of force using a pressure gauge dynamometer and load cell. If the difference in force determination for the two methods exceeds 5 percent, determine the cause and correct it.
- Measure strand elongation on the first and last strands stressed, and on at least 10 percent of the other strands in the bed.
- Record the jacking forces and the elongations produced.
- In single straight strand tensioning, and in a completely open bed with no headers or other possible sources of friction, loads indicated by the gauging system may be used.

00550.43 Placing Concrete:

(a) General - Place concrete so that the finished members are uniform and monolithic, free from cold joints.

Do not deposit concrete in the forms until the Engineer has inspected and approved the placement of reinforcement, conduit, anchorages and prestressing steel.

In preparation for placing concrete, prepare forms according to 00550.40. Remove struts, stays and braces serving temporarily to hold the forms in correct shape and alignment before the placing of concrete when the concrete placing has reached an elevation rendering them unnecessary. Remove these temporary members entirely from the forms and do not bury them in the concrete.

Place concrete close to its final position, without segregation of materials or displacement of the reinforcement.

(b) Consolidation - Consolidate concrete, during and immediately after placing, by mechanical vibration as follows:

- Operate vibrators at frequencies that produce consolidated placements.
- Do not use vibration for shifting concrete to the extent of causing segregation.
- Vibrate at points uniformly spaced and not further than twice the radius over which vibration is visibly effective.
- Continue vibration until the concrete is thoroughly consolidated, but not until segregation occurs or localized areas of grout form.

00550.44 Hot or Cold Weather - Produce and place concrete within the temperature range specified in 02001.20(d). When the air temperature is, or is expected to be, below 40 °F or above 100 °F, observe the following precautions:

- Do not place concrete on forms, reinforcing steel or appurtenances when the temperature of these facilities is below 40 °F. Provide heat to maintain their temperature at 40 °F minimum.
- Do not place concrete when the form temperature is 100 °F or more.

00550.45 Curing - Cure members with low-pressure steam or radiant heat inside a suitable enclosure to contain the steam or heat, and minimize moisture and heat loss.

(a) Curing Temperature - Measure cure temperature by one of the two following methods:

(1) Measuring Enclosure Temperature:

- Equip the enclosure with 24-hour recording thermometers at each end of each casting bed. Record the temperature for each thermometer on a single chart for each 24-hour period.
- Do not allow the curing temperature within the enclosure to exceed 160 °F. During the initial application of live steam or radiant heat, do not allow the temperature within the enclosure to increase at a rate exceeding 40 °F per hour.

(2) Measuring Concrete Temperature:

- Embed a thermocouple 6 inches to 8 inches from the top or bottom of the member on its centerline and near its midpoint.
- Record the concrete temperature with a calibrated recorder that provides a continuous record of time and temperature throughout the curing cycle.
- Do not allow the concrete temperature to exceed 190 °F. During the initial application of steam or radiant heat, do not allow the concrete temperature to increase at a rate exceeding 80 °F per hour.

(b) Curing with Low-Pressure Steam:

- Make the initial application of steam after initial set of concrete as determined by AASHTO T 197 (ASTM C403).
- Provide a steam supply line to the enclosure equipped with a motor-operated modulating steam control valve operated by a temperature-sensing element located in the enclosure.
- Provide steam at 100 percent relative humidity.
- Do not apply steam directly on the concrete, form surfaces or test cylinders.
- Distribute the steam within the enclosure through suitable ports located on each side of the units within the enclosure at not more than 30 foot centers to keep the units being cured completely and uniformly surrounded with steam.

(c) Curing with Radiant Heat - Radiant heat may be applied to beds by means of pipes circulating steam, hot oil or hot water, by electric blankets or heating elements adjacent to forms, or by circulating warm air under and around forms. Do not allow pipes, blankets or heating elements to be in contact with concrete, form surfaces, or test cylinders.

00550.46 Release of Prestress - Transfer bond stress to the concrete, or release end anchors, only when the concrete has attained the minimum compressive strength shown or specified for such transfer of load. Cut or release the elements according to the sequence shown on the reviewed Working Drawings so lateral eccentricity of prestress will be a minimum.

Determine the compressive strength of the concrete to establish time for detensioning by testing standard cylinders cast and cured identically with the member. Cast and test cylinders used to determine release time according to AASHTO T 22 and AASHTO T 23.

00550.47 Surface Finish - Apply the specified finish to each surface as shown or specified.

Where no finish is shown or specified, provide a Class 1 surface finish to all exposed concrete surfaces, except on the tops of members, unless shown otherwise. For concrete surfaces that are not exposed, provide a general surface finish except on the tops of members. For surfaces receiving a Class 1 surface finish (ground and coated), finish the surfaces when the member is in its final position and finish to a point 1 foot below the finished ground line.

After the concrete has been floated to produce a uniform surface and hardened sufficiently, provide a uniform textured finish on the top of members using a tool with 1/8 inch wide tines spaced 3/4 inch apart that will mark the finished surface to a depth of 1/8 inch to 3/16 inch. Do not overlap the texturing. Produce the texture transverse to the roadway centerline and full member width. In addition for members with an overlay less than 3 inches thick, struck the concrete to grade and Cross Section and provide a uniform surface according to 00540.55.

For the top of members used as a roadway surface, strike the concrete to grade and Cross Section and float it to produce a uniform smooth surface according to 00540.55. After the members are erected in the final position, provide deck roadway finish as shown. If not shown, provide deck roadway texturing according to 00540.50(c).

(a) General Surface Finish - Apply a general surface finish as a final finish or preparatory to a higher class finish.

Remove strands in members, except members with ends to be embedded in concrete, to a depth of 1 inch from the face of the concrete and point up the resulting holes flush with the end of the member with an epoxy grout from the QPL.

Remove all metal form bolts, snap ties and any other metal to a depth of 1 inch below the finished concrete surface. Repair air pockets over 1/2 inch in depth, all form tie removals, Rock pockets and unsound concrete, and fill resulting holes or depressions with concrete or PCC repair material. On exposed surfaces, correct all bulges, fins, depressions, repairs, stains or discolorations to produce a smooth surface with uniform texture, lines, and appearance.

The Engineer will determine the extent of required repairs.

(b) Class 1 Surface Finish (Ground and Coated) - After completion of the general surface finish:

- Grind the surface with a power grinder or other equal method to remove all laitance and surface film.
- Thoroughly saturate the surface with water and coat while damp with a coating material conforming to 02210.30.
- Apply a minimum of two coats of coating material. The second coat may be applied at any time after the previous coat does not adhere to the finger. Apply additional coats as required to provide uniformity in coverage and color.
- Mortar sand may be added to the coating material to achieve a uniform surface.

00550.48 Exposed Reinforcement - After a member is removed from the casting bed, clean any projecting reinforcement of dirt, oil, grease, rust and corrosives and protect it from damage until concrete is cast around it.

00550.49 Lifting, Storing, Transporting, Erecting, and Bracing - Be responsible for the safety of precast members during all stages of construction. Include lifting and storage details on the Working Drawings for all precast members. Lifting, storage, transporting, erecting, and bracing details will not be reviewed by the Engineer. Lifting, storage, transporting, erecting and bracing of members is the sole responsibility of the Contractor subject to the following requirements:

(a) Lifting:

- Lift members so as to prevent damage.
- Lift members at the support points specified by the manufacturer.
- Lift members in a manner that does not cause damaging bending or torsional forces.
- Members will be rejected if not handled correctly as specified.

(b) Storing - Store members with support points that are level transversely.

(c) Transporting - Transport members from the casting yard not less than 7 Calendar Days after casting, not less than 7 days after all concrete patching and repairing is complete and after 28-Day compressive strengths have been achieved.

- Temporary prestress strands may be added to precast concrete members for the purpose of controlling concrete stresses during transportation. Detension these strands after the members are set in the field and prior to establishing grades for the bottom of deck forms.
- Temporary strands may be either post-tensioned or pretensioned in the fabrication yard. Debond post-tensioned strands completely from end to end. Debond pretensioned strands completely from end to end except for a length at the end of the beam equal to the development length of the strand, but not more than 10 feet. Pretensioned strands may be used for simple span girders only.
- The stress from temporary strands may be transferred to the concrete member only after the stress from the permanent strands has been transferred to the concrete member. This

requirement may be waived for pretensioned strands if calculations are submitted, and approved by the Engineer, that show acceptable stress levels in the member.

- For pretensioned temporary strands, form a hole in the girder at mid-span or at each end of the debonded length, so the strand can be cut for detensioning. Ensure these holes are free-draining and patched after detensioning. The detensioned strands may be left in place.
- Post-tensioned temporary strands may be placed in a conduit or debonded full length with direct contact sheathing. In either case, patch the holes formed by the conduit or sheathing to a depth of 1 1/2 inch, after the removal of the conduit or sheathing to this same depth. The detensioned strands may be left in place.
- Submit stamped calculations that predict the effect of temporary strands on initial and long term girder Camber according to 00150.35.

Damaged members will be rejected. Replace damaged members, or if allowed by the Engineer, repair damaged members to the Engineer's satisfaction at no additional cost to the Agency.

(d) Erecting and Bracing - After a member has been erected and until it is secured to the Structure, provide temporary bracing as necessary to resist wind or other loads. Provide the Engineer with an erection plan and bracing details at least 2 days prior to erecting girders. Bracing details are not necessary for side-by-side slab and box beam construction.

00550.50 Tie Rods - Furnish tie rods according to the Plans and Section 02560. Install as follows:

- Clean and lubricate tie rods and nuts before installation.
- Lubricate galvanized tie rods and nuts with a lubricant from the QPL containing dye that visibly contrasts with the color of galvanizing or coating.
- Install compressible washer type direct tension indicators under the turned nuts and tighten the nuts as recommended by the manufacturer until the gaps in the indicators are nil or as shown. A nil gap is defined as a gap when the number of spaces between the protrusions of a direct tension indicator in which the 0.005 inch feeler gauge is refused at each tie rod equals or exceeds 2, 3, 3, 4, or 4, when the number of spaces between protrusions in the direct tension indicator are 4, 5, 6, 7, or 8, respectively, and a visible gap exists in at least one space.

00550.51 Keyway Grouting for Slabs, Box Beams, and Integral Deck Members - After forms have been removed from slabs, box beams and integral deck bulb tees, sandblast all keyways to remove residual form oil and any other foreign material. After the members are in place and the tie rods are tensioned (for slabs and box beams) or welded connections are made (integral deck bulb tee girders), clean the keyways of all foreign material and keep moist for 24 hours before grouting. For slabs and box beams, after the tie rods are tensioned, seal the space remaining at the bottom of the keyways with a backer rod as shown before grouting.

Do not pour keyway grout unless the air temperature is above 45 °F and at or below the maximum air temperature recommended by the manufacturer. Water cure grout for the period of time indicated by the manufacturer.

00550.52 Hot Applied Joint Sealant for Integral Deck Members with AC Wearing Surface - After grout is poured to the level of the keyway shown for slabs and box beams, remove loose grout, and other foreign material from exposed keyway walls. After keyway grout is fully cured, dry surfaces to be sealed immediately before installing hot applied joint sealant.

Install hot applied joint sealant according to the manufacturer's directions. Cure the filler sufficiently to resist the pressures and temperatures of the paving operation before the wearing surface is placed.

00550.53 Differential Camber Correction for Integral Deck Members with No Asphalt Concrete Wearing Surface - Correct differential Camber between adjacent slabs, box beams or integral deck bulb tees in a span (measured in place at the site) if the variance between adjacent members or stages is 1/2 inch or more at any place along the top edge corners.

Equalize the Camber differences by either patching with an epoxy or non-epoxy grout or other approved method, at no additional cost to the Agency. Before patching, clean the area by sandblasting. Water cure the patch for the period of time indicated by the manufacturer. If patching is used, slope it away from the joint on a 1V:6H Slope or flatter.

Measurement

00550.80 Measurement - The quantities of Work performed under this Section will be measured on the length basis, and will be the sum of the horizontal lengths shown for each type and size of member. Field measurement of each member length will not be made. The quantities will be determined by calculating the theoretical horizontal length shown, added together for a total for each type and size.

Payment

00550.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	____ Precast Prestressed Girders	Foot
(b)	____ Precast Prestressed Slabs	Foot
(c)	____ Precast Prestressed Box Beams	Foot

In item (a), the girder type and depth will be inserted in the blank.

In item (b), the slab depth will be inserted in the blank.

In item (c), the box beam depth will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- reinforcement, prestressing steel, enclosures for post-tensioning steel, anchorages, plates, nuts, and all other Material contained within the member
- furnishing, transporting, and placing members
- furnishing and tensioning rods and pretensioning strands
- grouting keyways and installing poured joint filler
- furnishing and installing metal diaphragms for integral deck bulb tees
- furnishing and placing anchor bolts, dowels and diaphragm threaded rods where applicable
- furnishing and installing plain elastomeric bearing pads
- surface finish on members

Section 00555 - Post-Tensioning

Description

00555.00 Scope - This Work consists of post-tensioning cast-in-place and precast concrete by furnishing, placing and tensioning stressing steel according to details shown and specified. This Work also includes furnishing and installing any items necessary for the stressing system used including, but not limited to, anchorage assemblies, ducts and grout for pressure grouting. Concrete that is to be stressed by the post-tensioning method will be referred to as a member.

00555.03 Anchorage Devices - Secure all post-tensioned stressing steel at the ends by means of approved permanent type anchorage devices. Design anchorage devices according to the current AASHTO *LRFD Bridge Design Specifications*. Identify post-tensioning anchorage systems as either "Normal Anchorage Devices" or "Special Anchorage Devices" as defined in the AASHTO *LRFD Bridge Design Specifications*. Provide anchorage devices that meet all testing and construction requirements of the AASHTO LRFD Bridge Design Specifications and the AASHTO *LRFD Bridge Construction Specifications*. Equip all anchorages with a permanent fiber reinforced plastic grout cap that encloses the whole wedge plate. Provide a grout cap that is vented, bolted to the anchorage and rated for a minimum pressure of 145 psi. Seal the group cap to the anchor plate using either a neoprene gasket or epoxy bonding agent.

For bearing plates, provide 7 inch minimum edge distance from the top of deck and 2 inch minimum edge distance from expansion joint blockouts and any other concrete edge.

Install 3 piece anchor wedges in all permanent post-tensioning applications.

Materials

00555.10 Materials - Furnish Materials meeting the following requirements:

Anchorage Devices ..... 02530 and 02540
Couplings 02515.60
Tendon Duct 02515.50

00555.11 Stressing Steel - Furnish stressing steel according to one of the following as the Contractor may elect, unless otherwise shown or specified:

Seven-Wire Strand 02515.10
High Strength Steel Bars 02515.30
Seven-wire strand epoxy coated reinforcement 02515.40

00555.12 Tendon Grout - For grouting post-tensioning ducts, furnish a commercial, pre-packaged, thixotropic tendon grout meeting the requirements of 02080.50. Label each grout bag with application, mixing and pumping instructions, lot number, date of manufacture and shelf life. A grout expiration date may be used in lieu of the date of manufacture and shelf life. Tendon grout will be rejected if the shelf life or expiration date has been exceeded.

Use water meeting the requirements of Section 02020.

At least 48 hours prior to the trial batch, submit a detailed written mix design showing the exact brand and batch quantities of pre-packaged grout and water including dosages proposed.

00555.13 Tendon Grout Trial Batch - Mix a trial batch of grout using the Equipment, materials, proportions, and grouting crew proposed for use on the Project. Mix a trial batch of grout for each separate tendon grout lot number. If the duration between grouting stages is greater than 14 Calendar

Days, a new trial batch is required. If the proposed grout mix design does not produce acceptable trial batch results, revise the mix design and perform another trial batch. Results from previous projects will not be considered acceptable documentation. Grouting may proceed any time after approval of the trial batch.

Perform the following tests:

(a) Flow Cone - Determine the efflux time at 0 quiescent time according to ASTM C939 modified as follows:

- Fill the flow cone to the top of the cone.
- When thoroughly mixed, the efflux time of grout will be the time to fill a 1 Liter container that is placed directly under the flow cone. Ensure the efflux time of the grout immediately after mixing is between 5 and 30 seconds.
- Let the grout stand for 30 minutes without agitation then retest as follows:
  - Remix for 30 seconds.
  - Ensure the efflux time of the grout immediately after remixing is within 10 seconds of the originally established flow.

(b) Bleed - Determine bleed resistance according to ASTM C1741 and the PTI "Specification for Grouting of Post-Tensioned Structures M55.1", modified as follows:

Vertical Rise, X (ft)	Gelman Pressure (psi)	Maximum % Bleed (% of sample volumes)
$0 \leq X \leq 20$	50	0
$X > 20$	100	0

(c) Mud Balance - Determine a wet density value for mud balance comparative testing during grouting operations according to API RP 13B-1 (American Petroleum Institute).

(d) Compressive Strength - Determine compressive strengths according to ASTM C109. Sample 2 sets of 3 cubes at least once for each trial batch. Provide the test results to the Engineer for 7 and 28-Day testing.

Equipment

00555.20 Certified Calibrated Jacking Equipment - Equip each jack used to stress tendons with either:

- A pressure gauge with an accurate reading dial at least 6 inches in diameter and of such capacity that the final pressure reading is in the upper half of its range. Calibrate each jack and its gauge as a unit with the cylinder extension in the approximate position that it will be at final jacking force, and provide a calibration chart certified by an independent testing agency; or
- A certified, calibrated load cell with an indicator by which the stressing force in the tendon may be determined, and with a range such that the lower 10 percent of the manufacturer's rated capacity will not be used in determining the jacking stress.

Adjustment or repair of jacks, gauges, or load cell after certification will be cause for rejection.

The calibration charts for the hydraulic jacks, pressure gauges or load cells used for tensioning stressing steel may be checked before and during tensioning operations by Agency personnel with Agency-furnished load cells. Perform certified calibration of stressing system not more than 180 days before use.

00555.21 Grouting Equipment - Provide grouting Equipment with:

- Separate motors or engines for the grout mixer and the grout pump, and a system for controlling each independent of the other.
- A high speed, high shear, colloidal mechanical grout mixer that will produce uniform and thoroughly mixed tendon grout.
- Equipment which will accurately measure solids and liquids to be batched.
- An easily accessible filter screen before the grout pump with clear openings of 1/8 inch maximum size.
- A grout pump capable of producing a minimum pressure of 75 psi, with a pressure gauge reading from 0 to 300 psi, and with a relief valve that will limit grouting pressures to less than 200 psi.
- Watertight grout hoses, valves and pipe fittings.

Provide standby water flushing Equipment which:

- Is in addition to and separate from the grouting Equipment
- Has a different power source than the grouting Equipment
- Is capable of developing a pumping pressure of 250 psi and has sufficient capacity to flush out any partially grouted ducts or vents if necessary

Labor

00555.30 Personnel - Provide the following:

- **Post-Tensioning Supervisor** - A person, skilled in the use of the system of stressing to be used, to supervise the Work.

- **Grouting Technician** - An American Segmental Bridge Institute (ASBI) certified grouting technician or PTI Level 2 Bonded PT Field Specialist to supervise, inspect, and document the entire grouting operation.

Construction

00555.40 Required Submittals:

(a) Test Report - Submit a certified test report to the Engineer for review and acceptance for each size and type of anchorage device showing that the device meets the requirements of the AASHTO *LRFD Bridge Design Specifications* and the AASHTO *LRFD Bridge Construction Specifications*. With the certification, include a statement that the design, materials and manufacture of the anchorage devices have not changed since testing. Ensure the concrete strength, edge clearance dimensions and amount of reinforcing for the test block is not greater than that proposed for the Project.

(b) Working Drawings and Calculations - Submit stamped Working Drawings and calculations for post-tensioning systems to the Engineer for review according to 00150.35.

(c) Review of Methods - Submit for review complete details of the materials, Equipment, method and sequence proposed for the stressing operations, including, but not limited to:

- Additions or rearrangement of reinforcing steel or changes in member dimensions from that shown.

- For normal anchorage devices, bearing stress and resistance calculations satisfying Section 5.10.9.7.2 in the LRFD Bridge Design Specifications.
- Complete specifications and details of the ducts, stressing steel including arrangement and alignment, and the anchoring devices.
- Pressure grouting materials and Equipment.

Furnish reinforcement Working Drawings that are compatible with the approved Post-Tensioning System Working Drawings.

Do not cast any member to be stressed before the Working Drawings have been reviewed according to 00150.35.

00555.41 Ducts - Provide ducts for post-tensioning tendons according to the following:

(a) General - Make ducts mortar-tight and place them accurately at the locations shown or as directed. Provide positive, metallic, mortar-tight connection joints between sections of rigid duct which do not permit angle changes at the joints. Use waterproof tape at connections.

(b) Vents - Provide vents in all ducts within plus or minus 3 feet of high and low points, and other locations shown. Make vents of 3/4-inch nominal diameter standard PVC, galvanized steel or copper pipe. Make connections to ducts with compatible structural fasteners. Make the vents mortar-tight, tape as necessary, and provide means for injecting grout through the vents and for sealing the vents. Securely fasten ducts and vents in place to prevent movement. After grouting, remove the ends of vents to provide 2 inches of cover to the nearest concrete surface.

(c) Repair - Before placing concrete, repair all holes or openings in the ducts. Holes less than 1/4 inch may be repaired by several wraps of waterproof tape. Repair holes larger than 1/4 inch with a split metal sleeve which overlaps itself by 3 inches, extends at least 3 inches on either side of the hole, is sealed with waterproof tape, and is secured to the duct. Cut out indentations which cannot be repaired and repair as above for holes larger than 1/4 inch.

(d) Maintenance - After installing ducts, keep the ends covered at all times in a manner that prevents entry of moisture or debris. If the surrounding temperature is below 32 °F, keep the ducts free of water to avoid damage due to freezing.

Before placing forms for the decks of box girder cells, demonstrate to the satisfaction of the Engineer that all ducts are unobstructed.

Clean all ducts and remove accumulated water at the time of placing stressing steel.

00555.42 Stressing:

(a) General - Do not make welds, or grounds for welding Equipment, on the forms or on the steel in the member after any stressing steel has been installed.

Protect stressing steel against physical damage and rust or other corrosion at all times until grouted. A corrosion inhibitor may be used. Stressing steel that has sustained physical damage, detrimental rust, pitting or other results of corrosion at any time will be rejected. Stressing steel with only light rust is acceptable if rust spots can be removed by rubbing or scraping with the fingernail and only light streaks of rust remain.

Tension stressing steel by means of hydraulic jacks so that the force in the stressing steel is not less than the value shown.

(b) Duct Alignment - Provide a duct alignment according to the approved Working Drawings to the follow tolerances:

- **Horizontal Alignment** - ± 1/4 inch unless shown otherwise
- **Vertical Alignment** - ± 3/8 inch

(c) Timing - Do not stress members until at least 14 days, excluding days when the surrounding temperature is below 40 °F for a total of 4 hours or more, after the last concrete has been placed in the member and not until all the concrete has reached the specified compressive strength.

Subject to prior written approval, a portion of the total stressing force may be applied to a member when the concrete compressive strength in the member is less than the value shown. Approval of such partial stressing will in no way relieve the Contractor of full responsibility for successfully constructing the member.

(d) Procedures - Tension stressing steel by jacking at each end of the tendon unless otherwise noted.

(1) Continuous Span Members - Jacking of both ends need not be done simultaneously.

(2) Simple Span Members - When jacking from one end only is allowed, tension half of the stressing steel in each member from one end of the span and the other half from the opposite end, unless otherwise allowed in writing.

(3) Bent Cap Members - Subject to prior written approval, bent cap stressing steel may be tensioned by jacking from one end only.

(e) Measuring Prestressing Force - Conduct tensioning so the tension being applied and the elongation of the stressing steel may be measured at any time. Keep a record of gauge pressures, load cell reading and elongations. Furnish a copy of the record to the Engineer when requested.

Determine prestressing force by both of the following methods:

(1) Measurement of Strand Elongation - Determine required elongation from average load-elongation curves for prestressing strand used.

(2) Observation of Jacking Force - Observe jacking force on a calibrated gauge or load cell or by use of a calibrated dynamometer.

Ascertain the cause of any difference in force determination between (1) and (2) that exceeds 5 percent and correct the condition causing the discrepancy.

(f) Post-Stressing Survey - Conduct a visual survey of all surfaces of all stressed concrete elements immediately after tensioning is complete. Search for cracking, distress, or other abnormalities and report findings to the Engineer. Obtain Engineer approval of the post-stressing survey before cutting strand ends.

00555.43 Bonding and Grouting - Bond stressing steel to the concrete by filling the void space between the duct and the tendon with tendon grout consistent with the approved trial batch. Complete grouting each tendon within 14 Calendar Days after placing it. If projects are within 25 aerial miles of the Pacific Ocean, complete grouting each tendon within 7 Calendar Days after placing it. Test grout according to ASTM C939, as modified in 00555.13(a) at the start of grout production, at least every 2 hours after the start of grout production, and as requested by the Engineer, to verify that flow characteristics of the grout remain within the tolerances specified in 00555.13(a). Perform Mud

Balance tests for each batch according to 00555.13(c). Compare and document the wet density value with the value obtained during the trial batch. If the values differ by more than 3 percent, rerun ASTM C939 as modified in 00555.13(a) for continued compliance.

Perform compressive strength tests according to 00555.13(d) at least once daily and provide the test results to the Engineer for 7 and 28-Day testing.

Perform bleed resistance tests at the mixer location according to 00555.13(b) at least once daily.

(a) Pre-Grouting Procedure - Cut stressing steel 1 inch beyond wedges or anchor nuts after stressing operations.

(b) Grouting Operation - Provide a standby flushing system and demonstrate that it is readily accessible and operable should it become necessary to flush out a partially grouted tendon.

Do not retemper grout. Continuously agitate grout until it is pumped.

(c) Grouting Procedure - Make all ducts clean and free of deleterious materials. Blow out each duct thoroughly with oil-free air immediately before grouting. Ducts may be flushed with water immediately before grouting if approved.

Fit grout injection pipes with positive mechanical shutoff valves. Fit vent and ejection pipes with grout-tight caps, valves or other mechanical closing devices.

Grout from the low end of the Structure.

Keep the temperature of the concrete surrounding the duct at 35 °F or higher at the time of grouting and until job-cured grout cubes reach 800 psi compressive strength.

Maintain grout temperatures between 50 °F and 90 °F during mixing and pumping. If necessary, cool the mixing water.

Open all vents when grouting starts. Allow grout to flow from the first vent until residual flushing water or entrapped air is removed, then close the vent. Close remaining vents in sequence in the same manner.

Pump thixotropic grouts with 75 psi pressure or less between outlets. Reduce the pumping pressure to 5 psi while passing intermediate outlets or approaching the end of the tendon. Maintain pressure at 5 psi for 15 seconds after each outlet is reached. Resume 75 psi pressure between intermediate outlets after an outlet is closed off. Allow effluent bleed at tendon end using 5 psi pressure.

Whenever the grout pumping pressure exceeds 100 psi:

- Inject grout at any other vent which has been, or is ready to be, closed as long as a one-way flow of grout is maintained. If this procedure is used, fit the vent used for injection with a mechanical shutoff valve.
- If the one-way flow of grout cannot be maintained, immediately flush the grout out of the duct with water.

Pump grout through the duct and continuously waste it at the outlet vent until:

- No visible slugs of water or air are ejected.

- The afflux time of the grout at the mixer during the grouting process is not more than 5 seconds different from the efflux time at the mixer during the initial measurements of the flow cone test during the trial batch, and is between 5 and 30 seconds.
- The efflux time of the ejected grout is not more than 5 seconds different from the efflux time at the mixer.

Do not over-mix the grout.

Close the outlet vent and maintain the pumping pressure or 60 psi, whichever is greater, for at least 30 seconds; then close the valve at the injection pipe while maintaining this pressure. Do not open valves or vents until the grout sets.

(d) Anchorage Encasement - Following grouting, encase grout caps and fill all grouting and post tensioning blockouts with concrete and finish flush. Prepare post tensioning blockouts according to 00540.43(a) or as approved. Apply an epoxy bonding agent from the QPL to exposed bearing plate and wedge plate surfaces prior to placing concrete in the blockouts.

Measurement

00555.80 Measurement - No measurement of quantities will be made for Work performed under this Section. Estimated quantities of materials will be listed in the Special Provisions.

Payment

00555.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract lump sum amount for the item "Post-Tensioning".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for anchorage devices, ducts, tendons, prestressing steel, grout, and admixtures, or for preparation and testing of grout.

Section 00556 - Multi-Layer Polymer Concrete Overlay

Description

00556.00 Scope - This Work consists of sealing and resurfacing bridge decks with a multi-layer polymer concrete overlay (MPCO).

00556.03 Submittals - At least 21 Calendar Days before the pre-placement conference, provide the following information to the Engineer for approval:

- A manufacturer's safety data sheet for each MPCO component.
- Manufacture dates and shelf-life expiration dates for each production lot of primer/sealer and polymer components.
- Tabulated data indicating the estimated cure time, in minutes, for the allowable ambient temperature range, in increments of 10 °F.
- A detailed work plan for the MPCO preparation, application, and cleanup. Include estimated dates and timeframes.
- Equipment information according to 00556.20.
- Personnel Qualifications according to 00556.30.
- An Inclement Weather Plan according to 00556.04.

00556.04 Inclement Weather Plan - Submit an inclement weather plan when application conditions of 00556.40(b) are not met. The inclement weather plan includes all Materials, Equipment, and methods to be used to heat the substrate, Aggregate, and resin. If concrete moisture content or capillary moisture is to be tested, provide Equipment information and calibration certificates.

00556.05 Pre-placement Conferences:

(a) Supervisory Personnel - Hold a pre-placement conference with all supervisory personnel, Subcontractors, Suppliers, MPCO manufacturer and other personnel who will be involved in the overlay Work. Meet at a mutually agreed time approximately 2 weeks in advance of the Work. Present and discuss all phases of the overlay Work.

(b) Placement Crew - Hold a second pre-placement conference with the Engineer and the entire overlay Work crew at the Project Site 1/2 hour before overlay Work begins to discuss placement duties and procedures. Do not begin the overlay Work until this meeting is held.

Materials

00556.10 Materials - Furnish Materials meeting the following requirements:

(a) Multi-Layer Polymer Concrete Overlay - Furnish a MPCO from the QPL.

Resin shall meet the requirements of ASTM C881, Type III.

(b) Multi-Layer Polymer Concrete Overlay Aggregate - Furnish MPCO Aggregate from the QPL.

Sample the furnished Aggregate and test according to the following:

Property	Test Method	Requirements
Moisture Content *	AASHTO T 255	0.20% max.
Moisture Content **	AASHTO T 255	1.00% max.

* At time of aggregate production.
** Field test at time of mixing the polymer resin.

Equipment

00556.20 Equipment - Provide approved Equipment to place the MPCO. Remove all Equipment that leaks oil or other contaminants from the Work area until they are repaired.

00556.21 Miscellaneous Equipment:

(a) Tools - Furnish squeegees, rollers, and other approved tools to apply the primer/sealer and the polymer resin.

Furnish a power broadcaster to uniformly apply the MPCO Aggregate.

Furnish pickup type power brooms capable of removing loose Aggregate.

(b) Coring Equipment - Furnish core cutting Equipment that can produce a core at least 3 inches in diameter.

(c) Bond Testing Equipment - Furnish bond testing Equipment that:

- Meets the requirements of ASTM D4541 Type V
- Is compatible with the core tested.
- Can exert a tensile load to the core sufficient to exceed 300 psi.
- Is equipped with a measuring device capable of reading tensile force exerted within 1 percent accuracy.

(d) Resin Conditioning Equipment - Furnish Equipment capable of conditioning resin to between 65 °F and 85 °F.

(e) Aggregate Heating Equipment - Furnish heating Equipment capable of pre-heating Aggregate to a minimum of 70 °F as measured at the time of placement.

(f) MPCO Heating Equipment - If required, or as a means to accelerate curing, furnish heating Equipment that:

- Can apply indirect heat to ensure that the entire completed membrane will meet the bond test requirements of 00556.43.
- Can maintain a minimum temperature of 70 °F within the heated area and does not exceed 110 °F.
- Will not segregate, shove, tear or gouge the MPCO system.

(g) Concrete Moisture Meter - Furnish a pin-type, instant read, concrete moisture meter meeting ASTM F2659. Provide current calibration documentation.

(h) Dew Point Measurement Equipment - Furnish dew point measurement Equipment that:

- Measures deck surface temperature accurate to ± 1 °F
- Measures ambient temperature and dew point accurate to ± 1 °F

Labor

00556.30 Personnel Qualifications - Provide employees meeting the following requirements:

- Workers that are certified, in writing, by the MPCO manufacturer that they are qualified to place the MPCO.
- A MPCO manufacturer technical representative that is experienced in MPCO application and mix designs.

The MPCO manufacturer technical representative duties include:

- Be present at both pre-placement conferences.
- Be at the Project Site and verify deck surface preparation quality control activities.
- Be at the Project Site during overlay placements and monitor the placement for MPCO quality control activities.

Construction

00556.40 Construction:

(a) General - Do not begin MPCO installation until all Materials and Equipment necessary to perform the installation and required repairs, and qualified personnel are at the Project Site. Prepare the entire deck surface, including the deck edge against the curb, to receive the MPCO. Remove all grease, oil, paint, dirt, laitance, rust, and all other contaminants that would affect adhesion of the MPCO.

(b) Application Conditions - Apply the MPCO on prepared surfaces when the following conditions are met:

- The deck surface has been visually dry for at least 72 hours.
- The ambient temperature and deck surface temperature are between 50 °F and 90 °F, or as specified by the resin manufacturer's product data sheet, whichever is more restrictive.
- The deck surface temperature is at least 5 °F above the dew point.
- No rain is forecasted for the duration of the estimated MPCO cure time, based on ambient and surface temperatures.

(c) Inclement Weather Plan - When an inclement weather plan is approved, apply MPCO on prepared surfaces when the following conditions are met:

- If the deck has been dry for less than 72 hours, mechanically heat the deck to a minimum of 300 °F and a maximum temperature of 350 °F. Perform one of the following tests after applying heat:
  - Test for capillary moisture using the plastic sheet method, according to ASTM D4263, with a minimum test time of 2 hours. Perform one test per 500 square feet.

- Test for concrete moisture content using a pin-type moisture meter according to 00556.21(g). Maximum allowable deck moisture content is 4 percent. Perform number of tests and locations according to ASTM F2659, with a minimum of eight tests per primer placement. Test additional locations as directed by the Engineer.

- The ambient temperature and deck surface temperature are between 40 °F and 90 °F. If the temperature falls, or is forecasted to fall below 50 °F perform the following:
  - Pre-heat the Aggregate to a minimum of 70 °F.
  - Heat the MPCO to a minimum of 70 °F to facilitate curing. Do not exceed 110 °F on the MPCO surface.
- The deck surface temperature is at least 3 °F and rising above the dew point.
- No rain is forecasted for the duration of the estimated MPCO cure time, based on ambient and surface temperatures.
- Do not place MPCO when temperatures are below 40 °F.

(d) Deck and MPCO Materials Heating - Do not use manually operated propane torches to heat the deck surface or MPCO Material. When the deck surface is mechanically heated, do not proceed with Work until the surface temperature is less than 90 °F.

00556.41 Surface Preparation: Prepare all surfaces that are to be in contact with the MPCO according to Section 00504.

Block out interior expansion joints with rigid polyethylene foam or other approved Material and place MPCO over joints.

00556.42 Placing Multi-Layer Polymer Concrete Overlay:

(a) Thickness - Place MPCO in Lifts to achieve a total nominal thickness of 3/8 inch.

(b) Mixing the Polymer Resin - Condition the polymer resin to between 65 °F and 85 °F and mix as recommended by the manufacturer.

(c) Overlay Application - With the Engineer's approval of the surface preparation, apply the MPCO according to the approved submittals and meeting the requirement of 00556.40(b).

After each Lift, before gelling of the polymer resin occurs, broadcast a layer of Aggregate at a rate of 1-2 pounds of Aggregate per square foot, as required to achieve refusal with no visible wet spots.

For each Lift, sweep the entire deck surface after the polymer has cured and remove all loose material.

Feather the MPCO to the end bridge joints located at end panels. Sawcut interior joints to allow for expansion joint installation prior to opening to traffic.

If application of the MPCO surface does not meet the requirements of the approved submittals in 00556.03, stop the operation until revised methods, changes in Equipment, or correction of procedures are proposed and approved.

(d) Curing - Allow the MPCO to cure for the amount of time stated in the submitted tabulated curing time and temperature chart before subjecting it to loads or traffic. Only allow traffic on portions of the MPCO with the final lift complete and fully cured.

Heating MPCO Materials to facilitate cure and decrease cure times may be performed, at no additional cost to the Agency, when application conditions of 00556.40(b) are met and heating is performed according to 00556.40(d).

00556.43 Bond Strength Test - Perform at least two bond tests for each Day of placement in the presence of and at locations designated by the Engineer. Test the bond strength within 48 hours after placing the MPCO overlay. Cut 2 inch to 3 inch diameter cores from in-place MPCO at least 1/2 inch into concrete substrate and conduct bond tests on the cores. Test according to ASTM D4541, Method "E", using Type "V" tester.

The bond test consists of:

- Coring through the MPCO overlay and approximately 1/2 inch into the existing concrete.
- Attaching a 50 mm (2-inch) test dollie to the top of the core.
- Exerting a tensile load to the core sufficient to cause failure or achieve 300 psi, whichever occurs first.
- Avoid taking cores in the wheel tracks.

Perform bond tests when the deck surface temperature is less than 80 °F.

A successful test is the failure of the concrete substrate or bond failure at or above 250 psi.

After coring and testing, restore the area voided by the cores by blowing with compressed air and filling with MPCO material.

00556.44 Delamination Survey and Repair - Perform a deck delamination survey, in the presence of the Engineer, using chain drag, coring, or other approved methods. If directed by the Engineer, perform additional bond tests according to 00556.43, at locations directed.

Repair all delaminated areas of 1 square foot or greater. Delaminated areas of less than 1 square foot will not require repair. Repair limits to be approved by the Engineer. Repair to the satisfaction of the Engineer at no additional cost to the Agency.

Make all repairs before opening to traffic or, if the resurfaced area is opened to traffic at the Contractor's request before completing repairs, all additional traffic control to complete the repairs will be at no additional cost to the Agency.

00556.45 Use of New Surface:

(a) Vehicles - Do not allow vehicles or construction Equipment on the MPCO surface until curing is complete according to 00556.42(d).

(b) Traffic - Do not open sections to traffic until approved by the Engineer. Before opening to traffic, remove all loose Aggregate by power brooming and open all drains.

Measurement

00556.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

- **Furnish MPCO Material and Constructing MPCO** - Furnishing and constructing multi-layer polymer concrete overlay will each be measured on the area basis. The area will be determined by measuring the actual surface area of the resurfaced bridge deck.

Payment

00556.90 Payment - The accepted quantities of Work performed under this Section will be paid at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Furnish MPCO Material	Square Yard
(b) Construct MPCO	Square Yard

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for the inclement weather plan or heating deck surface or MPCO Materials.

Section 00557 - Premixed Polymer Concrete Overlays

Description

00557.00 Scope - This work consists of constructing premixed polymer concrete (PPC) pavement overlays as shown or specified.

00557.01 Definitions:

PPC System - The combination of compatible resins and primers, mixed with aggregates and other specified ingredients and applied as specified, that produces an acceptable PPC pavement overlay.

System Provider - The polymer concrete supplier experienced in PPC mix design and the application of PPC systems.

00557.02 Submittals - At least 21 Calendar Days before the pre-placement conference, provide the following information and samples to the Engineer for approval:

- The inclement weather plan according to 00557.04.
- Test results, from an independent testing laboratory, for the first lot of primer manufactured for use on this Project, showing that the primer complies with the requirements of 00557.10. Provide a Certificate of Compliance from the manufacturer for each subsequent lot of primer, indicating that the primer was manufactured to the same formulation as the first lot.
- Test results, from an independent testing laboratory, for the first lot of polyester resin binder manufactured for use on this Project, showing that the binder complies with the requirements of 00557.12(a). Provide a Certificate of Compliance from the manufacturer for each subsequent lot of resin binder, indicating that the polyester resin binder was manufactured, to the same formulation as the first lot.
- A Certificate of Compliance for each lot stating that the primer and resin binder will not expire prior to use on this Project based on the published shelf life and manufacture date.
- A detailed work plan for the PPC preparation, application, and cleanup. Include estimated dates and timeframes.
- The finishing equipment according to 00557.22.
- Rebound Hammer calibration documentation and correlation number established per ASTM C805 used to determine when to open the overlay to traffic.
- The type of scarifying Equipment that will be used for deck preparation according to Section 00504.
- The method and materials used to contain, collect, and dispose of all concrete debris generated by the scarifying process, including provisions for protecting adjacent traffic from flying debris.
- The method and materials used to contain the high molecular weight methacrylate (HMWM) resin and the PPC mixture within the deck area that will receive the overlay.
- The PPC mix design.
- Certification from the System Provider stating that the polyester resin and the primer are approved and are fully compatible with one another and that they are compatible with the PCC repair material used for repairing Class 2 and Class 3 areas.
- Notice when bulk resin will be used on the Project. Bulk resin is resin that is stored in containers exceeding 55 gallons.
- A Material Safety Data Sheet for the polyester resin binder and HMWM resin.
- The personnel qualifications according to 00557.30.

- Two 50-pound samples of the blended aggregate.
- Heating plan according to 00557.44.

Provide all material delivery receipts upon availability, but no later than one hour after the end of the work shift.

00557.04 Inclement Weather Plan - Submit an inclement weather plan when application conditions of 00557.40(b)(1) are not met. The inclement weather plan includes all Materials, Equipment, and methods to be used to heat the substrate. If concrete moisture content or capillary moisture is to be tested, provide Equipment information and calibration certificates.

00557.05 Pre-placement Conferences:

(a) Supervisory Personnel - Hold a mandatory pre-placement conference with all supervisory personnel, Subcontractors, suppliers, the system provider's technical representative (SPTR), the quality control technician (ACI Concrete Field Testing Technician Grade 1), and all other personnel who will be involved in the PPC pavement overlay work. Meet at a mutually agreed time at least 14 Calendar Days before placing the PPC pavement overlay including the trial overlay. Schedule the pre-placement conference after all submittals have been reviewed and approved. Present and discuss all phases of the PPC pavement overlay work.

(b) Placement Crew - Hold a second pre-placement conference with the Engineer, the entire PPC pavement overlay crew, the quality control technician (ACI Concrete Field Testing Technician Grade 1), and the SPTR at the Project Site 1/2 hour before the first placement begins to discuss placement duties and procedures. Do not begin PPC pavement overlay work until this meeting is held.

Materials

00557.10 Resin Primer - Furnish a wax-free, low odor, high molecular weight methacrylate resin prime coat that has a maximum volatile content of 30 percent before adding an initiator, when tested according to ASTM D2369, and meeting the following requirements:

High Molecular Weight Methacrylate (HMWM) Resin		
Property	**Requirement**	**Test Method**
Viscosity*	25 cps max. (Brookfield RVT with UL adaptor, 50 RPM at 77 °F)	ASTM D2196
Specific Gravity*	0.90, min. at 77 °F	ASTM D1475
Flash Point*	180 °F, min.	ASTM D3278
Vapor Pressure*	0.039 in. Hg, max. at 77 °F	ASTM D323
Tack-free time	400 minutes, max. at 77 °F	California Test 551**
* Perform test before adding initiator. ** Copies of California Test 551 are available from the Engineer.		

00557.12 Concrete - Furnish premixed polymer concrete consisting of polyester resin binder and dry aggregate.

(a) Polyester Resin Binder - Furnish unsaturated isophthalic polyester-styrene co-polymer resin binder meeting the following requirements:

Polyester Resin Binder		
Property	**Requirement**	**Test Method**
Viscosity*	75 - 200 cps (RVT, No. 1 Spindle, 20 RPM at 77 °F)	ASTM D2196
Specific Gravity*	1.05 to 1.10 at 77 °F	ASTM D1475
Elongation	35% min. Type I at 0.45 in./min. Thickness = 0.25 ± 0.03 inch	ASTM D638
	Sample Conditioning: 18/25/50 + 5/70	ASTM D618
Tensile Strength	2,500 psi min. Type I at 0.45 in./min. Thickness = 0.25 ± 0.03 inch	ASTM D638
	Sample Conditioning: 18/25/50 + 5/70	ASTM D618
Styrene Content*	40 to 50 % (by weight)	ASTM D2369
Silane Coupler**	1.0% min. (by weight of polyester styrene resin)	n/a
PCC Saturated Surface-Dry Bond Strength	500 psi, min. at 24 hours and 70 ± 2 °F	California Test 551***
* Perform test before adding initiator. ** An organosilane ester, gammamethacryloxypropyltrimeth-oxysilane. *** Copies of California Test 551 are available from the Engineer. Perform bond test using mixed PPC and primer.		

Provide a promoter that is compatible with suitable methyl ethyl ketone peroxide.

Initiate and thoroughly blend the polyester resin binder just prior to mixing with aggregate.

(b) Initiator - Provide an initiator system for the methacrylate resin consisting of a metal drier and peroxide. If the initiator is supplied separately from the resin, do not directly mix the metal drier with the peroxide.

Store containers in a manner that prevents leakage or spillage from one material to contact the containers or material of the other.

(c) Accelerators and Inhibitors - Provide accelerators and inhibitors, if required, as recommended by the system provider.

(d) Aggregate - Furnish washed, clean, and dry 3/8" - 0 size aggregate meeting the following requirements:

- Meets the following combined gradation according to AASHTO T 27 and AASHTO T 11:

Sieve Size	Percent Passing (by Weight)
3/8"	100
No. 4	62 - 85
No. 8	45 - 67
No. 16	29 - 50
No. 30	16 - 36
No. 50	5 - 20
No. 100	0 - 7
No. 200	0 - 3

- Combined aggregate absorption does not exceed 1 percent according to AASHTO T 84 and AASHTO T 85.
- Moisture content does not exceed 0.2 percent at the time of aggregate production according to AASHTO T 255.
- Field tested moisture content does not exceed 1.00 percent according to AASHTO T 255. Test field moisture content prior to production Work, during the trial overlay strip. Perform additional field moisture tests, as directed by the Engineer
- The largest size aggregate does not exceed one-half the minimum depth of the overlay.
- Aggregate retained on the No. 8 to No. 200 sieves only consists of natural sand.
- When aggregate retained on the No. 4 and No. 8 sieves is combined, the aggregate shall have a maximum of 45 percent crushed particles with at least one fractured face when tested according to AASHTO T 335.

Deliver aggregate to the mixer in containers that maintain the specified moisture content.

(e) Surface Texture Sand - Furnish dry commercial quality blast sand, meeting the absorption and moisture content requirements of the aggregate with 95 percent of the sand passing the No. 8 sieve, and 95 percent of the sand retained on the No. 20 sieve.

00557.14 PPC Mixture Tolerances and Limits - Provide a uniform, consistent, workable PPC mixture with a polyester resin content, by weight, of 12 ± 1 percent of the aggregate weight.

00557.16 Acceptance of Premixed Polymer Concrete:

(a) General - Acceptance of PPC will be based on Contractor's modulus of elasticity and bond strength test results.

(b) Required Properties and Tolerances - The properties and requirements of the PPC are:

Property	Requirement	Test Method
Compressive Strength for Traffic	2,000 psi, min. before opening to traffic	ASTM C805
Surface Tolerance	See 00557.45(c)	n/a
Bond Strength	250 psi, min.	See 00557.44(f)
Set Time	30 to 90 minutes	Visual
Density	See (c) below	ASTM C138
Modulus of Elasticity at 7 Days	1,000 ksi, min. 2,000 ksi, max.	ODOT TM 759
Surface Preparation Depth	1/16 inch, min.	ASTM E965

Perform acceptance testing according to the referenced tests, and furnish samples to the Engineer as required. Failing test results may be cause for rejection of the mix with removal and replacement of the affected material at no additional cost to the Agency. If the Engineer determines that the PPC is suitable for the intended purpose, the PPC may be allowed to remain in place, subject to a price adjustment according to 00150.25.

(c) Density - Determine the unit weight of the PPC mixture according to AASHTO T 121 (ASTM C138). Submit test results to the Engineer. The correlation factor established through density testing will be used to determine equivalency between weight and volume for purposes of payment. Perform density testing at the rate of one test per batch.

Equipment

00557.20 General - Remove all Equipment that leaks oil or other contaminants from the Project Site until they are repaired.

00557.21 Mixing Equipment - Furnish mechanically operated continuous mixers specifically built or modified for PPC that:

- Employ an auger screw or chute device.
- Is equipped with a positive-displacement pump that is calibrated yearly and is connected to an adjustable catalyst pump.
- Is equipped with a metering device that is calibrated yearly and automatically measures and records the aggregate weight and the corresponding resin weight. Repeat calibration at the beginning of the project and when changes are made to the mix truck that may affect the accuracy of the truck measurements.
- Has a readout gage, visible to the Engineer at all times, which displays the weights being recorded.

00557.22 Finishing Equipment - Furnish slip-form finishing equipment with an automatic grade control device to strike off the PPC mixture to the established grade and cross section, or other Equipment such as 30 foot floating beams as approved by the Engineer. Fit the finishing equipment with vibrators or other means of consolidating the PPC.

00557.23 Miscellaneous Equipment:

(a) Hand Tools - Furnish hand tools for placing and finishing the PPC. Use manual type screeds with approved vibrators attached to consolidate and finish smaller areas where it is impractical to use a finishing machine.

(b) Straightedge - Furnish a 12 foot metal straightedge.

(c) Coring Equipment - Furnish core cutting equipment that can cut a core at least 2 inches in diameter.

(d) Bond Testing Equipment - Furnish bond testing equipment that:

- Meets the requirements of ASTM D4541 Type V
- Is compatible with the core tested.
- Can exert a tensile load to the core sufficient to exceed 250 psi.
- Is equipped with a measuring device capable of reading tensile force exerted within 1 percent accuracy.

(e) Diamond Grinders - Furnish power-driven self-propelled machines with the cutting head made up of diamond cutting blades to correct non-specification surface variations.

(f) Concrete Moisture Meter - Furnish a pin-type, instant read, concrete moisture meter meeting ASTM F2659. Provide current calibration documentation.

(**g) Dew Point Measurement Equipment** - Use dew point measurement equipment that:

- Measures deck surface temperature accurate to ± 1 °F.
- Measures ambient temperature and dew point accurate to ± 1 °F.

Labor

00557.30 Personnel Qualifications - Perform the PPC pavement overlay work using a company and personnel experienced in PPC pavement overlay work. Demonstrate the company's qualifications and experience and the qualifications of personnel scheduled to perform the PPC pavement overlay work by providing the Engineer the following:

- The name of the company that will be performing the PPC pavement overlay work.
- A project reference list of at least three PPC pavement overlay project, successfully completed within the last five years, that has used the same PPC pavement overlay system and materials that will be used on this Project. The minimum PPC overlay qualification area is 2,000 square feet. Include the following information for each qualifying project:
  - A brief description of each project.
  - Each project's name.
  - The owner’s contact person’s name, title, and current phone number for each project.
  - Alternate owner's contact person's name, title, and current phone number for each project.
  - The amount of PPC overlay material used on each project.
- Identify a SPTR, the mixer operators, and the finishing machine operators that will perform the PPC pavement overlay work. Include documentation that they have relevant experience with PPC pavement overlay work and that they have completed at least one PPC pavement overlay project within the last three years.

- A brief description of experience using slip-form screeds for either PPC or PCC roadway wearing surfaces.

The Engineer may suspend the PPC pavement overlay work if the Contractor substitutes unapproved personnel during construction. Submit requests for substitution of SPTR, mixer operators, and finishing machine operators to the Engineer. The Engineer will respond within seven Calendar Days of each request.

00557.32 Quality Control Personnel - Provide the following certified technicians:

(a) Certified Aggregate Technician (CAgT) - Duties:

- Sample and test the blended aggregate from the conveyor belt during the trial overlay to verify gradation, and moisture content.
- Provide split of blended aggregate samples to the Engineer.
- Provide test results to the Engineer before placing PPC overlay.

(b) PPC Field Testing Technician (ACI Concrete Field Testing Technician Grade 1) - Duties:

- Attend pre-placement meetings.
- Be at the PPC placement site when PPC placement is in progress.
- Performs applicable field testing.
- Notify the Contractor and the Engineer immediately when the PPC is not in compliance with Specifications.

(c) Concrete Strength Testing Technician (CSTT) - Duty:

- Modulus testing.

(d) System Provider's Technical Representative (SPTR) - Duties:

- Guide development of the PPC mix design.
- Attend pre-placement meetings and be present at the trial overlay placement.
- Verify that the primer gels, as mixed and applied.
- Guide the calibration of each mechanically operated mixer used on the Project.
- Be present throughout all mixing to control adjustments to the mix, if necessary.
- Be at the PPC placement site during PPC placement and evaluate each batch delivered and control adjustments to the mix, if necessary.

Construction

00557.40 Construction :

(a) General - Do not begin primer or PPC installation until all Materials and Equipment necessary to perform the installation and required repairs, and qualified personnel are at the Project Site.

(b) Application Conditions - Apply primer on prepared surfaces when the following conditions are met:

- The deck surface has been visually dry for at least 5 Days.
- The ambient temperature and deck surface temperature are between 50 °F and 90 °F.

- The deck surface temperature is at least 5 °F above the dew point.
- No rain is forecasted within 12 hours from the start of PPC placement.

(c) Inclement Weather Plan - When an Inclement Weather Plan is approved, apply primer on prepared surfaces when the following conditions are met:

- If the deck has been dry for less than 5 Days, mechanically heat the deck to a minimum of 300 °F and a maximum temperature of 350 °F. Perform one of the following tests after applying heat and the surface temperature is less than 110 °F:
  - Test for capillary moisture using the plastic sheet method, according to ASTM D4263, with a minimum test time of 2 hours. Perform one test per 500 square feet.
  - Test for concrete moisture content using a pin-type moisture meter according to 00557.23(f). Maximum allowable deck moisture content is 4 percent, or the primer manufacturer's recommendation, whichever is lower. Perform number of tests and locations according to ASTM F2659, with a minimum of eight tests per primer placement. Test additional locations as directed by the Engineer.
- The ambient temperature and deck surface temperature are between 40 °F and 90 °F.
- The deck surface temperature is at least 3 °F above the dew point and rising. Deck surface temperature may be mechanically heated to raise the temperature to at least 5 °F above the dew point.
- No rain is forecasted within 12 hours.

(d) Deck Heating - Do not use manually operated propane torches to heat the deck surface. When the deck surface is mechanically heated, do not proceed with Work until the surface temperature is less than 110 °F.

00557.41 Trial Overlay Strip - Before constructing the trial overlay strip, in the presence of the Engineer, verify weights of resin and aggregate being recorded by calibrating each mechanical mixer used on the Project using certified scales. Use the calibrated mixer to conduct one or more trial overlays on a concrete base approved by the Engineer to determine the initial set time and to demonstrate the effectiveness of deck preparation, mixing, placing, and finishing equipment proposed. Roughen the surface of the trial overlay strip leaving an exposed aggregate surface texture depth profile of at least 1/16 inch, determined according to ASTM E965 (standard volumetric test).

Construct trial overlays meeting the acceptance criteria of 00557.16, except test the modulus of elasticity at 24 ± 1 hours. Perform testing at locations designated by the Engineer. Construct each trial overlay 12 feet wide by at least 20 feet long, and at the same thickness as the final PPC overlay. Construct trial overlays when weather conditions are similar to those expected during construction of the PPC overlay. Use the same equipment, including deck preparation equipment, that will be used for the PPC overlay.

Sample the blended aggregate from the conveyor belt and test according to 00557.12(d) while constructing the trial overlay strip.

Do not proceed with PPC overlay work until the Engineer approves the trial overlay strip.

Remove and dispose of the trial overlay and the concrete base according to 00290.20.

00557.42 Surface Preparation - Prepare all surfaces that are to be in contact with the PPC according to Section 00504.

Block out expansion joint openings with rigid polyethylene foam or other approved Material, compatible with the resin and primer, before constructing the overlay. Place the PPC over the blocked

out joint openings. Create the expansion joint openings by saw cutting the overlay along each joint edge. Saw cut expansion joint openings each shift prior to allowing traffic.

00557.43 Placing Prime Coat - When conditions of 00557.40 are met, apply primer according to the following:

- Blow clean with compressed air to remove accumulated dust and all other loose material.
- Flood the deck surface with the resin primer at a rate of 75 to 100 square feet per gallon.
- Allow the resin primer to penetrate into the concrete and fill all cracks.
- Do not allow the primer coat to leak from cracks or other openings in the deck.
- Redistribute and work the applied resin primer into cracks with squeegees or brooms in a manner that does not cause foaming.
- Maintain free flowing consistency of the resin primer at all times. Only use enough initiated promoted resin that is needed to apply a prime coat.
- A noticeable increase in viscosity of the prime coat resin before it is placed will be cause for rejection.
- Do not allow traffic on the primed surface.
- Allow the prime coat to pond and penetrate into the deck surface a minimum of 15 minutes before placing the PPC.
- If the primed surface becomes contaminated, or if the prime coat fails, clean the contaminated area by abrasive blasting, and re-prime at no additional cost to the Agency.

00557.44 Premixed Polymer Concrete Pavement:

(a) Placement Conditions - Place PPC only when the ambient temperature, surface temperature and relative humidity meet the requirements on the manufacturer's written data sheet.

(b) Mixing - Mix PPC on-site. Do not allow packaging to enter the mix.

Use initiators to produce a set time of between 30 and 90 minutes after placement. Use accelerators or inhibitors, if required for the 30 to 90 minute set time, as recommended by the resin supplier.

Initiate and thoroughly blend the polyester resin binder before introduction of aggregate to the binder. Use all bags or other containers of aggregate that are opened at the time of mixing, otherwise discard them.

(c) Placing PPC - Place premixed polymer concrete:

- Before it gels or within 15 minutes after the addition of the initiator, whichever is first. Discard the PPC if it is not placed within this time.
- During the same work shift the prime coat is applied.
- Place PPC with a minimum thickness of 3/4 inches or as shown.
- Place PPC in Panel widths which hold the location of the longitudinal joints to the lane lines.

(d) Set Time - Use an appropriate amount of initiator to achieve the required set time. Accelerators or inhibitors may be required as recommended by the polyester resin binder supplier and as approved by the Engineer.

(e) Modulus of Elasticity - Sample PPC within one minute of mixing. Cast one set of three 4 by 8 inch cylinder specimens from each batch of PPC placed on the Project.

Cast one additional set of three 4 by 8 inch cylinder specimens for every ten batches of PPC placed on the project, minimum of one set per day. Submit the additional set to the Engineer for verification testing.

Cast the PPC cylinders with a minimum of two lifts, rodding 25 times for each lift. Keep the cylinders level and stationary until PPC overlay rebound test has been completed.

A batch is defined as "per mixer" or "portion of it placed". Test each set according to ODOT TM 759 to determine modulus of elasticity at 7 Days. Use a CSTT to perform modulus testing.

Do not allow traffic and Equipment on the PPC overlay until the overlay has reached a minimum compressive strength of 2,000 psi as verified by the rebound number determined according to ASTM C805. Test the deck surface at locations as directed.

(f) Bond Strength - Perform at least two bond tests for each day of placement in the presence of and at locations designated by the Engineer. Test the bond strength within 48 hours after placing the PPC overlay. Cut 2 inch to 3 inch diameter cores from in-place PPC at least 1/2 inch into concrete substrate and conduct bond tests on the cores. Test according to ASTM D4541, Method “E”, using Type “V” tester

The bond test consists of:

- Coring through the PPC overlay and approximately 1/2 inch into the existing concrete.
- Attaching a 50 mm (2-inch) test dollie to the top of the core.
- Exerting a tensile load to the core sufficient to cause failure or achieve 250 psi, whichever occurs first.
- Avoid taking cores in the wheel lines.

A successful test is the failure of the concrete substrate or bond failure above 250 psi.

After coring and testing, restore the area voided by the cores by blowing with compressed air and filling with PPC.

(g) Batch Weight - Record the batch weights at no greater than five minute intervals along with the time and date of each recording.

Furnish a batch ticket to the Engineer at the end of each Work shift or as requested. Batch tickets shall contain the following information:

- Name of PPC supplier.
- Serial number of the delivery ticket.
- Date; starting time, and finishing time.
- Identification number of batching and mixing Equipment.
- Name of purchaser.
- Specific designation of the job (Name, Location and Contract Number).
- Aggregate weight in pounds.
- Resin weight in pounds.
- Sampled PPC Unit Weight in pounds per cubic yard.
- Amount of PPC in cubic yards.

- Signature or initials of the person operating the batching or mixing equipment.

Batch tickets may be computer generated, hand written, or a combination of both.

00557.45 Roadway Finish:

(a) Sand Surface Treatment - After overlay strike-off and before gelling occurs, uniformly apply surface texture sand or PPC fine aggregate to the overlay surfaces at a rate of 1.8 pounds per square yard.

(b) Surface Texturing - Before gelling occurs, texture the PPC by one of the following methods:

- A steel-tined tool with 1/8 inch wide tines that will mark the finished PPC to a depth of 1/8 to 3/16 inch. Randomly space the markings from 3/4 to 1 1/2 inch as approved.
- Orient the texturing perpendicular or longitudinal to the roadway centerline and full width of the roadway width except leave smooth strips 14 inches wide along each curb faces. Do not overlap texturing.

Correct all non-specification surface texturing, at no additional cost to the Agency, according to the following:

- Correct texturing after PPC curing and before opening the roadway to traffic.
- Cut grooves 1/8 inch wide and 1/8 to 3/16 inch deep.
- Unequally space grooves from 3/4 to 1 1/2 inch apart.
- Remove saw slurry and laitance from the sawing operation while cutting the grooves.
- Orient the grooves perpendicular or longitudinal to the roadway centerline and full width of the roadway width except leave smooth strips 14 inches wide along each curb faces. Do not overlap grooves.

(c) Surface Tolerance - The finished surface of the PPC overlay, when tested with a 12 foot straightedge, shall not vary by more than 1/4 inch. Furnish the straightedge and operate it under the direction of the Engineer.

Correct all non-specification surface tolerance with a diamond grinder at no additional cost to the Agency.

Measurement

00557.80 Measurement - The quantities of work performed under this Section will be measured according to the following:

(a) Furnishing Premixed Polymer Concrete - Furnishing premixed polymer concrete material will be measured on the volume basis. The quantities will be determined by converting the weight identified on the mixer's automatic metering device to volume, using the yield factor according to AASHTO T 121 (ASTM C138).

(b) Constructing Premixed Polymer Concrete Overlay - Constructing premixed polymer concrete overlays will be measured on the area basis. Field measurement of the area will not be made. The area will be determined by calculating the area from the dimensions shown.

Payment

00557.90 Payment - The accepted quantities of work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following item(s):

Pay Item	Unit of Measurement
(a) Furnish Premixed Polymer Concrete	Cubic Yard
(b) Construct PPC Overlay	Square Yard

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for constructing and disposing of the trial overlays.

Section 00559 - Structural Concrete Overlays

Description

00559.00 Scope - This Work consists of constructing structural concrete overlays (SCO).

00559.04 Preplacement Conferences:

(a) Supervisory Personnel - Hold a pre-placement conference with all supervisory personnel, Subcontractors, Suppliers, the quality control technician, the concrete control technician, and all other personnel who will be involved in the resurfacing Work. Meet at a mutually agreed time approximately 2 weeks in advance of the Work. Present and discuss all phases of the resurfacing Work.

(b) Placement Crew - Hold a second pre-placement conference with the Engineer and the entire resurfacing work crew and the QCT, at the Project Site 1/2 hour before resurfacing Work begins to discuss placement duties and procedures. Do not begin the resurfacing Work until this meeting is held.

Materials

00559.10 Materials - Furnish Materials meeting the following requirements:

Concrete.....02001
Concrete and Crack Sealers 02060
Curing Materials 02050
Portland Cement Concrete Repair Material.....02015

00559.11 Class of Concrete - Furnish class HPC4500 - 3/4" according to Section 02001 unless otherwise shown.

00559.12 Quality Control - Provide quality control according to Section 00165.

00559.13 Acceptance of Concrete - Acceptance of concrete will be according to Section 00165.

Equipment

00559.20 Equipment - Remove all Equipment that leaks oil or other contaminants from the Work area until they are repaired.

00559.21 Finishing Equipment - Furnish a concrete finishing machine for all new surfaces that is:

- Self-propelled with positive control in both forward and reverse direction.
- Capable of mechanically raising the screed, pan, and any other parts of the finishing mechanical operation to clear the screeded surface, and capable of automatically returning to the specified grade.
- Equipped with augers, followed by oscillating, vibrating screed, vibrating roller tamper, or a vibrating pan, followed by a finish roller or rollers.
- Capable of transmitting vibration at frequencies between 3,500 and 4,500 impulses per minute.

Provide continuous supporting rails for the finishing machine that are adequately supported and sufficiently rigid so there is no visible deflection under the weight of the fully loaded machine. Provide anchorage for the supporting rails to ensure horizontal and vertical stability.

Set the finishing machine so it is capable of finishing to the edge of previously placed concrete.

Set the screed rails on the completed lane surface when placing concrete in a lane abutting a previously completed lane.

00559.22 Miscellaneous Equipment:

(a) Hand Tools - Furnish hand tools for placing and finishing concrete. Use manual type screeds with approved vibrators attached to consolidate and finish smaller areas where it is impracticable to use a finishing machine. Use spud vibrators when depths exceed 2 1/2 inches. Use supplemental vibration along the meet lines where adjacent pours come together at bulkheads, and along curb lines, unless it can be shown that vibration reaches the meet lines.

(b) Straightedge - Furnish a 12 foot metal straightedge.

(c) Recording Thermometer - Furnish a 24-hour recording thermometer accurate to ± 1 °F.

(d) Coring Equipment - Furnish core cutting Equipment that can produce a core at least 3 inches in diameter.

(e) Bond Testing Equipment - Furnish bond testing Equipment that:

- Is compatible with the core tested.
- Can exert a tensile load to the core sufficient to exceed 300 psi.
- Is equipped with a measuring device capable of reading tensile force exerted within 1 percent accuracy.

(f) Wet-dry Vacuum Equipment - Furnish vacuum Equipment that can remove puddled water ahead of the concrete placement.

Labor

00559.30 Quality Control Personnel - Provide certified technicians according to 02001.50.

Construction

00559.41 Surface Preparation - Perform surface preparation according to Section 00504.

00559.42 Placement Conditions - Place structural concrete overlays according to 00540.49 and the following:

- The surface temperature of the prepared deck is 40 °F or greater and less than 80 °F. The surface temperature is rising if it is between 40 °F and 45 °F. In the presence of the Engineer, measure the surface temperature with an infra-red thermometer at a minimum of three locations on the deck.

00559.43 Handling and Placing Concrete:

(a) Thickness - Place structural concrete overlays with a minimum thickness of 2 inches, as shown.

(b) Construction Limitations - Place structural concrete overlays against a firmly fixed bulkhead. Control sagging or running of freshly placed concrete in areas of steep gradient by one or both of the following methods:

- Modifying direction or method of placement
- Modifying slump

Except when allowed, keep traffic off the lane adjacent to a placement for at least 4 hours after the placement is completed. When allowed, slow traffic by flagging for at least 4 hours after completion of the pour. In both cases, the Engineer may increase the time limits due to weather or traffic conditions.

(c) Placement Procedures - Furnish at least two transverse work Bridges, not counting the finishing machine for structural concrete overlays.

(1) Preceding Placement - Each Day before placing concrete operate the finishing machine, in the presence of the Engineer, over the deck to check that the required thickness of concrete overlay will be achieved. Place concrete working up-grade, unless otherwise approved.

(2) Joints - At transverse and longitudinal joints, saw cut the section previously placed to form a straight, vertical edge before placing any adjacent sections. Saw cutting joints may be omitted if the bulkhead produces a straight, smooth, vertical surface. On both saw cut and formed joints remove all loose material by sand blasting or water blasting the face of the joints.

a. Longitudinal Joint - Place overlays full width with no longitudinal joints. Longitudinal joints will only be allowed as shown or approved by the Engineer.

b. Transverse Joint - When placement operation is delayed by 1/2 hour or more, form a construction joint by removing all material not up to finish grade, in a straight line.

(3) Placing - After the deck surface has been cleaned and immediately before resurfacing, broom a thin coat of grout onto the prepared deck. Ensure that all parts of the prepared deck receive a vigorous brooming that scrubs the grout into the deck surface and results in an even coat with no excess grout collecting in pockets. Do not extend grout placement more than 15 feet ahead of the overlay being placed. Grout shall be a mixture of water and cement with a w/c ratio of between 0.45 and 0.50. Broom the grout at a rate to prevent drying before being covered by the overlay. If the grout does dry, stop the overlay, remove the dried grout, clean and prepare the affected area of the deck, and reapply grout according to this Subsection.

Stop all placement operations if it starts to rain. Protect fresh previously placed concrete from rain. The Engineer may order removal of all concrete damaged by rain.

(d) Roadway Finish - After the deck has been struck off with a finishing machine, fog the surface horizontally with water according to 00540.28 and float it, only if necessary, to produce a smooth, uniform, sealed surface. Do not spray water directly on the freshly placed concrete and do not allow water to puddle or pond. Hand finishing may be required along edges of concrete placement. Use a 12 foot straightedge during placement to verify deck grades and to correct defects in hand finished areas. The finished surface, when tested with a 12 foot straightedge, shall not vary by more than 1/8 inch. If the concrete surface does not meet the surface tolerance, stop the operation until revised methods, changes in Equipment, or correction of procedures are proposed and approved.

00559.44 Curing Concrete - Wet cure structural concrete overlays according to 00540.51 for a minimum of 7 days.

00559.45 Bond Strength Test - Perform two bond tests for each placement in the presence of and at locations designated by the Engineer within 28 Calendar Days of overlay placement and before opening the Roadway to traffic. Cut 3 inch diameter cores and conduct bond tests on the cores.

The bond tests consist of:

- Coring through the overlay and approximately 1 inch into the existing concrete.
- Attaching a device to the top of the core.
- Exerting a tensile load to the core sufficient to cause failure or achieve 300 psi, whichever occurs first.
- Avoid taking cores in wheel lines.

A successful test is the failure of the concrete substrate or bond failure at or above 175 psi.

After coring and testing, restore the area voided by the cores by blowing with compressed air and filling with an approved PCC repair material.

00559.46 Delamination Inspection:

(a) Delamination Inspection and Repair - Perform a deck delamination survey, in the presence of the Engineer, using chain drag or other approved methods.

Repair all delaminated areas of 1 square foot or greater. Delaminated areas of less than 1 square foot will not require repair. Repair limits to be approved by the Engineer.

00559.47 Surface Finish and Tolerance:

(a) Surface Tolerance - Correct all non-specification surface tolerances according to 0559.43(d) after curing and before texturing with a self-propelled diamond grinder. Correct the surface tolerances before opening the Roadway to traffic at no additional cost to the Agency.

(b) Saw Cut Texturing - Texture the concrete according to 00540.50(c) after wet curing for 7 Calendar Days and correcting non-specification surface tolerances.

00559.48 Crack Sealing - The surface will be inspected by the Engineer for cracks.

After correcting non-specification surface tolerances and after texturing the deck surface, seal all visible cracks as follows:

- In areas where cracks are 10 feet or more apart, seal each crack separately.
- In areas where the cracks are numerous or are less than 10 feet apart, seal the entire area where the cracks occur.

Seal with a low modulus concrete and crack sealer.

Perform all repair and sealing Work at no additional cost to the Agency. Complete all repair and sealing Work before opening to traffic. If the Bridge is opened to traffic at the Contractor's request before completing repair Work, all additional traffic control to complete the repair Work will be at no additional cost to the Agency.

Maintenance

00559.60 Protection of Concrete - Repair or replace any part of the overlay damaged by traffic or damaged from any other cause before its official acceptance, according to 00170.80. Do not operate

construction Equipment or allow Public Traffic on newly placed concrete until the following requirements are met:

- Comply with 00150.60, 00559.45, 00559.46 and 0559.47.
- The concrete attains a compressive strength of at least 3000 psi as determined by testing at least three cylinders cured according to AASHTO T 23 (field cure) and tested according to AASHTO T 22. The maturity method, AASHTO T 325, may be used to estimate concrete strength for opening Pavement to construction traffic. Install at least two maturity thermocouples for each Day's placement in areas where the maturity method will be used for early opening. Install the thermocouples near the Day's final placement for areas being evaluated for early opening. When the maturity method is used, the Engineer may verify the maturity method with strength specimens. Establish a new strength-maturity relationship if strength specimens deviate more than 10 percent from the maturity-estimated strengths. Suspend use of the maturity method for opening Pavements to traffic when the strength-maturity relationship deviates by more than 10 percent until a new strength maturity relationship is established.
- The surface of the concrete is protected from scarring or abrasion and kept free of stones, loose mortar and other matter apt to be deleterious to the concrete in the paths of Equipment.

Measurement

00559.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Structural Concrete Overlay Material - Structural concrete overlay Material will be measured on the volume basis. The quantities will be determined from the delivery vehicle batch tickets and checked using the yield factor according to AASHTO T 121 (ASTM C138).

A deduction will be made for Material placed and removed beyond saw cuts or formed construction joints.

(b) Construct Structural Concrete Overlay - Constructing structural concrete overlays will be measured on the area basis. The area will be determined by measuring the actual surface area of the resurfaced bridge deck.

(c) Saw Cut Texturing - The quantities of surface texturing will be measured on the area basis and will be the area of each bridge deck or end panel shown less 16 inches along each curb and 6 inches from joint blockouts and bridge ends. Field measurement of surface texturing will not be made.

Payment

00559.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Structural Concrete Overlay Material	Cubic Yard
(b)	Construct Structural Concrete Overlay	Square Yard
(c)	Saw Cut Texturing	Square Yard

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00560 - Structural Steel Bridges

Description

00560.00 Scope - This Work consists of furnishing, fabricating, and erecting steel Structures as shown or specified. It also includes miscellaneous metal Work on Bridges and Structures, such as access hole covers, frames, ladders, hangers, anchor bolts, scuppers, conduits, ducts, bearing devices, and structural steel shapes.

00560.02 Prefabrication Conference - Meet with the Steel Fabricator, the Engineer and the Agency's steel Inspector for a conference at a time mutually agreed upon in advance of ordering steel materials for fabrication. At this conference, present and discuss all phases of the steel fabrication schedule and Work. A prefabrication conference is not required for miscellaneous metal Work, unless required by Special Provision.

00560.03 Working Drawings - Submit unstamped Working Drawings according to 00150.35. Any Work done before review of these drawings shall be at the Contractor's risk. When material is ordered in advance, obtain approval before placing the order.

Provide steel identification on the Working Drawings according to 00560.22(a).

(a) Reviews - The Engineer's review of the Working Drawings submitted will only cover "strength and detail" requirements. The Engineer assumes no responsibility for errors in dimensions.

(b) Revisions - Submit copies of any revisions to the detailed Working Drawings for review. Work done before review of these revisions shall be at the Contractor's risk.

Materials

00560.10 Materials - Furnish structural plates, shapes, bars, and miscellaneous metals meeting the requirements of Section 02530 and Section 02560.

Shop Fabrication

00560.20 Notice of Work - Give the Engineer at least 14 Calendar Days' notice of the beginning of Work at the mill, when directed, or at the shop, so inspection may be provided. The term "mill" means any rolling mill or foundry where material for the Work is to be manufactured. Do not fabricate material, or perform Work at the mill or shop, before the Engineer has been notified.

00560.22 Test Results Certificate and Steel Identification:

(a) Test Results Certificate and Initial Identification - Furnish test results certificates, showing chemical analysis and physical tests for each heat or plate of steel, for all members according to 00165.35 and Section 02530. Identify each piece of steel to be fabricated.

Identify on Working Drawings each piece to be made of steel other than AASHTO M 270 (ASTM A709), Grade 36 steel. Give pieces made of different grades of steel different assembling or erecting marks, even though they are of identical dimensions and detail.

Provide a system of marking individual pieces made of steel, other than AASHTO M 270 (ASTM A709), Grade 36, and issue cutting instructions to the shop (generally by cross-referencing the assembly marks on the Working Drawings with the corresponding item on the mill purchase order) that maintain identity of the heat number.

Material that can be identified by heat number and mill test report may be furnished from stock.

Mark any unmarked excess material placed in stock for later use with the heat number and with its AASHTO M 160 (ASTM A6) specification identification color code.

(b) Steel Identification during Fabrication - During fabrication, and until member assembly, each piece of steel, other than AASHTO M 270 (ASTM A709), Grade 36 steel, shall show clearly and legibly its specification identification color code shown in AASHTO M 160 (ASTM A6).

Individually marked pieces of steel used in furnished size, or reduced from furnished size, may be used only if end or edge trim does not disturb the heat number or color code. Any usable piece may be used without further color coding providing the heat number or color code remains legible.

Mark individual pieces, other than AASHTO M 270 (ASTM A709), Grade 36, with the AASHTO M 160 (ASTM A6) specification identification color code before cutting to a smaller size.

Mark individual pieces of steel, other than AASHTO M 270 (ASTM A709), Grade 36 steel, which are furnished in tagged lifts or bundles with the AASHTO M 160 (ASTM A6) specification identification color code immediately on being removed from the bundle or lift.

Pieces of steel, other than AASHTO M 270 (ASTM A709), Grade 36 steel, which before assembling into members, will be subject to fabricating operations such as heating, blast cleaning, galvanizing or other coating that might obliterate paint color code marking, shall be marked for grade by steel die stamping or by a substantial tag firmly attached. Use only rounded characters when primary stress components are identified by steel die stamping. Impressions shall have a maximum allowable depth of 0.010 inch and shall be placed a minimum distance of 2 inches from edges of tension-stressed plate members. Characters shall be 1/4 inch to 3/8 inch high and shall have a minimum face radius of 0.015 inch.

(c) Check Samples - To verify the accuracy of test reports, obtain check samples from material furnished for fabrication. The plates, shapes or bars from which check samples are required will be as designated on the Plans, and shall be ordered from the mill with the extra size required for samples. The Engineer may take additional samples from drop-offs or scrap material as deemed necessary. No more than two samples will be required from any one plate according to AASHTO M 270 (ASTM A709) Grade 36, 50, HPS 50W and HPS 70 W with QT processing, or from any one shape or bar. Remove material for check samples in the presence of the Engineer. The Engineer will select the locations where samples are to be taken. Check samples may be ordered cut from either end of the designated steel plate, according to AASHTO M 270 (ASTM A709) Grade 36, 50, HPS 50W and HPS 70 W with QT processing, or shape or bar. To verify accuracy of test reports for HPS 50W and HPS 70W with thermo-mechanical control process, check samples of both ends of each plate is required.

Check samples in plates shall be rectangular, not less than 24 inches long in the required direction, depending on plate width, for the longitudinal axis of tensile specimens, and 5 inches wide. Bend specimens, where required, shall be not less than 24 inches long in the direction of rolling of the plate. Check samples in bars or shapes shall be the full section and at least 24 inches long. In removing the sample, take care not to damage it by overheating. The Agency will be responsible for the necessary machining of check test specimens and their testing. To expedite obtaining test results, the Contractor may, if approved, perform machining and testing of specimens, in the presence of the Engineer.

The normal basis of acceptance of material will be the mill report or other test report, and fabrication need not be held up pending results of check tests. If the check tests indicate material with properties failing to meet the minimum requirements of the material specification, the material may be rejected and the Contractor required to order new material at no additional cost to the Agency.

For purposes of determining compliance with the Specifications, if the results on an original tensile specimen are within 2,000 psi of the required tensile strength, within 1,000 psi of the required yield point, or within 2 percent of the required elongation, a retest will be allowed on two random specimens from the heat or lot. If the results from both of these retest specimens meet Specifications, the heat or lot will be accepted. The specimens shall be oriented with the final direction of rolling in the same manner as the original specimen, and may come from any location within the plate. The extra material from plates, shapes or bars that is not used for check testing shall become the property of the Contractor.

(d) Certification of Identification - Upon request, furnish an affidavit certifying that throughout the fabrication operation the identification of steel has been maintained according to this Specification.

00560.23 Shop Inspection and Testing:

(a) Facilities - Furnish facilities for the inspection of material and Work in the mill and shop. Allow the Engineer free access to the material and Work for inspection.

(b) Testing - Furnish samples for testing as specified according to Section 00165.

(c) Rejections - The Inspector's inspection at the mill or shop of any material, Work or finished members will not prevent their subsequent rejection, if later found damaged or defective, nor relieve the Contractor of the responsibility to correct or replace the Work at no additional cost to the Agency.

(d) Transport - Ship no member or piece of fabricated steel without the Inspectors' label or marking.

00560.24 Transporting to, Handling and Storage at Shop - In transporting, handling, and storing the steel Work at the shop, avoid bending, scraping, or overstressing the pieces. Reject pieces bent or otherwise damaged. In addition:

- Conduct the loading, transporting and unloading of pieces so the metal remains clean.
- Keep materials free from dirt, oil or other contaminants, and protect from corrosion.
- If pieces are shop-painted, handle with slings or other means that will not damage coating system.
- Handle and store girders and beams upright, and shore.
- Support and handle members so Camber is maintained.
- Support long members, such as columns and chords, on skids placed near enough together to prevent damage from deflection.
- Store materials on platforms, skids or other supports above ground and high water elevations and slightly pitch all trough sections that might retain water to provide drainage.

00560.25 Plate Work:

(a) Straightening - Straighten bent or distorted plates, angles, and other shapes or built-up members according to paragraph 3.7.3 of AWS D 1.5, and as specified.

(b) Orientation of Plates - Unless otherwise shown, cut and fabricate steel plates for main members, and splice plates for flanges and main tension members, so the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses.

(c) Plate Cut Edges:

(1) Edge Planing - Plane, mill, grind or thermal cut to a depth of 1/4 inch all sheared edges of plate more than 5/8 inch in thickness and carrying calculated stress.

(2) Flame Cutting - Flame cut structural steel according to paragraph 3.2.2 of AWS D1.5, and as specified.

(3) Visual Inspection and Repair - Visually inspect and repair plate cut edges according to paragraph 3.2.3 of AWS D1.5, and as specified.

(4) Re-entrant Corners - Fillet re-entrant corners to a radius of at least 3/4 inch before cutting.

(5) Corners and Edges - Round all corners and edges of steel members, or bevel 1/16 inch.

(d) Bent Plates - Unwelded, cold-bent, load-carrying, rolled-steel plates shall be:

- Rounded at the corners of the plate before bending, to a radius of 1/16 inch throughout the portion of the plate at which the bending is to occur.
- Bent at right angles to the direction of rolling, except that cold-bent ribs for orthotropic-deck Structures may be bent in the direction of rolling if allowed.
- Bent so no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal, are:

	Plate Thickness				
	Up to 1/2"	**Over 1/2" to 1"**	**Over 1" to 1 1/2"**	**Over 1 1/2" to 2 1/2"**	**Over 2 1/2" to 4"**
All grades of structural steel in this Specification	2 t	2.5 t	3 t	3.5 t	4 t

Where t = Plate thickness in inches

Low alloy steel in thicknesses over 1/2 inch may require hot bending for small radii.

00560.26 Welding:

(a) Bridge Welding - Welding, welder qualifications, prequalification of weld details, and inspection of welds for Bridge Structures shall all conform to AWS D1.5.

(b) Non-Bridge Structures - Welding, welder qualifications, prequalification of weld details and inspection of welds for non-Bridge Structures shall all conform to AWS D1.1. Non-Bridge Structures include bridge railing posts, railing splices, deck expansion joints, earthquake restraints and similar Structures. Submit all welding procedure specifications to the Engineer for approval.

Test earthquake restraint welds radiographically or ultrasonically. Testing will be witnessed by the Engineer. Additional inspection for earthquake restraint welds shall include:

- Ultrasonic inspection of 100 percent of the complete penetration welds using a straight beam transducer. A weld will be acceptable if it has no indications of cracks and no indications of lack of fusion between adjacent layers of weld metal and between weld metal and base metal.
- Magnetic particle inspection of 10 percent of the fillet welds.

00560.27 Bolt Holes:

(a) Punched Holes - Use a die with a diameter not exceeding the diameter of the punch by more than 1/16 inch. Ream any holes that are required to be enlarged to admit the bolts. Make clean cut holes without torn or ragged edges. Poor matching of holes will be cause for rejection.

(b) Drilled or Reamed Holes - Assemble and securely hold connecting parts requiring drilled or reamed holes. Match-mark connecting parts before disassembling.

Where practicable, direct reamers by mechanical means.

Perform drilling and reaming with twist drills. Make drilled or reamed holes cylindrical, perpendicular to the member, and complying with the size requirements of the Specifications. Remove burrs on the outside surfaces. If required, take apart assembled parts for removal of burrs caused by drilling.

Poor matching of holes will be cause for rejection.

(c) Accuracy of Punched and Drilled Holes - Locate all holes punched full size, subpunched, or subdrilled so accurately that after assembling (before any reaming is done) a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the connecting holes in the same plane. Non-conforming pieces will be rejected. If any hole will not pass a pin 3/16 inch smaller than the nominal size of the hole, the non-conforming pieces will be rejected.

(d) Accuracy of Drilled and Reamed Holes - When holes are drilled or reamed, 85 percent of the holes in any connecting group shall, after drilling or reaming, show no offset greater than 1/32 inch between adjacent thicknesses of metal.

Provide steel templates with hardened steel bushings in holes and accurately dimensioned from centerlines of the connections inscribed on the template. Use the centerlines in accurately locating the template from the milled or scribed ends of the members. When steel templates 1 inch or greater in thickness are used six or fewer times in drilling members, hardened steel bushings are not required.

(e) Fitting for Bolting - Clean surfaces of metal in contact before assembling. Assemble, well pin, and firmly draw together the parts of a member before drilling, reaming, or bolting is commenced. Take apart assembled pieces, if necessary, for the removal of burrs and shavings produced by the operation. Construct the member free from twists, bends, and other deformation.

Perform drift pinning during assembling only to bring the parts into position and not sufficient to enlarge the holes or distort the metal.

(f) Holes for High-Strength Bolts and Unfinished Bolts - Punch or drill all holes for high-strength bolts and unfinished bolts. When there are not more than five thicknesses of material in a member, and the material is not thicker than 3/4 inch for structural steel or 5/8 inch for high-

strength steel, the metal may be punched 1/16 inch larger than the nominal diameter of the bolts unless subpunching and reaming are required by the Specifications.

When there are more than five material thicknesses in a member, or when any material is thicker than 3/4 inch for structural steel or 5/8 inch for high-strength steel, either sub drill holes or drill full size.

When required by 00560.27(g), subpunch or sub drill all holes 3/16 inch smaller and, after assembling, ream 1/16 inch larger or drill full size to 1/16 inch larger than the nominal diameter of the bolts. Sub drill if thickness limitation governs.

Holes not more than 1/32 inch larger than the nominal diameter resulting from a drill or reamer of the nominal diameter are considered acceptable. The slightly conical hole from punching operations is considered acceptable.

(g) Holes for Ribbed Bolts, Turned Bolts, and Others - Make holes with a driving fit as specified for ribbed bolts, turned bolts, or other approved bearing-type bolts by one of these methods:

- Subpunch or sub drill 3/16 inch smaller than the nominal diameter of the bolt and ream, while assembled,
- Drill to a steel template, or
- Drill from the solid after assembling.

(h) Holes for Field Connections:

(1) Subpunching and Reaming Field Connections - Unless otherwise specified, subpunch (or sub drill if subdrilling is required according to 00560.27(f) or 00560.27(g)) and subsequently ream holes in all field connections and field splices of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders, and rigid frames while assembled on a steel template, as required by 00560.43. Holes for field splices of rolled beam stringers continuous over floor beams or crossframes may be drilled full size unassembled to a steel template.

Subpunch and ream all holes for floor beam and stringer field end connections to a steel template or ream while assembled. Drill or ream full size field connection holes through a steel template after the template has been carefully located as to position and angle and firmly bolted in place. Make templates used for reaming matching members, or the opposite faces of a single member, exact duplicates. Locate templates used for connections on like parts or members so accurately that the parts or members are duplicates and require no match-marking.

For any field connection, instead of subpunching and reaming or subdrilling and reaming, the Contractor may drill holes full size with all thicknesses of material assembled in proper position.

Use templates as described above, or do not interchange splice plates.

(2) Numerically Controlled Punched or Drilled Field Connections - Alternately, for any connection or splice designated in 00560.27(f), instead of subpunching and reaming field connections according to 00560.27(h), the Contractor may punch or drill bolt holes full-size in unassembled pieces and connections, including templates, for use with matching subsized and reamed holes by means of suitable numerically controlled punching or drilling Equipment subject to this Section. Punch or drill full-size holes according to 00560.27(c).

Submit for review a detailed outline of the procedures proposed for accomplishing the Work from initial punching or drilling through check assembly, if required. Include the specific members of

the Structure that may be numerically controlled punched or drilled, the sizes of the holes, the location of common index and other reference points, composition of check assemblies, and all other pertinent information. Do not begin until written approval is received.

Punch or drill holes by numerically controlled Equipment to appropriate size through individual pieces, or drill through any combination of pieces held tightly together. Use each splice plate only once as a template and do not interchange after assembly drilling is complete.

If numerically controlled punching or drilling Equipment is used, the Engineer may require the Contractor, by means of check assemblies, to demonstrate that this punching or drilling procedure consistently produces holes and connections conforming to 00560.27(g) and 00560.43.

00560.28 Carbon Steel Bolt Connections - Unless otherwise shown or specified, make connections with unfinished carbon steel bolts nuts and washers conforming to Section 02560. Use holes conforming to 00560.27.

(a) Turned Bolts - Provide and install turned bolts as follows:

- The body surface shall have a surface roughness of 125 microinches, or less, according to ANSI B46.1.
- The unthreaded body shall equal total thickness of connected parts.
- The outer thread diameter shall equal the nominal diameter of the bolt specified.
- Heads and nuts shall be hexagonal with standard dimensions for bolts of the nominal size specified or the next larger nominal size.
- Install bolts in carefully reamed holes with a tight driving fit.

(b) Ribbed Bolts - Provide and install ribbed bolts as follows:

- The body shall have an approved form with continuous longitudinal ribs.
- The diameter of the body, measured on a circle through the points of the ribs, shall be 5/64 inch greater than the nominal bolt diameter specified.
- Round heads shall conform to ASME B 18.5 unless otherwise specified.
- Ribbed bolts shall make a driving fit with the holes.
- The hardness of the ribs shall be such that the ribs do not permit the bolts to turn in the holes during tightening.
- If for any reason the bolt twists before drawing tight, ream the hole and use an oversized bolt as a replacement.
- Nuts shall be hexagonal, with standard dimensions for bolts of nominal size specified or the next larger nominal size.

(c) Washers - Use hardened washers of suitable thickness under the turning element (nut or bolt head) in tightening.

Use beveled washers where bearing faces have a Slope of more than 1:20 with respect to a plane normal to the bolt axis.

(d) Nuts - Use single self-locking nuts or double nuts unless otherwise shown or specified. The finished side shall be against the washer or plate.

00560.29 High-Strength Bolt Connections:

(a) General - When shown or specified, assemble structural joint connections with high-strength bolts conforming to ASTM F3125, Grade A325 or Grade F1852 or equivalent fastener using bolts, nuts, and washers conforming to Section 02560 and in holes conforming to 00560.27.

Fit-up bolted connections as follows:

- Provide all steel material within the grip of high-strength bolts (no compressible material such as gaskets or insulation).
- Remove burrs that would prevent solid seating, so that parts fit solidly together after bolts are tightened.
- Make Slope of surfaces in contact with the bolt head or nut less than 1:20 with respect to a plane normal to the bolt axis.
- Install all bolts, unless otherwise shown, to expose the heads on the exterior surface of the Structure.

(b) Washer Requirements:

- Where the outer surface of the bolted parts has a Slope greater than 1:20 with respect to a plane normal to the bolt axis, use a hardened, beveled washer to compensate for the lack of parallelism.
- Where ASTM F3125, Grade A325 or Grade F1852 bolts of any diameter are to be installed in standard, oversize, or short slotted hole in an outer ply, provide a hardened washer under the element of the fastener (nut or bolt head) turned in tightening.
- Where ASTM F3125, Grade A325 or Grade F1852 bolts of any diameter are to be installed in a long slotted hole in an outer ply, use plate washers or continuous bars of at least 5/16 inch thickness with standard holes. Provide washers or bars with sufficient size to completely cover the slot after installation. Make the plate washer from structural grade steel. In addition to a plate washer, provide a hardened washer under element of the fastener (nut or bolt head) turned in tightening.
- Oversize and slotted holes are defined by the *Manual of Steel Construction Load and Resistance Factor Design* (AISC).

(c) Surface Conditions - Make all joint surfaces including surfaces adjacent to the bolt head and nut free of scale, oil, grease, dirt, foreign material, and unless otherwise shown or specified, free of paint, lacquer, rust inhibitor, galvanizing or other coating.

(1) Coated Members - Prepare and coat steel-to-steel contact surfaces within slip-critical bolted joints for coated steel according to Section 00594. Prior to assembly, prepare the contact surfaces with approved methods not harmful to the primer.

Coat fasteners visible to the public, as determined by the Engineer, according to Section 00594 (except the primer coat) after installation. Mechanically galvanize all direct tension indicators according to 02560.40.

a. Non-Coastal Projects - On projects more than 25 aerial miles, of the Pacific Ocean, use high-strength fasteners either black or galvanized as the Contractor elects. Use fasteners that meet the following requirements:

1. Black Fasteners - Clean black fasteners, including hardened washers, and the surrounding areas stained by the black fasteners, after installation, using an approved method. Coat according to Section 00594.

2. Galvanized Fasteners - Clean and prepare fasteners as approved, in areas visible to the public, as determined by the Engineer, and coat according to Section 00594 after installation.

b. Coastal Projects - On projects within 25 aerial miles of the Pacific Ocean, use high-strength fasteners, including hardened flat washers, galvanized according to 02560.40 prior to installation. In areas visible to the public, as determined by the Engineer, clean and prepare fasteners as approved, and coat according to Section 00594.

(2) Non-Coated Weathering Steel Members - Blast clean steel-to-steel contact surfaces within slip-critical bolted joints for non-coated weathering steel according to SSPC-SP 10 "Near White Blast Cleaning". Make the appearance of the blast-cleaned surface to closely approximate Pictorial Standard Sa 2-1/2 of SSPC-Vis 1.

Use only fasteners that are black. Do not use direct tension indicators for non-coated weathering steel connections.

Prior to final bolting, ensure all steel-to-steel contact surfaces have maintained the minimum requirements of SSPC-SP 6 *Commercial Blast Cleaning*. The minimum appearance of the surface shall approximate Pictorial Standard Sa 2 of SSPC-VIS 1, Pictorial Surface Preparation Standards for Painting Steel Surfaces. Surfaces that do not meet the requirements of SSPC-SP 6 shall be hand tooled or re-blasted until the appearance of the blast-cleaned surface closely resembles Pictorial Standard Sa 2-1/2 of SSPC-VIS 1 as determined by the Engineer.

(3) Galvanized Members - After galvanizing, roughen surfaces of galvanized slip critical connections by means of hand wire brushing. Power wire brushing is not allowed.

(d) Verification Testing, Installation, and Inspection - Assign lot numbers (including rotational capacity lot numbers) to all fasteners before shipping them. Assemble all components during installation of the fasteners.

Protect fasteners from dirt and moisture at the Project Site. Take from protected storage only as many fasteners as anticipated to be installed and tightened during a work shift. Return fasteners not used to protected storage at the end of the shift.

Do not remove lubricant present in as-delivered condition. If necessary, clean and lubricate fasteners and retest before installation. Use lubricant according to 02560.70. Do not re-lubricate Tension Control fasteners.

Install the bolt, nut, and washer or DTI assembly so that at least three and not more than five threads are located between the bearing face of the nut and the bolt head.

Tighten all connections progressing systematically from the most rigid part of the connection to the free edges.

The Engineer will do the following:

- Before installing fasteners:
  - Check markings, surface conditions, and bolt, nut, washer and DTIs if used storage conditions, and faying surfaces of joints for compliance with 00560.29(c).
  - Observe calibration and testing procedures.
- During fastener installation, monitor to:

- Confirm that the installation procedure is followed and that, when fastener assemblies are supplied, the tensions specified in Table 00560-1 are achieved.
- Assure that the installation method demonstrated in the Verification Testing procedure develops the specified tension.

Provide a tension measuring device at the Project Site that has the capacity for the bolt being installed. Confirm the accuracy of the tension-measuring device through calibration by an approved testing agency at the start of Work and at least annually. Use the tension-measuring device to:

- Calibrate wrenches.
- Assist the bolting crew in understanding and proper use of the method to be used.
- Confirm the ability of the complete fastener assembly to be used in the Work, including lubrication satisfies the tension requirements of Table 00560-1.

Install and tighten all fasteners in aligned holes to at least the tension specified in Table 00560-1. Tightening may be done by turning the bolt while the nut is prevented from rotating when it is impracticable to turn the nut, if approved. When impact wrenches are used, provide them with enough capacity and supplied air to tighten each bolt in 10 seconds or less.

Non-galvanized fasteners may be reused once if approved. Retightening previously tightened fasteners loosened by the tightening of adjacent fasteners will not be considered a reuse. Do not reuse galvanized fasteners.

Use bolt, nut, and washer combinations from the same rotational-capacity lot.

Verify correct lengths of all ASTM F3125, Grade A325 or Grade F1852 bolts. In the tightened connection, do not allow the unthreaded portion of the bolt to jam against the internal threads of the nut.

In the Specifications, "snug-tight" is defined as having all plies of the connection in firm contact.

Table 00560-1

Required Fastener Tension in Bolts

Nominal Bolt Size (inch)	Minimum Tension (kips)
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1 1/8	56
1 1/4	71
1 3/8	85
1 1/2	103

(1) Direct Tension Indicator Tightening - Test, install, and inspect direct tension indicators (DTIs) at the Project Site. Install DTIs under the head of the bolt with the nut turned to tension the bolt. Orient DTI protrusions against the bolt head or a hardened washer. Follow the manufacturer's recommendations for correct orientation of the DTI and additional washers, if any, required for the correct use of the DTI. Do not allow the surface contacting the protrusions of a DTI to turn during the tightening operation. Provide new, unused DTIs galvanized according

to 02560.40. Where tapered holes in washers are in contact with the protrusions of DTI washers, place the face with the smallest hole against the DTI.

a. Testing:

1. Rotational Capacity Testing - Perform Rotational Capacity Tests according to 02560.60.

2. Verification Testing - Perform verification tests in a calibrated bolt tension-measuring device. Conduct three verification tests for each combination of fastener assembly, rotational-capacity lot, DTI lot, and DTI position relative to the turned element (bolt or nut).

Use a special flat insert in place of the normal bolt head holding insert. Do not allow the restrained element to rotate. Install the fastener assembly in the tension-measuring device with the DTI located in the same position as in the Work.

Conduct Verification Tests in two stages.

First, tension the bolt to the load listed in Table 00560-2 under Verification Tension. If an impact wrench is used, tighten the nut using the impact wrench to no more than two-thirds the required tension. Subsequently, use a manual wrench to attain the required tension.

Record the number of refusals of a 0.005 inch tapered feeler gauge in the spaces between the protrusions.

For uncoated DTIs under the stationary or turned element, or for coated DTIs used under the stationary element, do not exceed the number of refusals listed under Maximum Verification refusals in Table 00560-2.

For coated DTIs under a turned element, do not exceed the number of spaces on the DTI less one.

Reject the DTI lot if the number of refusals are not met.

Next, after the number of refusals is recorded at the Verification Tension load, further tension the bolt until the 0.005 inch feeler gauge is refused at all spaces and a visible gap exists in at least one space. Record the load at this condition and remove the bolt from the tension-measuring device. Run the nut down by hand the complete thread length of the bolt, excluding the thread runout. If the nut cannot be run down for this thread length, reject the DTI lot unless the load recorded is less than 95 percent of the average load measured in the rotational capacity test for the fastener lot.

If the bolt is too short to be tested in the calibration device, verify the DTI lot on a long bolt in a calibrator to determine the number of refusals at the Verification Tension listed in Table 00560-2. Reject the lot if the number of refusals exceeds the values listed under Maximum Verification Refusals in Table 00560-2. Verify another DTI from the same lot with the short bolt in a convenient hole in the work. Tension the bolt until the 0.005 inch feeler gauge is refused in all spaces and a visible gap exists in at least one space. Remove the bolt from the tension-measuring device. Run the nut down by hand the complete thread length of the bolt excluding the thread runout. Reject the DTI lot if the nut cannot be run down for this thread length.

b. Installation - Install DTI fastener assemblies using DTIs in two stages. Do not allow the stationary element to rotate.

First, snug the connection with all bolts installed in all holes of the connection and tension to achieve a snug tight condition by snugging in multiple cycles. If the number of spaces in which a 0.005 inch feeler gauge is refused in the DTI after snugging exceeds those listed under Maximum Verification refusals in Table 00560-2, remove the fastener assembly and install and snug another DTI.

Next, for uncoated DTIs under the stationary or turned element, or for coated DTIs used under the stationary element further tension the bolts until the number of refusals of the 0.005 inch feeler gauge is equal to or greater than the number listed under Minimum Installation Refusals in Table 00560-2. If the bolt is tensioned so that no visible gap in any space remains, remove the bolt and DTI, and replace with a new properly tensioned bolt and DTI.

Tighten coated DTIs under the turned element to achieve 0.005 inch feeler gauge refusal in all space locations.

Table 00560-2

Direct Tension Indicators

Bolt Diameter (inch)	Verification Tension (Kips)	Maximum Verification Refusals	DTI Spaces	Minimum Installation Refusals
1/2	13	1	4	2
5/8	20	1	4	2
3/4	29	2	5	3
7/8	41	2	5	3
1	54	2	6	3
1 1/8	59	2	6	3
1 1/4	75	3	7	4
1 3/8	89	3	7	4
1 1/2	108	3	8	4

c. Inspection - In the presence and at the direction of the Engineer, inspect completed DTI connections.

Select, at random, 10 percent of the DTIs or at least two, whichever is greater, for each separate connection. Probe each DTI washer being inspected with the 0.005 inch feeler gauge and document the number of refusals. If the number of refusals meets the Minimum Installation Refusals listed in Table 00560-2 consider the fastener to be correctly tensioned. If the number of refusals does not meet the Minimum Installation Refusals listed in Table 00560-2, test each DTI in the connection with the 0.005 inch feeler gauge and tighten to meet the Minimum Installation Refusals requirements.

(2) Tension Control Fasteners Tightening - Test, install, and inspect tension control fasteners at the Project Site.

a. Testing:

1. Rotational Capacity Testing - Perform Rotational Capacity Tests according to 02560.60.

2. Verification Testing - Perform Verification Testing in a calibrated bolt tension-measuring device. Test a representative sample of not less than three bolt and nut assemblies of each diameter, length, and grade to be used.

Use a special round head insert in place of the typical hex head insert.

Repeat Verification Testing when the condition of fasteners are altered, when changes in method, Equipment or personnel occur, or as directed.

Conduct verification tests in two stages:

First, demonstrate the method for estimating the snug-tight condition to be used on the final product. Record the snug-tight tension.

Next, apply a tension control shear wrench to demonstrate that each bolt develops a tension not less than 5 percent greater than required by Table 00560-1. Follow manufacturer's installation procedure for installation of bolts. Record the final tension.

3. Inspection Torque - Determine Inspection Torque in a calibrated bolt tension-measuring device. Provide a torque wrench with sufficient capacity to perform testing. Match the sampled fastener conditions to the conditions under inspection. Test at least three randomly sampled bolt, nut, and washer assemblies for each diameter, length, and grade used. Tension the sampled bolts to the specified tension in Table 00560-1 by any convenient means. Apply the Inspection Torque wrench to the tensioned bolt to determine the torque required to turn the nut 5 degrees (approximately 1 inch at a 12 inch radius) in the tensioning direction. Calculate the Inspection Torque by averaging the three bolt, nut and washer assemblies of each diameter, length, and grade.

Repeat the Inspection Torque determination when the fasteners conditions are altered, when changes in method, Equipment, or personnel occur, or as directed.

b. Installation - Install tension control fasteners in two stages.

First, using the method developed in the Verification Testing procedure, snug the connection with all bolts installed in all holes of the connection and tension to achieve snug-tight condition.

Next, apply the tension control shear wrench until the spline fractures.

c. Inspection - In the presence and at the direction of the Engineer, inspect completed connections using the Inspection Torque wrench and visually inspect splines for each bolt in the connection. Conduct inspection tests before loss of lubricant and before corrosion begins.

Select at random 10 percent or at least two, whichever is greater, of the tensioned bolts and nuts on the Structure for each separate connection. Apply the Inspection Torque to each nut in the tensioning direction. If the Inspection Torque does not turn the bolt or nut, the connection will be considered properly tensioned. If the Inspection Torque turns the bolt or nut, apply the Inspection Torque to all the bolts and nut in the connection. Re-tension and re-inspect all bolts and nuts that turned at this inspection. The Contractor may re-tension all the bolts in the connection and resubmit it for inspection, provided fasteners assemblies are not damaged.

(3) Turn-of-Nut Fastener Tightening - Test, install, and inspect turn-of-nut fasteners at the Project site.

a. Testing:

1. Rotational Capacity Testing - Perform Rotational Capacity Tests according to 02560.60.

2. Verification Testing - Perform verification testing in a calibrated bolt tension-measuring device. Test a representative sample of not less than three bolt and nut assemblies of each diameter, length, and grade used.

Repeat Verification Testing if the condition of fasteners are altered, when changes in method, Equipment or personnel occur, or as directed.

Conduct verification tests in two stages:

First, demonstrate the method for estimating the snug-tight condition using the same method to be used on the final product. Record the snug-tight tension. Match mark the bolt, nut, and plate.

Next, apply a tensioning wrench to achieve the nut rotation requirement of Table 00560-3 and develop a tension of not less than 5 percent greater than required in Table 00560-1. If necessary, increase rotation to meet these requirements. Record all tension and rotation readings.

3. Inspection Torque - Determine Inspection Torque in a calibrated bolt tension-measuring device. Provide a torque wrench with sufficient capacity to perform testing. Match the sampled fastener conditions to the conditions under inspection. Test at least three randomly sampled bolt, nut, and washer assemblies for each diameter, length, and grade used. Tension the sampled bolts to the specified tension in Table 00560-1 by any convenient means. Apply the Inspection Torque wrench to the tensioned bolt to determine the torque required to turn the nut 5 degrees (approximately 1 inch at a 12 inch radius) in the tensioning direction. Calculate the Inspection Torque by averaging three bolt, nut, and washer assemblies of each diameter, length, and grade.

Repeat the Inspection Torque determination when the fastener conditions are altered, when changes in method, Equipment, or personnel occur, or as directed.

b. Installation - Install fasteners using Turn-of-Nut method in two stages:

First, using the method developed in the Verification Testing procedure, snug the connection with all bolts installed in all holes of the connection and tension to achieve snug-tight condition by snugging in multiple cycles. Match mark each fastener bolt, nut and plate.

Next, apply the tensioning wrench to achieve the nut rotation determined during the Verification Testing. Do not allow the bolt to turn during the tightening process.

c. Inspection - In the presence and at the direction of the Engineer, inspect completed connections using the Inspection Torque wrench and the match marked nut rotation for each bolt in the connection. Conduct inspection tests before loss of lubricant and before corrosion begins.

Select at random 10 percent or at least two, whichever is greater, of the tensioned bolts and nuts on the Structure for each separate connection. Apply the Inspection Torque to each nut the tensioning direction. If the Inspection Torque does not turn the bolt or nut, the connection will be considered properly tensioned. If the Inspection Torque turns the bolt or nut, apply the Inspection Torque to all bolts in the connection. Re-tension and re-inspect all bolts and nuts that turned at this inspection. The Contractor may re-tension all the bolts in the connection and resubmit it for inspection, provided fastener assemblies are not damaged.

Table 00560-3

Nut Rotation from Snug-Tight Condition [1]

Bolt Length (underside of head to end of bolt)	Disposition of Outer Faces of Bolted Parts: Both faces normal to bolt axis	One face normal to bolt axis and other sloped not more than 1:20 (beveled washer not used)	Both Faces sloped not more than 1:20 from normal to bolt axis (beveled washer not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters [2, 3]	2/3 turn (1 1/6 turn)	5/6 turn (1 1/2 turn)	1 turn (1 5/6 turn)

[1] Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by one-half turn and less, the tolerance shall be plus or minus 30°; for bolts installed by two-thirds turn and more, the tolerance shall be plus or minus 45°.

[2] No research has been performed by the Research Council on Structural Connections to establish the turn-of-nut procedure for bolt lengths exceeding 12 diameters. Therefore, the required rotation shall be determined by actual test in a suitable tension measuring device according to 00560.29(d)(3).

[3] Values in parentheses are twice the rotation as defined in 02560.60(a)(1) and 02560.60(a)(2) for zinc coated ASTM F3125, Grade A325 or Grade F1852 bolts only.

Labor

00560.30 Fabricators - Structural steel Bridge fabricators shall have an American Institute of Steel Construction (AISC) Major Steel Bridges (Cbr) certification. For fracture critical Structures, the fabricator shall also have an AISC Fracture Critical Endorsement (F). All fabricators of earthquake restraints shall have either a current AISC Cbr certification or a Simple Steel Bridge Structures (Sbr) certification.

Construction

00560.40 Members Work:

(a) General - Fabricate members true to line and free from twists, bends and open joints.

(b) End Connection Angles - Fabricate floor beams, stringers and girders having end connection angles to exact length shown, as measured between the heels of the connection angles, with a permissible tolerance of + 0 to – 1/16 inch. Where continuity is required, face end connections. Provide connection angles with a thickness of not less than 3/8 inch, nor less than shown after facing.

(c) Stiffeners - Fabricate end stiffeners of girders and stiffeners intended as supports for concentrated loads to have full bearing (either milled, ground, or on weldable steel in compression

areas of flanges, welded as specified) on the flanges to which they transmit load or from which they receive load. Fabricate stiffeners not intended to support concentrated loads, according to paragraph 3.5.1.10 of AWS D1.5, unless specified otherwise.

(d) Abutting Members - Mill, saw-cut or flame cut abutting members carrying compression at joints in trusses, columns and girder flanges, to give a square joint and uniform bearing. At joints not required to be faced, the opening shall not exceed 1/4 inch.

(e) Annealing and Stress Relieving - Perform finished machining, boring and straightening on structural members which are specified to be annealed or normalized subsequent to heat treatment. Normalize and anneal (full annealing) according to ASTM A941. Maintain the temperatures uniformly throughout the furnace during the heating and cooling so the temperature at no two points on the member will differ by more than 100 °F at any one time.

Make a record identifying the pieces in each furnace charge and show the temperatures and schedule actually used. Provide proper instruments, including recording pyrometers, for determining at any time the temperatures of members in the furnace. Provide the records of the treatment operation to the Engineer.

Stress relieve members, such as bridge shoes, pedestals or other parts that are built up by welding sections of plate together according to paragraph 4.4 of AWS D1.5, when specified.

(f) Facing of Bearing Surfaces - The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall conform to ANSI surface roughness requirements of ANSI B46.1, Surface Roughness, Waviness and Lay, Part I, and the following table:

Member	Maximum Surface Roughness
Steel slabs	2,000 microinch
Heavy plates in contact with shoes to be welded	1,000 microinch
Milled ends of compression members, milled or ground ends of stiffeners and fillers	500 microinch
Bridge rollers and rockers	250 microinch
Pins and pin holes	125 microinch
Sliding bearings	125 microinch

(g) Pins and Rollers - Turn pins and rollers to the dimensions shown. Make them straight, smooth and free from flaws. Pins and rollers more than 9 inches in diameter shall be forged and annealed carbon-steel shafting. Pins and rollers 9 inches or less in diameter may be cold-finished or forged and annealed carbon-steel shafting.

In pins larger than 9 inches in diameter, bore a hole not less than 2 inches in diameter full length along the axis after the forging has cooled to a temperature below the critical range, under conditions that prevent injury by too rapid cooling, and before annealing.

Provide threads for all bolts and pins for structural steel construction according to ASME B1.1, Unified Inch Screw Threads, Class 2A for external threads and Class 2B for internal threads, except for pin ends having a diameter of 1 3/8 inch, or more, use a thread pitch of 6 threads per inch.

(h) Pin Holes - Bore pin holes true to the specified diameter, smooth and straight, at right angles to the axis of the member and parallel with each other unless otherwise specified. Produce the final surface by a finishing cut.

The diameter of the pin hole shall not exceed that of the pin by more than 0.02 inch for pins 5 inches or less in diameter, or by 0.03 inch for larger pins.

The distance outside-to-outside of end holes in tension members and inside-to-inside of end holes in compression members shall not vary from that specified more than 1/32 inch. Bore holes in built-up members after the fabrication is completed.

(i) Shear Connectors - Fabricate shear connector studs with material, welding and inspection according to Section 7 of AWS D1.5.

00560.41 Repair of Defects - Do not begin the repair of defects in the fabricated material until the proposed corrective procedure has been approved.

00560.42 Cambering - Provide a smooth, unbroken curve or Camber over the full length of the member when shown.

Camber roll beams in the fabricating shop by use of heat or hydraulic jacks. The temperature of the heated area shall not exceed 1,200 °F as controlled by pyrometric stick (temperature crayon) or thermometers. Do not quench to accelerate cooling.

Trim web plates of cambered plate girders before assembly.

Camber truss spans according to 00560.46.

00560.43 Shop Assembling:

(a) General - Assemble in the shop the field connections of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders and rigid frames with milled ends of compression members in full bearing, and then ream their subsize holes to specified size while the connections are assembled. Use full truss or girder assembly, unless progressive truss or girder assembly, full chord assembly, progressive chord assembly, or complete Structure assembly is specified.

Make check assemblies with numerically controlled punched or drilled field connections and template drilled field connections of rolled beam stringers continuous over floor beams or cross frames according to 00560.43(g).

Obtain approval for each assembly, including Camber, alignment, accuracy of holes and fit of milled joints before reaming is commenced or before a numerically controlled drilled check assembly is dismantled.

Furnish a Camber diagram, prepared by the fabricator, showing the Camber at each panel point in the cases of trusses or arch ribs, and at the location of field splices and fractions of span length (quarter points minimum, tenth points maximum) in the cases of continuous beam and girders or rigid frames. When the shop assembly is Full Truss or Girder Assembly or Complete Structure Assembly, show the Camber measured in assembly. When any of the other methods of shop assembly is used, show calculated Camber.

(b) Full Truss or Girder Assembly - Assemble all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder or rigid frame at one time.

(c) Progressive Truss or Girder Assembly - Assemble, initially for each truss, bent, tower face or rigid frame, all members in at least three connecting panels, but not less than the number of panels in three connecting chord lengths.

Assemble, initially for each arch rib, continuous beam line or plate girder, at least three connecting shop sections.

Make successive assemblies with at least one panel or section of the previous assembly (repositioned if necessary and adequately pinned to assure accurate alignment) plus two or more panels or sections added at the advancing end.

In the case of Structures longer than 150 feet, make each assembly not less than 150 feet long regardless of the length of individual continuous panels or sections.

The sequence of assembly may start from any location in the Structure and proceed in one or both directions, so long as the preceding requirements are satisfied.

Obtain approval for assemblies consisting of less than three panels or shop sections.

(d) Full Chord Assembly - Assemble, with geometric angles at the joints, the full length of each chord of each truss or open spandrel arch, or each leg of each bent or tower, then ream their field connection holes while the members are assembled, and ream the web member connections to steel templates set at geometric (not cambered) angular relation to the chord lines. Mill at least one end of each web member or scribe normal to the longitudinal axis of the member and accurately locate the templates at both ends of the member from one of the milled ends or scribed lines.

(e) Progressive Chord Assembly - Assemble connecting chord members in the manner specified for Full Chord Assembly and in the number and length specified for Progressive Truss or Girder Assembly.

(f) Complete Structure Assembly - Assemble the entire Structure, including the floor system.

(g) Check Assemblies with Numerically Controlled Punched and Drilled Field Connections - A check assembly consists of at least three connecting shop sections, or in a truss, all members in at least three connecting panels, but not less than the number of panels in three connecting chord lengths; that is, the length between field splices. Check assemblies shall be based on the proposed order of erection, joints in bearings, special complex points such as the portals of skewed trusses, and similar considerations, as directed. Check assemblies shall be the first such sections of each major structural type to be fabricated.

Use geometric angles (giving theoretically zero secondary stresses under dead-load conditions after erection) or cambered angles (giving theoretically zero secondary stresses under no-load conditions) as shown or specified.

No match-marking and no shop assemblies other than the check assemblies are required.

If the check assembly fails to demonstrate that the required accuracy is being obtained, further check assemblies may be required at no additional cost to the Agency. Acceptance of the check assembly does not relieve the Contractor of the responsibility for assuring accurate fit-up during erection.

(h) Match-Marking - Match-mark connecting parts assembled in the shop for the purpose of reaming holes in field connections, and furnish a diagram showing such marks to the Engineer.

00560.44 Coatings :

(a) Galvanizing - Galvanize as shown or specified according to 02530.70.

(b) Other Coatings - Unless otherwise shown or specified, prepare and coat all steel surfaces according to Section 00594.

00560.45 Marking and Transporting to Site - Handle members and transport to the Project Site according to 00560.24 and the following:

- Mark each member with an erection mark for identification and furnish an erection diagram showing the erection marks.
- Mark the weight of members weighing more than 6,000 pounds on the member.
- Load structural members on trucks or cars so they may be transported and unloaded without being excessively stressed, deformed or otherwise damaged.
- Ship fasteners (bolts, nuts, and washers) according to 02560.60(a)(3).
- Do not allow welding to be done on the steel members for the purpose of transporting anchorage.
- List and describe the contained material plainly on the outside of each shipping container.
- Furnish as many copies of material orders, shipping statements and erection diagrams as directed and show the weights of the individual members on the statements.
- Brace the girders properly and adequately, so as to eliminate cyclic out-of-plane bending stresses in the web gap between the end of stiffener on the web and the girder flange due to cyclic swaying motion in transit. Take care to minimize dynamic loads transmitted to girder support points during transit.
- Furnish the Engineer stamped detail Plans of loading, unloading, supporting and bracing of the steel plate girders on trucks or cars for shipment to the Project Site, according to 00150.35. The review will not relieve the Contractor of responsibility for safe transportation of steel members.

00560.46 Erecting:

(a) General - Erect the metalwork, remove temporary construction and do all Work required to complete the Structures, including the removal of the old Structures according to Section 00501, if specified.

(b) Methods and Equipment - Before starting the erection Work, the erection method proposed and the amount and character of Equipment to be used will be reviewed. This review will not relieve the Contractor of the responsibility for the safety of the method or Equipment, or from carrying out the Work in full according to the Plans and Specifications. Do not perform Work until approval has been obtained.

(c) Falsework - Design, construct, maintain and remove falsework according to 00540.41, 00540.42, and 00540.52. Review of the Contractor's Plans will not relieve the Contractor of any responsibility.

(d) Field Inspecting and Testing - All erecting Work is subject to the Engineer's inspection. Provide all facilities required for a thorough inspection of the Work. Material not previously inspected, as well as previously inspected material, will be inspected after delivery to the construction Site.

(e) Handling and Storing Materials - Handle and store materials at the erection site according to 00560.24 and 00560.45.

(f) Bearings and Anchorages - Test, furnish and place structure bearings according to Section 00582. Construct rockers, hangers and other anchorages made entirely of structural steel according to the following:

- Drill holes for anchor bolts and set them in portland cement grout, or preset them as specified.
- Locate anchors and set rockers or rollers considering variation from mean temperature at the time of setting, and anticipated lengthening of bottom chord or bottom flange due to dead load after setting. As nearly as practicable, at mean temperature and under dead load, the rockers and rollers shall stand vertically and anchor bolts at expansion bearings shall center their slots.
- Provide full and free movement of the Superstructure at moveable bearings. Make sure it is not restricted by improper setting or adjustment of bearings or anchor bolts and nuts.

(g) Assembling Steel - Handle the material carefully so no parts will be bent, broken or otherwise damaged.

Do not perform hammering which will injure or distort the members.

Prepare bearing surfaces and surfaces to be in permanent contact before the members are assembled.

Assemble the parts accurately as shown, following any match-marks.

Unless erecting by the cantilever method, erect truss spans on blocking that gives the trusses proper Camber. Leave the blocking in place until the tension chord splices are completed and all other truss connections are pinned and bolted.

Use fitting-up bolts of the same nominal diameter as the high-strength bolts, and cylindrical erection pins 1/32 inch larger.

Fill 50 percent of the holes in splices and field connections with equal numbers of fitting-up bolts and cylindrical erection pins before bolting with high-strength bolts. Fill 75 percent of the holes in splices and connections carrying added construction loads during erection with equal numbers of fitting up bolts and erection pins.

Tighten permanent bolts in butt-jointed splices of compression members and in railings after the span, if movable, has been swung.

Perform all field welding according to AWS D1.5 and all interim specifications.

(h) Pin Connection - Use pilot and driving nuts when driving pins. Drive pins so the members take full bearing on them. Screw pin nuts up tight and burr the threads at the face of the nut with a pointed tool.

(i) Misfits - The correction of minor misfits involving small amounts of reaming, cutting, and chipping will be considered a legitimate part of the erection. However, immediately report to the Engineer any error in the shop fabrication or deformation resulting from handling, storage and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins, or by a moderate amount of reaming and slight chipping or cutting. Have the correction method approved. Make the correction in the Engineer's presence. The Contractor shall be responsible for all misfits, errors and injuries. Make the necessary corrections and replacements as approved by the Engineer.

Finishing and Cleaning Up

00560.70 Finish (Non-Coated Weathering Steel Only) - Sandblast all exposed surfaces of AASHTO M 270 (ASTM A709), Grade 50W non-coated weathering steel, according to SSPC-SP6, Commercial Blast Cleaning, SSPC's *Steel Structures Painting Manual*. The appearance of the

blast-cleaned surface shall approximate Pictorial Standard Sa 2 of SSPC-VIS 1, Pictorial Surface Preparation Standards for Painting Steel Surfaces, except no mill scale particles will be allowed; only rust or mill scale stains down in the profile will be allowed. The use of acids to remove scale and stains in the field is not allowed.

Promptly clean exposed surfaces of steel contaminated with stains, oil or foreign material after the above sand blasting cleaning process, as directed, to preserve conditions for uniform weathering of steel.

Measurement

00560.80 Measurement - No measurement of quantities will be made for Work performed under this Section. Estimated quantities of structural steel will be listed in the Special Provisions.

00560.81 Miscellaneous Metal - Minor metal parts such as access hole covers, frames, ladders, hangers, anchor bolts, scuppers, conduits, ducts, bearing devices and other structural steel shapes, unless otherwise provided, will be classified as structural steel.

The weight of miscellaneous metal will be included in the estimated quantity of structural steel specified.

Payment

00560.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Steel Plate Girder	Lump Sum
(b)	Steel Plate Girder with Haunch	Lump Sum
(c)	Horizontal Curved Steel Plate Girder	Lump Sum
(d)	Steel Box Girder	Lump Sum
(e)	Trapezoidal Steel Box Girder with Haunch	Lump Sum
(f)	Horizontal Curved Steel Box Girder	Lump Sum
(g)	Steel Rolled Beam	Lump Sum
(h)	Structural Steel Maintenance	Lump Sum

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- bolts, studs or bearing devices made entirely of structural steel (such as rockers and hinges)
- fabricating, transporting and erecting the Structures
- furnishing, erecting, and removing falsework
- preparing and coating
- furnishing and installing plain elastomeric bearing pads

Section 00566 – Carbon Fiber Reinforced Polymer Strengthening - Near Surface Mounted

Description

00566.00 Scope - This Work consists of designing and installing a complete, near surface mounted, carbon fiber reinforced polymer (CFRP) strengthening system meeting the loading and design requirements shown. The system is comprised of CFRP reinforcement ("bars") embedded in saw-cut grooves with epoxy.

00566.01 Abbreviations:

CFRP - Carbon Fiber Reinforced Polymer
FRP - Fiber Reinforced Polymer
NSM - Near Surface Mounted

00566.02 Design Standards - Design the NSM-CFRP system according to the requirements of this Section and the requirements of ACI 440.2R or AASHTO *Guide Specifications for Design of Bonded FRP Systems for Repair*.

00566.03 Required Submittals:

(a) Materials Certifications - At least 21 Calendar Days before starting Work, submit the manufacturer's material certifications for the CFRP strengthening system. Include the supplier's name and ranges of the properties listed below, including test methods used, for CFRP and epoxy resin.

Material	Properties to be Furnished
CFRP	Tensile Strength Elongation Tensile Modulus Rupture Strain Surface Finishes Cross-Sectional Area Width Thickness
High Strength Epoxy Resin	Tensile Strength Elongation Tensile Modulus Coefficient of Thermal Expansion Mix Ratio Pot Life Shelf Life UV Resistance

(b) Test Results - At least 21 Calendar Days before starting Work, conduct longitudinal tensile property testing on five samples of the CFRP bar according to Part 2 of ACI 440.3R, ASTM D7205, or ASTM D3039 and submit test results. Sample CFRP bars shall have the same physical properties as and be from the same manufacturer as the bars that will be installed in permanent Work.

(c) Personnel Qualifications - Submit personnel qualifications at the pre-construction conference.

(1) CFRP Application Advisor Certification - Submit the CFRP materials manufacturer's certification of the Contractor's designated CFRP Application Advisor.

(2) CFRP Application Advisor Certification Experience - Submit documentation showing that the Contractor's designated CFRP Application Advisor has experience as CFRP Application Supervisor, CFRP Application Advisor, or lead worker on three bridge or building projects using near surface mounted CFRP bars in the last 5 years. The CFRP material used on projects submitted for experience does not need to be from the same manufacturer as material proposed for this Project.

For each project submitted, include:

- Project name
- Contract number
- Location
- Owner, including contact person's name and telephone number
- Installation work duration (month and year)
- Material used and material manufacturer

(3) Applicators Certification - Submit certification(s) from the CFRP material manufacturer, or from the Contractor's designated CFRP Application Advisor, affirming that all applicators who will install the CFRP system have been trained in the installation of CFRP.

(d) Working Drawings and Calculations - At least 21 Calendar Days before starting Work, submit stamped Working Drawings and design calculations from the manufacturer of the CFRP system according to 00150.35(b) except as modified by this Subsection. Include the following in the Working Drawings:

- All information required for proper construction of the CFRP system
- Material properties of CFRP bars
- Spacing and length of CFRP bars
- Dimensions of saw-cut groove
- Furnished epoxy resin

Include the following in the design calculation:

- Design specifications
- Design criteria
- Material properties
- Calculations
- Installation guide

As-constructed plans of the existing structure(s) are available from the Engineer.

Materials

00566.10 Pre-Approved CFRP Manufacturers and Material List - Furnish rectangular or circular CFRP bars from one of the following list of pre-approved manufacturers.

Manufacturer	Material
Owens Corning Infrastructure Solutions 210 N. 13th Street Seward, NE 68434 Contact: Doug Gremel Phone: (800) 869-0359 or (402) 643-2991 Fax: (402) 643-2149	Aslan™ 500 CFRP Tape Aslan™ 200 CFRP Rod
BASF Building Systems, LLC 5185 Linn Lane West Linn, OR 97068 Contact: Bruce Jackson Phone: (503) 722-4101 or (503) 887-4402 FAX: (503) 722-4131	MBrace® S&P Laminate
Fyfe Co., LLCTyfo® NSM Composite 3940 Ruffin Road, Suite C San Diego, CA 92123 Contact: Scott Arnold Phone: (858) 642-0694 FAX: (858) 444-2982	Laminate Strip System

All bars shall have a textured, deformed, or roughly sanded surface and shall be marked at regular intervals along the length, spaced not more than 6 feet, showing the manufacturer's mark, size designation and production lot number.

00566.11 Epoxy Resin - Furnish high strength epoxy resin from the QPL and according to the CFRP manufacturer's recommendations. Furnish epoxy resin having a viscosity appropriate for the installation, as determined by the CFRP manufacturer.

00566.12 Material Sampling - Provide five samples per lot of CFRP bar materials for testing by the Agency. Samples shall be from the same lot(s) used in the permanent work. Provide the samples at least 21 Calendar Days before starting CFRP installation work. Prepare samples' length and end anchors according to ASTM D7205 or ASTM D3039.

Allow the Engineer to select six additional samples per lot of CFRP bar materials delivered to the site for testing by the Agency. Samples will be a minimum of 8 feet in length.

Labor

00566.30 Personnel Qualifications - Provide a certified and trained CFRP Application Advisor to provide technical assistance prior to and during CFRP Work. Ensure the CFRP Application Advisor remains available for consultation until the completion and acceptance of all CFRP Work.

Provide trained personnel to install the CFRP system.

Construction

00566.40 Existing Reinforcement Location and Concrete Cover - Use rebar detectors or other approved devices, capable of locating existing reinforcement within 0.1 inch, to locate existing top mat reinforcement and determine the thickness of concrete cover. Before constructing grooves, provide the Engineer with a summary of top mat transverse and longitudinal reinforcement measurements.

00566.41 Saw-Cutting Grooves - Construct saw-cut grooves in the concrete at the spacing established by the design submitted according to 00566.03(d), and to the designed width and depth ± 1/8 inch. Make grooves deep enough to allow the CFRP bar to be installed at least 1/8 inch below the surface in all locations along the length of CFRP bars. Where practicable, do not cut into existing rebar during construction of saw-cut grooves. Visually inspect all existing rebar locations after saw-cutting grooves. When existing reinforcement is cut, inform the Engineer before installation of CFRP bars.

Groove spacing may be adjusted in the field as necessary to avoid existing reinforcement or other unforeseen conflicts; however, the average spacing of all grooves over any 2 foot long section may not be more than the spacing required by the submitted design.

00566.42 Groove Preparation - Prepare saw-cut grooves for CFRP bar installation as follows:

(a) Surface Cleaning - Clean the groove according to the manufacturer's recommendations. If the manufacturer has not provided recommendations, thoroughly clean the groove with high-pressure water and a non-metallic brush. Before the groove dries out, blow it free of water and debris with compressed air. Ensure that all dust, sand, laitance, grease, curing compounds, and any other bond-inhibiting matter is removed from the groove. The concrete surface of grooves shall be clean and structurally sound prior to installing CFRP bars.

(b) Moisture on Groove Surfaces - Before installation of CFRP bars, dry groove surfaces using a drying method approved by the Engineer and according to the epoxy manufacturer's recommendations. Do not directly apply a flame to the groove surfaces.

00566.43 Compressed Air - When using high-pressure air for cleaning or blowing down, use adequate separators and traps to ensure that the air is free of water, oil, or any other material detrimental to the CFRP system. Compressed air cleanliness may be tested by the Engineer according to ASTM D4285.

00566.44 CFRP Bar Installation - Begin installation only after all groove preparation work is complete.

Install the CFRP bars according to the manufacturer's recommendations and to the embedment depths shown.

Do not install CFRP bars and epoxy resin when the concrete temperature is below 50 °F, unless otherwise advised by the resin manufacturer’s recommendations.

Provide temporary containment, as required, to contain epoxy resin in the groove. Mask the concrete adjacent to the groove to prevent excess epoxy from adhering to the concrete outside the groove.

Center the CFRP bar in the groove using approved centering devices at one-third points along the CFRP. Centering devices shall not have less than 1/8 inch resin cover when installed. Place nylon or polyethylene spacer material between the CFRP bars and exposed, existing steel reinforcing.

Level epoxy resin flush with the surface of the adjacent concrete.

00566.45 Surface Cleanup - Remove excess epoxy resin outside the groove.

Measurement

00566.80 Measurement - No measurement of quantities will be made for work performed under this Section.

Estimated quantities of CFRP bars will be listed in the Special Provisions.

Payment

00566.90 Payment - The accepted quantities of installed CFRP strengthening will be paid for at the Contract lump sum amount for the item "CFRP Strengthening - Near Surface Mounted".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00570 - Timber Structures

Description

00570.00 Scope - This Work consists of furnishing and installing timber and glue laminated timber in Bridges and other timber Structures as shown or directed. Timber and lumber will be identified as timber in this Section.

The terms "hardware" and "fastenings" include nails, spikes, bolts, washers and nuts, dowels, lag screws, timber connectors, truss rods and shoes, and all other metal used in timber construction.

Materials

00570.10 Materials - Furnish Materials meeting the following requirements:

Coatings for Steel	00594
Coatings for Timber	02210
Connectors and Fasteners	02150
Driven Piles	00520
Galvanizing	02530.70
Glued Laminated Timber	02140
Preservative Treatment	02190
Timber	02130

When preservative treatment of timber is required, the Plans or Special Provisions will indicate the type and kind of treatment.

00570.11 Metal Parts - Hot-dip galvanize all hardware and all other metal parts after fabrication according to 02530.70 or coat all hardware and all other metal parts after fabrication according to Section 00594.

00570.12 Timber Fabrication:

- Use either split ring or shear plate timber connectors as specified. Install in precut grooves of dimensions as recommended by the manufacturer.
- Fabricate all members including holes, grooves, and special cuts, requiring timber connectors before treatment.
- When prefabricating from templates or shop details, bore bolt holes not more than 1/16 inch from specified location and perpendicular to the face of the timber. Bore bolt holes according to 00570.41.
- Submit unstamped Working Drawings for review, according to 00150.35, for prefabricated material before fabrication.

00570.13 Timber Storage - Store timber on the site in orderly piles or stacks. Provide protection from the weather or direct sun by a suitable covering.

Open-stack untreated timber on supports at least 12 inches above the ground surface and sticker to permit air circulation between the tiers and courses. Provide 1/2 inch thick by 1 1/2 inch wide stickers. Place stickers with the wide face bearing against the timber and at a spacing that provides adequate support for the members for their full length. Align stickers vertically to prevent uneven support and warp during storage.

Store timber after fabrication in a manner that prevents alignment changes of the members before assembly.

Store, protect, and handle glue laminated timber according to the American Institute of Timber Construction AITC 111 "Recommended Practice for Protection of Structural Glued Laminated Timber during Transit, Storage, and Erection".

Construction

00570.40 Treated Timber - Handle treated timber that prevents dropping, breaking of outer fibers, bruising, or penetrating the surface with tools. Use nylon slings to handle treated timber. Do not use cant hooks, peaveys, pikes or hooks.

When treated timbers are to be placed in a marine or brackish environments, field treated and untreated cuts, borings and other joint framings will not be allowed below high-water elevation.

Do not cut, frame, or bore treated timber after treatment unless necessary. If untreated wood is exposed by cutting, planing, sanding, or any other means, trim all cuts and abrasions in timber, and cover with two applications of a field preservative according to 02190.30.

Pour field preservative into all holes bored after treatment, or treat the holes with field preservative with an approved pressure hole treater. Treat all unfilled holes with field preservative and plug with treated plugs. Field treat according to 02190.30 and the recommendations of the manufacturer.

When forms or temporary braces are attached to treated timber with nails or spikes, fill the resulting holes by driving larger size galvanized nails or spikes flush with the surface, or plug holes as required for unfilled bolt holes.

00570.41 Fasteners:

- Bore holes for drift pins, drift bolts, and dowels either 1/32 inch smaller than or the same size of the actual pin diameter.
- Bore holes for bolts 1/32 inch to 1/16 inch larger than the bolt diameter. Accurately align holes in main members and side plates. Do not force drive bolts.
- Bore holes for truss rods with a bit 1/16 inch larger than the rod.
- Drive nails and spikes with sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces are evidence of poor Work and sufficient cause for removal of damaged material.
- Bore holes for lag screws in two parts as follows:
  - Bore the lead hole for the shank the same diameter as the shank and the same depth as the length of the unthreaded shank.
  - Bore the lead hole for the threaded portion a diameter equal to approximately two-thirds of the shank diameter.
- Use a malleable iron washer of the size and type designated under all bolt heads and nuts in contact with wood except under button-head bolt heads.
- Lock all nuts after final tightening with a second nut or use self-locking nuts.
- Countersink where smooth faces are required. Coat recesses formed for countersinking with field preservative according to 02190.30 and the manufacturer's directions. After the bolt or screw is in place, fill horizontal recesses with asphalt roofing cement.
- Install all fasteners and connections according to the manufacturer's recommendations.

00570.42 Framing - Cut and frame all timber to a close fit so that the joints have even bearing over the entire contact surfaces. Shimming will not be allowed.

(a) Pile Bents - Drive piles according to Section 00520. No shimming on tops of piles will be allowed.

Select the piles for any one bent as to size, to avoid undue bending or distortion of the sway bracing.

Distribute the piles of varying sizes to secure uniform strength and rigidity in the bents of any given Structure.

(b) Framed Bents - Provide true and even bearing of sills on pedestals or piles. Finish concrete pedestals so the sills or posts support framed bents with even bearing.

Fasten posts to sills as shown. Remove all earth from contact with all timber so there will be free air circulation around them.

(c) Caps - Place timber caps to obtain an even and uniform bearing over the tops of the supporting posts or piles.

(d) Bracing - Bolt or lag screw intermediate intersections of bracing.

00570.43 Stringers - Place stringers according to the following:

- Knots near edges will be in the top portions of the stringers.
- Outside stringers may have butt joints, but lap interior stringers to take bearing over the full width of the floor beam or cap at each end. Do not extend the stringer end more than 6 inches beyond the floor beam or cap.
- Separate the lapped ends of untreated stringers at least 1/2 inch and securely fasten where shown or specified.
- Stagger joints when stringers are two spans in length.
- Frame cross-bridging between stringers as shown, with full bearing at each end against the sides of stringers, and securely toe-nail with at least two nails in each end.

00570.44 Decking - Unless otherwise shown or specified, construct decking with 4 inch x 12 inch planking and covering materials.

(a) Planking - Provide planking that is surfaced on four sides (S4S).

Place planking heart side down with 1/4 inch opening between planks for seasoned material and with tight joints for unseasoned material. Spike planks securely to each stringer with a minimum of one 3/8 inch x 8 inch spike placed 3 inches in from each edge.

(b) Covering Materials - Cover the planking with one of the following:

- 2 inch x 2 inch timber strips, placed transverse to the planking and nailed with 16d galvanized common nails at 12 inch centers. Cover deck with a Level 2, 1/2 inch ACP wearing surface according to Sections 00744 and 00745, as applicable; or
- 1 inch thick tongue and groove structural CD exterior grade plywood. Nail the plywood with face grain parallel to stringers using 10d galvanized or zinc coated ring shank nails. Place nails at 6 inch centers along all edges and 12 inch maximum centers intermediate. Fasten expanded metal grillage with a minimum opening of 1/4 inch and a minimum thickness of 1/8 inch to the top of the plywood for the entire roadway area. Minimum fastening shall be at 12 inch centers each direction using 8d galvanized common nails. Cover deck with a Level 2, 1/2 inch ACP wearing surface according to Sections 00744 and 00745, as applicable.

00570.45 Wheel Guards and Railings - Frame wheel guards and railing as shown, and erect true to line and grade.

Unless otherwise specified, provide wheel guards, rails, and rail posts that are surfaced on four sides (S4S).

Lay wheel guards in sections not less than 12 feet long unless otherwise shown.

For trusses, build railings after the removal of the falsework and the adjustment of the trusses to correct alignment and Camber.

00570.46 Trusses - Finished trusses shall show no irregularities of line. Chords shall be straight and true from end to end in horizontal projection and show a smooth curve through panel points conforming to the correct Camber. Fit all bearing surfaces accurately. Uneven or rough cuts at the points of bearing will be cause for rejection of the piece containing the defect.

00570.47 Coating - When specified, coat timber Bridges according to the manufacturer's recommendations. Kiln dry all timber to 19 percent before coating.

Measurement

00570.80 Measurement - The quantities of all timber, except piling and glue laminated timber, incorporated into the permanent, finished Structure, will be measured on the volume basis, based on the nominal dimensions of the members and the actual dimensioned length. No allowance will be made for waste.

The quantities of glue laminated timber members will be measured on the volume basis, based on the net dimensions of the members.

Driven piles will be measured according to 00520.80.

Asphalt concrete wearing surface will be measured according to 00744.80 and 00745.80, as applicable.

Payment

00570.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Timber and Lumber	MFBM
(b) Glued Laminated Timber	MFBM

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Driven piles will be paid for according to 00520.90.

Asphalt concrete wearing surface will be paid for according to 00744.90 and 00745.90, as applicable.

No separate or additional payment will be made for hardware, fastenings, preservative treatment, or coatings.

Section 00581 - Bridge Drainage Systems

Description

00581.00 Scope - This Work consists of furnishing and installing metal deck drains, drain pipe and appurtenances for Bridges as shown, specified or directed.

Materials

00581.10 Materials - Furnish steel pipe of standard weight meeting the requirements of ASTM A53 and galvanized after fabrication according to AASHTO M 111 (ASTM A123).

Furnish deck drains, hangers, clamps, and other Incidentals meeting the requirements of Section 02530 and Section 02560.

Construction

00581.40 General - To prevent movement during concrete placement, support the pipe and deck drains by ties and other approved devices according to 00530.41.

00581.42 Appurtenances - Provide a watertight connection to the deck drains in the bridge deck as shown or directed.

00581.50 Test Bridge Drainage Systems - Test bridge deck drains and pipe connections to the storm drain system according to Section 00445 to ensure that the drains and drain pipe are water tight and free of obstructions.

Measurement

00581.80 Measurement - The quantities of bridge deck drains will be measured on the unit basis of each deck drain installed.

Payment

00581.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per each, for the item "Bridge Drains".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for drain pipe connected to bridge drains or for water used in testing the drain systems.

Section 00582 - Bridge Bearings

Description

00582.00 Scope - This Work consists of furnishing and installing composite bridge bearings, elastomeric bridge bearings, and rockers and hangers for Bridges as shown, specified, or directed.

00582.02 Definitions:

Composite Bearing - Bearing having a rotational element between an upper and a lower unit. This includes disc bearings, fabric pad bearings, pot bearings and spherical bearings.

Disc Bearing - Composite bearing whose rotational element is comprised of a polyether urethane disc with an upper and lower unit.

Elastomeric Bearing - Bearing consisting of a single layer of elastomer (plain) or of several layers of elastomer alternated with steel plates (reinforced).

Fabric Pad Bearing - Composite bearing whose rotational element is a preformed fabric pad.

Fixed - Restrained against all horizontal structural movement.

Guide Bars - The elements that restrain the lateral movement of a sliding bearing.

Guided - Able to accommodate structural movement in a specified horizontal direction.

Nonguided - Able to accommodate structural movement in all horizontal directions.

Pot Bearing - Composite bearing whose rotational element is a piston supported on an elastomeric disc, totally confined within a base pot cylinder.

Spherical Bearing - Composite bearing whose rotational element consists of an upper plate with a spherical concave bottom surface and a lower plate with a spherical convex top surface.

00582.03 Design - Design and fabricate composite bridge bearings according to the latest edition of the AASHTO *LRFD Design Specifications*.

Materials

00582.10 Materials - Furnish composite bridge bearing Materials meeting the requirements of Section 02570. Furnish elastomeric bridge bearings from the QPL and meeting the requirements of Section 02571.

Furnish rockers and hangers, constructed entirely of structural steel, according to Section 00560.

00582.20 Composite Bearings - Provide only one type of composite bearing from the QPL for each Bridge, subject to the following requirements:

- Make composite bearings, including all plates except distribution plates and masonry plates, removable and replaceable.
- Provide rotational elements between upper and lower units to meet the following:
    - **Upper Unit** - The upper unit shall consist of a distribution plate that is permanently attached to the Superstructure and a sole plate attached to the distribution plate with cap screws. For

a guided or nonguided bearing, a stainless steel sheet shall be welded to the bottom surface of the sole plate.

- **Lower Unit** - The lower unit shall consist of a masonry plate permanently anchored to the structural support and a base plate attached to the masonry plate with cap screws. A separate masonry plate and base plate are not necessary for fabric pad bearings fabricated as outlined in 00582.27, third paragraph.

- **Bearing-to-Base Connection:**

  - The base pot of a pot bearing, the lower bearing plate of a disc bearing, or the convex plate of a spherical bearing shall be welded to the base plate.
  - For guided or nonguided bearings, a polytetrafluoroethylene (PTFE) sheet shall be recessed into and bonded to the top surface of the piston of a pot bearing, the upper bearing plate of a disc bearing, the top surface of the concave plate of a spherical bearing, or a steel backing plate bonded to the top surface of a fabric pad forming a sliding surface with the stainless steel surface of the sole plate.
  - For fixed bearings, the piston of a pot bearing, the upper bearing plate of a disc bearing, or the concave plate of a spherical bearing shall be welded to the sole plate.

Provide bearings that accommodate the loads, movements, and rotations as shown.

Use schematic drawings, and/or details of bearings shown, to describe the attachment of the upper unit to the Superstructure, and the attachment of the lower unit to the Substructure.

00582.21 Disc Bearings - Design disc bearings according to the following:

- The shear restriction mechanism shall allow free rotation but prevent any shear being applied to the rotational element.
- Each guided bearing shall resist the total horizontal load at the bent or hinge where it is located.

00582.25 Composite Bearings with Polytetrafluoroethylene Sliding Surface:

(a) Polytetrafluoroethylene Sliding Surfaces - Recess PTFE 1/16 inch into the material it is bonded to for all composite bearings.

Bond PTFE to the steel substrate sufficiently to develop a horizontal force as shown and not less than 10 percent of the vertical design capacity shown, in addition to the shear force developed as a result of the natural bearing friction shear force.

(b) Polytetrafluoroethylene Rotational Surface for Spherical Bearings - Use only woven PTFE having a minimum thickness of 1/8 inch. The PTFE shall be recessed 1/16 inch into the spherical element.

PTFE fabric minimum thickness shall be 1/16 inch when measured according to ASTM D1777.

(c) Stainless Steel Sliding Surfaces - Provide a flat stainless steel sliding surface which completely covers the PTFE surface in all operating positions, plus at least 2 inches more in every direction of possible movement.

Provide a spherical stainless steel rotational surface attached to the convex surface of the spherical convex plate of each spherical bearing so that it completely covers the convex surface of the plate.

00582.26 Guide Bars for Composite Bearings - Provide a sliding surface between the guide bars and the guide element made of polished stainless steel against virgin PTFE. The virgin PTFE shall be bonded and mechanically fastened to the guide bars. Provide guide bars that:

- Resist the horizontal design forces on the bearing, but not less than 10 percent of the vertical design load of the bearing.
- Resist the total horizontal load at the bent or hinge where it is located. Do not include the resistance due to bearing friction as part of the horizontal load capacity of guided bearings and fixed bearings.
- Are Integral and machined from a solid plate, or attached by welding or with cap screws, or fabricated from a single steel plate.
- Have a space equal to 3/16 inch plus or minus 1/16 inch to the guided member.
- Allow the guided member to be always within the guides at all points of translation and rotation of the bearing. Avoid guiding the member off the fixed base or any extension of it where transverse rotation is anticipated.

00582.27 Sole, Base, Distribution, and Masonry Plates for Composite Bearings - Make the bottom surface of sole plates flat and level. Make the top surface flat, and sloped as required to mate with the bottom surface of the distribution plate.

Use 3/4 inch minimum plates, except sole plates may taper to 5/8 inch at the thinnest edge.

For fabric pad bearings, keeper bars at least 1/4 inch thick shall be fastened to the top surface of the base plate, around the perimeter of the fabric pad, with high-strength cap screws. Provide a gap at all bar ends to allow drainage.

Provide studded anchors or threaded bolts, as shown or specified, to anchor the masonry plates to the supported and supporting members. Locate anchoring devices to avoid conflict with metal reinforcement and prestressing systems.

00582.30 Fabrication - Fabricate bearings according to the reviewed Working Drawings and the Specifications.

(a) Working Drawings - Submit unstamped Working Drawings according to 00150.35 for both composite bearings and elastomeric bearings.

(1) Composite Bearings - For composite bearings, include:

- Complete details of the anchor layout
- Plan and elevation of the bearing showing dimensions and tolerances
- Complete details of all components with sections showing all materials incorporated into the bearing
- All ASTM or other material designations
- Vertical and horizontal force capacity
- Compressive stresses on all sliding surfaces, and on elastomeric polyether urethane and cotton duck surfaces, at maximum and minimum design loads
- Rotational capacity
- Translation capacity for guided and nonguided bearings
- Instructions for installation of the bearing

(2) Elastomeric Bearings - For elastomeric bearings, include:

- The overall dimensions of the bearings
- The durometer hardness of the elastomer and the ASTM designation of reinforcing materials, if any
- The thicknesses of the components of reinforced bearings and the cover over edges of reinforcements

(b) Minimum Requirements for Composite Bearings:

(1) Edges - Grind edges of all parts of the bearing so that sharp edges are eliminated.

(2) Welding - Perform all welding and inspection of welding for structural steel according to 00560.26.

(c) Special Requirements for Horizontal Capacity of Composite Bearings - Submit stamped calculations supporting the design for horizontal force capacity, according to 00150.35. Calculations are not required when the design horizontal capacity is less than, or equal to, 10 percent of the design vertical capacity. A horizontal proof load test report may be submitted instead of engineer's calculations. See 02570.20(b) for test requirements.

00582.31 Disc Bearings - Fabricate upper and lower bearing plates as follows:

- Connect the lower bearing plate to base plate by means of a fillet weld around entire perimeter of the lower bearing plate.
- For a fixed bearing, connect upper bearing plate to the sole plate by means of a fillet weld around the entire perimeter of upper bearing plate.

00582.32 Fabric Pad Bearings - Fabricate fabric pad bearings according to the following:

(a) Steel Backing Plate - Minimum thickness of the steel backing plate shall be 3/8 inch.

Bond the backing plate to the top surface of the fabric pad under controlled conditions and according to the written instructions of the manufacturer of the adhesive system specified by the fabric pad manufacturer.

Finish the surface of steel recess to a surface roughness of 250 microinches or better, and to Class A flatness:

(b) Fabric Pad - Maximum allowable bearing pad thickness is 4 inches. For pads over 2 inches thick, place an 11 gauge steel shim at mid-depth.

00582.33 Pot Bearings - Fabricate pot bearings according to the following:

(a) Pot - Fabricate the pot from one solid plate by machining.

Finish the top and bottom surfaces of the pot cylinder to Class A flatness.

Connect the pot cylinder to the base plate by means of a fillet weld around the entire perimeter of the pot cylinder.

(b) Piston - Fabricate the piston from one solid plate by machining.

Finish the top surface to Class A flatness.

Finish the bottom surface to Class C flatness.

For a fixed bearing connect the piston to the sole plate by means of a fillet weld around the entire perimeter of the piston.

(c) Elastomeric Disc - Make the disc in one piece.

Recess the upper edge of the elastomeric disc to accommodate the flat brass sealing rings.

Lubricate the disc with a material compatible with the elastomer.

00582.34 Spherical Bearings - Fabricate spherical bearings according to the following:

(a) Spherical Concave Plate:

Finish top surface to a roughness of 125 microinches or better, and Class A flatness.

Fabricate the concave radius of the bottom surface to have a positive tolerance not to exceed 0.010 inch according to ANSI Y14.5.

For a fixed bearing, connect to the sole plate by means of a fillet weld around the entire perimeter of top surface of spherical concave plate.

(b) Spherical Convex Plate - Fabricate the top convex stainless surface from one of the following:

- Solid stainless steel ASTM A240, Type 304 or 304L
- Stainless steel weld overlay a minimum of 3/32 inch thick

Fabricate convex radius of the top surface to have a negative tolerance not to exceed 0.010 inch according to ANSI Y14.5.

Finish the top surface to a roughness of 20 microinches or better, and other surfaces to a roughness of 250 microinches or better.

Finish the bottom surface to Class B flatness.

Connect to base plate by means of a fillet weld around entire perimeter of bottom surface of spherical convex plate.

00582.35 Composite Bearings with Polytetrafluoroethylene Sliding Surfaces:

(a) Polytetrafluoroethylene Sliding Surfaces - Bond PTFE to steel substrate under controlled conditions and according to the written instructions of the manufacturer of the adhesive system specified by the PTFE manufacturer.

After completion of the bonding operation, the PTFE surface shall be smooth and free of bubbles.

(b) Stainless Steel Sliding Surfaces - Attach stainless steel to steel substrate by a seal weld around entire perimeter of stainless steel sheet. Clamp stainless steel sheet down to have full contact with the steel substrate during welding. Fabricate so welds do not protrude beyond the sliding surface of the stainless steel.

00582.36 Guide Bars for Composite Bearings - Construct guide bars parallel to the surface on which they bear and to other guide bars to within a tolerance of plus or minus 1/32 inch for the full length of the bar.

The tolerance for section dimensions is plus or minus 1/16 inch.

If guide bars are welded to the sole plate, weld before attaching the stainless steel surface.

00582.38 Coatings for Steel Bearings - Coat all exposed steel surfaces, except stainless steel, according to Section 00594.

00582.39 Elastomeric Bearings - Fabricate elastomeric bearings according to the following:

(a) Pads - Pads 1/2 inch and less in thickness shall be made entirely of elastomer. Pads over 1/2 inch in thickness shall consist of alternate laminations of elastomer and metal.

(b) Pad Sizing - Mold pads individually to the sizes required. No shearing to size or drilling of holes will be allowed except pads 1/2 inch and less in thickness may be sheared.

(c) Tolerances and Finishes - Tolerances and finishes shall be according to 02571.20(d).

00582.40 Shipping and Handling - Protect all bearings from damage during shipment, and keep them dust-free. Protect composite bearings as follows:

- Fully assemble each bearing at the manufacturing plant and deliver to the construction site as a complete unit ready for installation.
- Mark centerlines on the sole plate and base plate for checking alignment in the field.
- Hold bearings together with removable restraints so the sliding surfaces are not damaged.
- Ship and store bearings in lightproof, moisture-proof and dustproof packages.

Construction

00582.50 Installation - Use only one type of bearing on any one Bridge unless shown, specified or directed otherwise.

(a) Composite Bearings - Install composite bearings as follows:

- Obtain approval of the bearing assembly proposed for use before constructing the upper portions of the supporting Structure so bearing elevations may be properly determined.
- Before constructing bridge bearing seats, inform the Engineer in writing, of the total bearing thickness.
- Do not place bridge bearings on concrete bearing areas that are irregular or improperly prepared.
- Install bearings level and according to the manufacturer's recommendations, subject to the Specifications.
- Install bearings in exact positions, and with full and even bearing.
- Protect the sliding surfaces of PTFE bearings from contact with concrete or other foreign matter.
- To prevent gouging and contamination, install bearing with the stainless steel surface on top of the PTFE interface.

(b) Elastomeric Bearings - Construct bearing seats for elastomeric bearings parallel to the bottom surfaces of the members which will bear on them. Install as follows:

- Set elastomeric bearing pads directly on the concrete pad surface.

- Provide for a uniform bearing over the entire area of the bearing seat and over the entire area of the Superstructure member in contact with the bearing pad.
- Keep pads in correct position during erection of Superstructure members.

(c) Cleanup - Remove all forms and debris that interfere with the free action of the bearing assemblies.

Measurement

00582.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Composite Bearings and Steel-Reinforced Elastomeric Bearing Pads - Composite bearings and steel-reinforced elastomeric bearing pads will be measured on the unit basis, of bearing devices in place which includes all components from the bearing seat attachment through the Superstructure attachment.

(b) Plain Elastomeric Bearing Pads - Plain elastomeric bearing pads will not be measured.

Payment

00582.90 Payment - The accepted quantities of bridge bearings will be paid for according to the following:

(a) Composite Bearings and Steel-Reinforced Elastomeric Bearing Pads - Composite bearings and steel-reinforced elastomeric bearing pads will be paid for at the Contract unit price, per each, for the following items:

	Pay Item	Unit of Measurement
(a)	Bearing Devices, ____	Each
(b)	Bearing Devices, _Inch wide, _Inch long, _Inch thick	Each

In item (a), the type (disc, fabric pad, pot, spherical) of composite bearing device will be inserted in the blank.

In item (b), for steel-reinforced elastomeric bearing pads, the width of bearing pad will be inserted in the first blank, the length of the bearing pad will be inserted in the second blank, and the thickness of the bearing pad will be inserted in the third blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for designing, fabricating, and testing composite bearings or steel-reinforced elastomeric bearing pads.

(b) Plain Elastomeric Bearing Pads - No separate payment will be made for plain elastomeric bearing pads. This item is included in payment of precast prestressed concrete and structural steel members.

Section 00583 - Electrical Conduit On Structures

Description

00583.00 Scope - This Work consists of furnishing and installing electrical conduit systems attached to or encased in Structures as shown or as directed.

00583.01 Abbreviations:

GRC - Galvanized rigid conduit
LFNC - Liquid tight flexible non-metallic conduit
PVC - Polyvinyl chloride
RMC - Rigid metallic conduit
RTRC - Reinforced thermosetting resin conduit
SS - Stainless steel

00583.02 Codes and Standards - The publications listed below are referenced by this specification:

- American National Standards Institute, Inc.
  C80.1 *Standard for Electrical Rigid Steel Conduit* (ERSC)

- American Society for Testing and Materials (ASTM)
  B1.20.1 *Pipe Threads, General Purpose, Inch*
  A153 *Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*
  D2564 *Specification for Solvent Cements for Poly (Vinyl Chloride)* (PVC) *Plastic Piping System*

- The Institute of Electrical and Electronics Engineers, Inc. (IEEE)
  IEEE C2 *National Electrical Safety Code* (NESC)

- National Electrical Manufacturers Association (NEMA)
  250 *Enclosures for Electrical Equipment (1000 Volts Maximum)*

- National Fire Protection Association (NFPA)
  NFPA 70 *National Electric Code* (NEC)

- Underwriters Laboratories Inc. (UL)
  UL 1660 *Liquid-Tight Flexible Nonmetallic Conduit*
  UL 6 *Electrical Rigid Metal Conduit - Steel*
  UL 6A *Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel*
  UL 514B *Standard for Safety Conduit, Tubing, and Cable Fittings*
  UL 651 *Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings*
  UL 2515 *Aboveground Reinforced Thermosetting Resin Conduit* (RTRC) *and Fittings*

00583.03 Submittals - Submit detailed descriptions of all Materials to the Agency according to 00150.37 at least 21 Calendar Days before the scheduled start of the Work. Identify all relevant constituents and properties of each Material and the Specifications with which it complies. Data published by the manufacturer is acceptable.

Submit detailed procedures for the Work of this Section according to 00150.37 at least 21 Calendar Days before the scheduled start of the Work. Include the manufacturer's specifications and operating instructions for all Equipment. Do not begin Work before receiving written approval of submittals from the Engineer.

Submit stamped conduit system Working Drawings designed according to NFPA 70 *National Electrical Code* (NEC) according to 00150.35. Design Working Drawings according to the ODOT *Bridge Design Manual*.

Submit unstamped as-built drawings according to 00150.37 showing the final location of all conduit systems within 30 Calendar Days of completing the Work.

Materials

00583.10 Conduit and Elbows - Furnish conduit and elbows meeting one of the following requirements:

(a) Extruded PVC - Extruded PVC electrical conduit and factory bent elbows conforming to UL 651. Furnish gray conduit and elbows. Furnish solvent cement conforming to ASTM D2564 or as recommended by the conduit manufacturer.

(b) Hot-dip GRC - Hot-dip GRC and elbows conforming to UL 6 and ANSI C80.1 with each end threaded per ANSI B1.20.1. Factory threads are to be hot-dip galvanized after cutting. Coating thickness is to conform to ASTM A153.

(c) 316 SS RMC - 316 SS RMC and elbows conforming to UL 6A and ANSI C80.1 with each end threaded per ANSI B1.20.1.

(d) RTRC - RTRC and elbows conforming to UL 2515 for above ground applications. Furnish conduit with UV stabilized gray pigmented resin. Furnish a joint adhesive recommended by the manufacturer.

(e) LFNC - LFNC conforming to UL1660.

00583.11 Fittings and Conduit Bodies - Furnish fittings and conduit bodies conforming to UL 514B. Furnish conduit bodies with a weather tight gasket and expansion fittings with a weather tight seal. Set screw type fittings and conduit bodies are not allowed. Furnish fittings and conduit bodies meeting one of the following requirements:

(a) PVC or thermoplastic - Furnish gray fittings and conduit bodies.

(b) Hot-Dip galvanized malleable iron - Coating thickness is to conform to ASTM A153.

(**c) 316 SS** - Furnish uncoated conduit bodies.

00583.12 Junction Boxes - Furnish UL listed junction boxes meeting one of the following requirements:

(a) PVC or Thermoplastic - PVC or thermoplastic conforming to NEMA 250 Type 4X. Furnish gray junction boxes.

(b) Galvanized Steel - Galvanized steel conforming to NEMA 250 Type 4. Coating thickness is to conform to ASTM A153.

(c) 316 SS - 316 SS conforming to NEMA 250 Type 4X

(d) GFRP - GFRP conforming to NEMA 250 Type 4X.

00583.13 Supports - Furnish supports meeting one of the following:

(a) Hot-dip galvanized - Hot-dip galvanized wedge type anchors, bolts, threaded rod, nuts, and washers according to 02560.10. Furnish hot-dip galvanized steel channel strut, hangers, clamps, support straps, and coil inserts. Coating thickness is to conform to ASTM A153.

(b) 316 SS - 316 SS wedge type anchors, bolts, threaded rod and nuts conforming to ASTM A193/194, Grade B8M, B8MA, B8M2, or B8M3, Class 1, 1A, 1D, or 2 or ASTM F593/594 Group 2 Condition CW. Furnish 316 SS channel strut, hangers, clamps, support straps, and coil inserts, and washers.

For built-up conduit hanger assemblies, furnish assemblies constructed from the same alloy group and with the same finish as the Materials listed in the Subsection.

Adhesive anchoring systems and PVC conduit straps are not allowed.

00583.14 Fire Barrier Sealant - Provide a UL listed fire barrier sealant rated for wall, floor, or ceiling penetrations.

00583.15 Electrical Isolation - Furnish non-conductive resin according to 00535.10 designated as “high strength”.

Furnish neoprene rubber sheets, nylon washers and nylon bolt-hole inserts.

00583.16 Pull Line - Furnish Materials meeting the following requirements:

- Provide nylon, polypropylene, or polyester pull line or rope with a minimum tensile strength of 1,000 pounds.

Labor

00583.30 Electrician Qualifications - Provide electricians licensed in the State of Oregon, holding a General Journeyman or General Supervising license.

00583.31 Supervisor Qualifications - Supervise all Work in the section using Oregon licensed electricians holding a General Supervising license.

Construction

00583.40 General - Install conduit systems on structures according to:

- *National Fire Protection Association, National Electrical Code* (NEC)
- *Institute of Electrical and Electronics Engineers, Inc., National Electrical Safety Code* (NESC)
- *Oregon Electrical Specialty Code* (OESC)
- ODOT *Bridge Design Manual* (BDM)
- Any other local rules, regulations and ordinances which may apply

Field verify all dimensions. Install anchoring systems as shown following all manufacturer’s instructions. Install conduit in the location and of the sizes shown. If field dimensions dictate that conduit size or route differ from the Plans, obtain written approval from the Engineer before proceeding.

Only drill through structural members with written approval from the Engineer. Locate reinforcing bars before drilling through concrete. Perform drilling through concrete without drilling through reinforcing

bars unless otherwise approved, in writing. Repair any damage to the surrounding concrete as directed by the Engineer using an appropriate repair product from the QPL.

Metallic raceways, fittings, boxes, and cabinets shall be free from contact with reinforcing steel.

Where conduits passing through openings are exposed in finished rooms, use a UL listed fire barrier sealant filling Material.

00583.41 Field Cutting - Provide square-cut or square-formed ends on all sections of conduit. Remove any internal and external sharp edges.

Only field cut, clean, and prepare RTRC joints as recommended by the manufacturer.

Field thread cut ends of GRC and RMC according to ANSI B1.20.1 following all manufacturer's recommendations.

00583.42 Bends and Routing - All bends in conduit 1 1/2" diameter and smaller may be made using manual or power tools designed for the purpose. Redirect conduit with 2" and larger diameter with manufactured elbows or conduit bodies.

If field bending is necessary, provide a bending radius not less than six times the inside diameter of the conduit. Make all bends in the conduit without kinking, flattening or appreciably reducing the internal diameter of the conduit.

Avoid trapped runs on conduit. Provide junction boxes with drain fittings at low points in exposed conduit locations.

Do not install more than the equivalent of three 90 degree bends (total 270 degrees) between junction boxes. Use conduit bodies to make sharp changes in direction.

00583.43 Expansion Fittings - Provide expansion fittings with at least a 6-inch throw for all major conduit runs at all Bridge expansion joints.

Secure the expansion fitting to the surface only at the barrel end of the fitting. Adjust the initial setting of the fitting to account for installation temperature and future expansion/contraction movement based on a minimum design temperature of 10 °F and a maximum design temperature of 110 °F.

00583.44 Joints and Terminations - For threaded joints, engage the full number of threads provided or as recommended by the manufacturer for field threaded applications.

Securely fasten conduit to junction boxes in one of the following manners:

- With the full number of threads projecting through tapped bosses.
- Liquid-tight conduit hubs.

Join PVC conduit using cement and fittings in accordance with all manufacturer's recommendations.

Join RTRC conduit using adhesive and fittings in accordance with all manufacturer's recommendations.

Make final connection of rigid conduit to electrical Equipment subject to vibration with liquid-tight flexible conduit and suitable liquid-tight connectors. Flexible conduits are used only where final connection to Equipment with rigid conduit is not practicable, or where Equipment is subject to vibration, such as to Equipment with adjustable mountings or to all machinery.

00583.45 Electrical Isolation - Provide electrical isolation of all dissimilar metals or when adjacent Materials are unknown such as attachments to painted structural steel members by one or more of the following methods:

- Neoprene pads placed between the dissimilar metals.
- Nylon washers and bolt hole inserts.
- Where the NEC requires bonding jumpers resulting in dissimilar metal joints, completely encapsulate the joint in non-conductive resin.

Maintenance

00583.60 Repair of Galvanizing - Repair damaged hot-dip galvanizing according to ASTM A780 Method A2 with a minimum zinc content of 94 percent on the dry film.

00583.61 Protection of Work and Materials - Protect conduits at all times from the entrance of water and other foreign Material by being capped or plugged overnight and when the Work is temporarily suspended.

Handle, store and protect Materials in accordance with the manufacturer's recommendations.

Finishing and Cleaning Up

00583.70 Proofing - Upon completion of conduit installation proof each conduit by pulling a solid aluminum or steel mandrel, brush, and fiberglass fish through the conduit. Use a mandrel with a minimum outside diameter 80 percent of the inside diameter of the conduit.

Proof each conduit in the presence of the Engineer. Draw the mandrel assembly through each completed conduit run manually without mechanical assistance. Mark distance to areas offering resistance to the mandrel assembly on the fiberglass fish. Repair or replace any conduit that does not proof out at no additional cost to the Agency.

00583.71 Pull Line - After conduits have proofed out, install a continuous pull line from outlet to outlet in all empty conduits without splices. Leave a minimum of two feet of slack at each outlet. Install approved caps or plugs, leaving the pull line in each conduit. Ensure pull boxes are capped or plugged after installing the pull line.

Measurement

00583.80 Measurement - The quantities of Work performed under this Section will be measured on the length basis.

Payment

00583.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	PVC Conduit System, ___ Inch Diameter	Foot
(b)	GRC Conduit System, ___ Inch Diameter	Foot
(c)	316 SS RMC Conduit System, ___ Inch Diameter	Foot
(d)	RTRC Conduit System, ___ Inch Diameter	Foot

In items (a), (b), (c), and (d) the nominal size of the pipe will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- Conduit supports or anchorage systems
- Fittings or junction boxes
- Proofing mandrels, brushes, or fish lines
- Pull lines
- Adhesives, sealants, or Materials used for electrical isolation

Conduit installed on Structures for traffic signal systems will be paid for according to 00990.90.

Section 00584 - Elastomeric Concrete Nosing

Description

00584.00 Scope - This Work consists of furnishing and placing elastomeric concrete nosing to form a bulkhead at bridge ends or at expansion joints, including cleaning and preparing the concrete or steel surfaces as shown and specified.

Materials

00584.10 Materials - Furnish elastomeric concrete nosing using Materials from the QPL and the following:

Provide materials delivered in their original, undamaged containers bearing the manufacturer's label with the following information:

- Product name
- Component part
- Name and address of manufacturer
- Date of manufacture
- Use-by date
- Batch number
- Mixing ratio

Provide sufficient materials in storage at the site prior to beginning construction to complete the entire elastomeric concrete nosing as detailed on the Plans or as directed. Store the materials to prevent damage by the elements and to ensure the materials maintain their original quality.

Store the materials so that the storage space is dry and maintains a temperature as recommended by the manufacturer. Use only stored materials that meet these requirements at the time of use.

If used, the promoter/initiator for the methacrylate resin may consist of a metal drier and peroxide. Do not mix the metal drier directly with the peroxide. Store the containers so that no leakage from one material contacts the containers of the other materials.

When making repairs to or filling voids in the existing deck, use epoxy from the QPL.

Equipment

00584.20 Equipment - Use Equipment recommended by the product manufacturer and approved by the Engineer.

Labor

00584.30 Manufacturer's Representative - Provide a manufacturer's representative on-site during the installation of the elastomeric concrete nosing. The manufacturer's representative shall be either someone independent of the Contractor's work force or a member of the Contractor's work force that possesses certification from the manufacture that the Contractor's representative has the knowledge, skills, and training to install the elastomeric concrete nosing. Discuss the Work to be done with the manufacturer's representative to review the methods of installation and the Equipment needed before beginning the Work.

The representative shall advise both the Engineer and the Contractor on proper installation procedures to assure correct installation of the elastomeric concrete nosing.

Mix, place, and cure the elastomeric concrete nosing according to the recommendations of the manufacturer's representative.

Construction

00584.40 General - Construct elastomeric concrete nosing according to the following:

(a) Training - Use installers trained in application methods and in the health and safety requirements specific to the materials used.

(b) Safety - Make available to workers any manufacturer's safety precautions for hazardous chemicals. Ensure that all workers wear appropriate impermeable protective clothing when using hazardous chemicals.

(c) Weather Conditions at Time of Installation - Do not proceed with installation until the weather conditions meet the requirements of the manufacturer's representative.

00584.41 Surface Preparation - Ensure that all surfaces to receive elastomeric concrete nosing material are sound, dry, clean, frost free, and sandblasted at the time of nosing installation. Sandblast steel contact surfaces to SSPC-10 *Near White Blast Cleaning*, immediately before constructing the nosing. Prepare the deck surface according to the Specifications and the material manufacturer's recommendations.

00584.42 Existing Concrete Repair - Perform existing concrete repair before installing elastomeric concrete nosing or expansion joints. Repair the expansion joint edges or concrete deck surface as shown and the following:

- Remove all cracked, spalled, and unsound concrete from the expansion joint area, without damaging existing reinforcement, and replace with elastomeric concrete. At armored corners, weld damaged areas of steel armoring, and epoxy-inject all voids left by removal of unsound concrete. Replace existing armor as directed. Complete welding of existing armor prior to epoxy injection.
- Remove existing expansion joint material and reconstruct the joint edges as shown. Remove all existing joint anchorage material from the joint areas, as required for installation of new elastomeric concrete nosing.

00584.43 Elastomeric Concrete Placement - When an asphaltic concrete overlay is to be used as the wearing surface, place a bond breaker on the area where the concrete nosings are to be constructed before placing the asphaltic concrete overlay over the bridge deck joints. After the overlay is placed, sawcut the overlay to the width shown on the Plans, remove the overlay material in the joint area and construct the elastomeric concrete nosing.

Prepare the elastomeric concrete nosing material by mixing the Aggregate at the recommended temperature with the mixed binder. Clean and dry the bonding surfaces and prepare joint surfaces according to the manufacturer's recommendations. Place the properly mixed elastomeric concrete into the prepared area on each side of the expansion joint. Compact and trowel the elastomeric concrete to the required shape.

Form and cast the elastomeric concrete nosing to smoothly match the surface of the finished Roadway. Finish the surface to a moderately rough texture such as that produced by a wood float.

Protect the elastomeric concrete nosing material from damage, and allow the nosing to cure properly prior to opening the work area to traffic. Do not open up to traffic without the approval of the manufacturer's representative.

Measurement

00584.80 Measurement - The quantities of elastomeric concrete nosing will be measured on the length basis, from face of curb to face of curb taken along the centerline of the joint, between the outer limits of the installed Material. Only one measurement will be taken along each installed joint, regardless of the number of recesses, openings, or voids filled with the elastomeric concrete nosing Material.

The estimated quantities of elastomeric concrete nosing and elastomeric concrete nosing repair are based on a nominal depth of 2 inches.

The quantities of elastomeric concrete nosing repair deeper than 2 inches will be measured on the volume basis.

Joint seal Material will be measured according to 00585.80.

Payment

00584.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Elastomeric Concrete Nosing	Foot
(b)	Repair Elastomeric Concrete Nosing	Foot
(c)	Elastomeric Concrete Nosing Material for Repair	Cubic Yard

Item (a) includes elastomeric concrete nosing installed to the depths shown.

Item (b) includes elastomeric concrete nosing repair installed to a nominal depth of 2 inches.

Item (c) includes Materials only for concrete nosing repair depths greater than 2 inches.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Joint seal Material will be paid for according to 00585.90.

No separate or additional payment will be made for providing the manufacturer's representative.

Section 00585 - Expansion Joints

Description

00585.00 Scope - This Work consists of fabricating, preparing, and installing expansion joints as shown or specified.

00585.01 Definitions:

Armored Corner - Steel armoring to protect the vertical edges of a joint.

Asphaltic Plug Joint Seal - A sealed joint composed of Aggregate and flexible binder material placed over a steel bridging plate.

Closed Joint - A sealed or filled joint designed to prevent water and debris from passing through the joint.

Edgebeam - Steel armoring to protect the vertical edges of a joint opening including recesses to accept elastomeric seals.

Filled Joint - A joint using a preformed material placed prior to concrete pour.

Open Joint - A joint designed to allow water and debris to pass through the joint.

Poured Joint Seal - A seal made of materials that remain flexible which is poured into the gap of a joint and adheres to the sides of the gap.

Precompressed Foam Silicone Joint Seal - A joint system consisting of a preformed, pre-compressed, silicone-coated, self-expanding foam joint system bonded to joint faces using epoxy adhesive.

Preformed Compression Joint Seal - A preformed elastomeric device that is precompressed in the gap of a joint.

Sealed Joint - A joint using a compressible or expandable seal including asphaltic plug joint seals, preformed compression joint seals, poured joint seals, strip seals, and precompressed foam silicone joint seals.

Strip Seal - A sealed joint with an extruded elastomeric seal retained by edgebeams that are anchored to the structural elements.

Materials

00585.10 Materials - Furnish expansion joints using Materials from the QPL and meeting the following requirements:

Backer Rod	02440.14
Elastomer	02570.10
Hot Applied Joint Sealant	02440.30
Lubricant/Adhesive	02440.15
Polytetrafluoroethylene (PTFE)	02570.10
Poured Joint Sealant	02440.11
Precompressed Foam Silicone Joint Seal	02440.23
Preformed Compression Joint Seal	02440.22
Preformed Joint Filler for Concrete	02440.10
Stainless Steel Sliding Surfaces	02570.10
Steel Bridging Plate	02440.19
Strip Seals	02440.20
Structural Steel	02530

00585.11 Approval of Materials - Submit QPL listed products to the Engineer for Project specific approval.

00585.12 Concrete for Blockout Opening - Fill blockout openings with the same class and type of concrete used in the deck or as shown.

Equipment

00585.20 Equipment - Use approved Equipment as recommended by the product manufacturer.

Labor

00585.30 Closed Joint Installers - Provide installers that have been trained by the joint manufacturer in application methods of materials and health and safety to install closed expansion joints as detailed. Provide a written statement from the joint manufacturer that the installers have been trained.

00585.31 Sealed Joint Manufacturer's Representative - Provide a manufacturer's representative on-site during the installation of sealed joints. The manufacturer's representative shall be either someone independent of the Contractor's work force or someone having a manufacturer's certified proof of sealed joint installation.

The representative shall discuss the Work to be done, the methods of installation, and the required Equipment as well as advise both the Engineer and the Contractor on proper installation procedures to assure correct installation of expansion joints.

Construction

00585.40 Filled and Closed Joint Tolerances - The following apply to all filled and closed joints:

- **Relative Alignment** - Locate joint openings through members within 1/2 inch of plan location.
- **Joint Edges** - Construct all joint edges straight, parallel, and without deviation from a true line by more than 1/4 inch horizontal over the length of the joint.

- **Joint Width** - Construct all joint widths within 1/8 inch of planned joint width.

- **Deck Roadway Texturing** - Do not groove within 6 inches of joint blockouts and bridge ends. For skewed Bridges, additional ungrooved portions at joint blockouts and bridge ends are allowed to accommodate the width of the gang saw.

00585.41 Filled Joints - Unless otherwise specified, form filled joints with preformed joint filler by placing concrete directly against the preformed joint filler material. Provide formwork behind the preformed joint filler material firm enough to prevent deflection of the joint material when placing the concrete, or place preformed joint filler against formed concrete. Unless shown or specified, place hot applied joint sealant at the top of the joint.

00585.42 Closed Joints - The following requirements apply to all closed joints:

(a) Submittals - Submit stamped Working Drawings according to 00150.35 for each joint at least 21 Calendar Days before beginning Work.

(1) Design - Design joints to:

- Prevent the entrance of water and debris into the joint.
- Produce no appreciable elevation changes in the deck surface plane with the expansion and contraction movements of the Structure.
- Accommodate the required structure movements shown.
- Support a wheel load (plus impact) corresponding to the design load shown.

(2) Working Drawings - Include the following details with the Working Drawings:

- Plan, elevation and section of the joint system with dimensions and tolerances.
- Complete details of all joint materials with all ASTM, AASHTO or other material designations.
- Method of installation including sequence and installation details at traffic barriers, roadway surfaces, curbs and sidewalks.

(3) Notification - Notify the Engineer in writing at least 7 Calendar Days before installing the joint. Include the Contract number, bridge number, joint seal material, product name, and the approximate date of installation.

(b) Safety - Before installing joints, provide safety precautions from the manufacturer for hazardous chemicals. Wear appropriate impermeable protective clothing when using hazardous chemicals.

(c) Joint Preparation - Prepare the joint surfaces as directed in this Section and according to the joint material manufacturer's recommendations. Ensure that all joint surfaces to receive a seal are sound, dry, clean, and frost-free at the time of joint installation.

For joint replacement, remove joint material from existing joints and clean the existing joints full depth and full width as directed by the Engineer. If existing joint surfaces have spalled, cracked, or deteriorated concrete, repair as shown or as directed to provide a uniform and smooth surface along the joint.

(d) Weather Conditions at Time of Installation - Install joint seals when the joint is dry and meets the manufacturer's representative's approval.

(e) Leakage Check - Check joints for leakage by flooding the joint with water. If leakage is observed, repair the joints at no additional cost to the Agency and according to the manufacturer's recommendations.

00585.43 Armored Corners - Provide joint corner armoring and anchors as shown or specified, and according to the following:

(a) Tolerance - Install armored corners that are straight and do not deviate from a true line by more than 1/4 inch horizontal and 1/8 inch vertical over the length of the joint, nor more than 1/16 inch in either direction from a 12-foot straightedge.

Maintain a minimum cross sectional thickness of 1/2 inch. The steel retainer edgebeams may be manufactured from rolled shapes and plates or may be hot-rolled steel with the gland groove milled after rolling.

(b) Installation - Furnish armored corners in the longest practical length as controlled by transportation and installation.

Fabricate steel according to Section 00560. Sandblast steel shapes just prior to installation. Use welding procedures conforming to AWS D1.1.

For new construction, install armored corners in preformed blockouts at least 14 days after the deck is cast with the joint opening as shown. Support the armored corners securely in position before placing concrete in the joint blockout. Install the preformed seal at least 7 days after the concrete blockouts have been cast and after the deck concrete reaches 3,000 psi.

00585.44 Asphaltic Plug Joint Seal - Install asphaltic plug joint seals according to the following:

- Provide a clean, intact, and plane surface on which to place the steel bridging plate.
- Ensure the gap below a 12 foot unleveled straightedge does not vary from the testing edge by more than 1/8 inch when placed across the joint in any direction. Use either an elastomeric concrete or a structural patching product from the QPL as needed to repair the deck surface of new or existing concrete.
- Ensure steel bridging plates are clean, free from surface rust, oil, or other residues and contaminants when installed. Place centering pins through the holes in the steel bridging plates and down into the expansion gap to assure proper centering. Avoid placing the steel bridging plate ends under wheel rut area.
- Install asphaltic plug joint seals according to the manufacturer's recommendations.
- Place preformed compression joint seal or poured joint seal in curbs and sidewalks.

00585.45 Poured Joint Seal - Install poured joint seals according to the manufacturer's recommendations.

00585.46 Preformed Compression Joint Seal - Install compression seals according to the manufacturer's recommendations and the following:

- Install in one continuous strip that extends across the full roadway width and into the curbs without splices.
- Install so they remain in compression throughout the design movement range. Provide for maximum and minimum compressive pressures according to AASHTO M 297 (ASTM D3542).

Base the compression seal nominal size on the design movement of the joint and the seal's anticipated compression set.

00585.47 Strip Seal - Install strip seals according to the manufacturer's recommendations and the following:

- Use steel retainers acting as the edgebeams according to 00585.43(a).
- Field weld rail segments that are too long to ship in one piece according to AWS D1.1.
- Base the joint opening between edgebeams on Structure temperature at the time of joint placement and the designed temperature movement rating.
- Install seals in one continuous strip, extending across the full roadway width and into the curbs without splices.
- Remove all lubricant/adhesive from the top of the installed seal before the adhesive sets.

00585.48 Precompressed Foam Silicone Joint Seal - Install precompressed foam silicone joint seal according to the manufacturer's recommendations and the following:

- Ensure that top of joint system is 3/4 inch minimum below deck surface.
- Do not install the joint system in a joint width greater than 3 inches.

00585.49 Hot-Dip Galvanizing - Hot-dip galvanize steel expansion joint surfaces, except stainless steel, according to AASHTO M 111 (ASTM A123).

The contact surfaces at all galvanized slip critical structural bolted connections shall meet Class C (slip coefficient 0.33) surface preparation requirements.

Measurement

00585.80 Measurement - No measurement of quantities will be made for expansion joints. Estimated quantities of expansion joints will be listed in the Special Provisions.

The estimated quantities of asphaltic plug joint seals is based on a nominal depth of 2 1/4 inches.

The quantities of asphaltic plug joint seal Material for joints deeper than 2 1/4 inches will be measured on the volume basis.

Payment

00585.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Asphaltic Plug Joint Seals	Lump Sum
(b)	Asphaltic Plug Joint Seal Material	Cubic Yard
(c)	Poured Joint Seal	Lump Sum
(d)	Type ____ Preformed Compression Joint Seal	Lump Sum
(e)	Strip Seals	Lump Sum
(f)	Precompressed Foam Silicone Joint Seal	Lump Sum

Item (a) includes saw cutting, steel bridging plate, and asphaltic plug joint seal Material to a nominal depth of 2 1/4 inches.

Item (b) includes additional Material required when the nominal depth of an asphaltic plug joint seal is greater than 2 1/4 inches.

In item (d), the type of compression joint seal will be inserted in the blank.

Payment will not be made before joints have passed the leakage check of 00585.42(e). No payment will be made for any Material installed as replacement Material for that removed, unless the Engineer determines that the reason for the removal was beyond the Contractor's control, or that the Plans specifically required the removal.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- elastomeric concrete or structural patching Material used to provide a plane surface on which to place the steel bridging plate
- preformed expansion joint filler, hot applied joint sealant, or sawcutting
- providing the manufacturer's representative

Section 00587 - Bridge Rails

Description

00587.00 Scope - This Work consists of constructing bridge rails of the Material or combination of Materials shown or specified.

Bridge rails will be classified as concrete or steel according to the predominant material used in the rail.

Materials

00587.10 Materials - Furnish Materials meeting the following requirements:

Bridge Rail.....02810
Coating Materials for Concrete.....02210.30
Concrete.....02001
Concrete Coating 02210
Grout 02080.30
Reinforcement.....00530
Fasteners 02560

Construction

00587.40 General - Construct bridge rails:

- True to line, grade and dimensions shown or established, with a smooth, even top rail without following any unevenness in the Superstructure.
- Vertical, rather than normal to the deck, whether the deck is superelevated or not, unless shown otherwise.
- After falsework has been removed, so that the span is self-supporting.

00587.42 Concrete Rails:

(a) General - Construct concrete rails according to Section 00540 and the following:

- Cast-in-place rails may be slipformed as the Contractor elects subject to paragraph (c) of this Subsection.
- Construct expansion joints which permit freedom of movement. After all other Work is completed, use a sharp chisel to remove all loose or thin shells of concrete likely to spall under movement at expansion joints.

(b) Fixed Forms - Forms shall be smooth and tight fitting, rigidly held in line and grade, and removed without damage to the concrete. Make form joints in vertical planes. Construct all moldings, panel Work, and bevel strips as shown. Make corners in the finished Work true, sharp and free from cracks, spalls or other defects.

(c) Slipformed - Concrete rails may be slipformed if the Plans contain details for slipforming. Before slipforming any permanent rail, the Contractor shall meet one or both of the following requirements (1) and (2) as directed:

(1) Cast a test section at least 20 feet long as follows:

- Place the test section off the Structure.
- Use the same section and reinforcement as detailed for use on the Structure.
- Include one typical contraction or open joint.
- Remove at no additional cost to the Agency.

(2) Identify, for the purposes of evaluating Work quality, at least two recent slipformed rail projects completed by the Contractor.

The Engineer will make the final decision about the use of slipforming on the Project based on Work quality. If slipforming is used, conform to the following:

- Provide concrete with a slump of 1 inch ± 1/2 inch.
- Keep the top and faces of the finished rail free from sags, humps, and other irregularities.
- Maintain contraction joints, open joints, and expansion joints to the dimensions shown until the concrete sets.
- Use slipforming only for sections of rail with constant dimensions. Use fixed forms where dimensions vary, as at luminaire or signal supports and at rail end transitions.
- Brush-finish exposed rail surfaces with vertical strokes. Do not grind brush-finished surfaces that are to receive a Class 1 finish.
- Remove and replace any unsatisfactory Work at no additional cost to the Agency.

(d) Surface Finish - Give all exposed concrete surfaces a general surface finish followed by a Class 1 surface finish (ground and coated) according to 00540.53 except as provided in 00587.42(c).

(e) Latex Emulsion Paint Cure for PCC - As an option to curing cast-in-place or slipformed bridge rails, the following procedure may be used:

- Allow free moisture to flash off, but only until the concrete surface does not glisten, and never for more than 1 hour.
- Apply latex emulsion paint from the QPL as follows:
  - Apply the first coat at an application rate of 150 square feet per gallon.
  - Allow the first coat to air-dry for 1 hour.
  - Apply the second coat at an application rate of 150 square feet per gallon, with the application direction transverse to the direction of the first coat.

00587.43 Metal Rails:

(a) Construction - Provide structural steel tubing, tube or metal thrie beam rail as shown or specified. Fabricate and erect metal rails according to Section 00560. Adjust metal rails before fixing in place to ensure proper matching at abutting joints and correct alignment and Camber throughout their length.

(b) Coating - Unless otherwise specified, galvanize steel portions of the railing. Galvanize after fabrication of the rail according to 02530.70. If galvanized portions of the rail are to be coated, coat according to Section 00594.

Measurement

00587.80 Measurement - No measurement of quantities will be made for Work performed under this Section. Estimated quantities of bridge rails will be listed in the Special Provisions.

Payment

00587.90 Payment - The accepted quantities of bridge rails will be paid for at the Contract lump sum amount for the appropriate bridge rail items listed in the Contract Schedule of Items.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for anchor bolts and anchorage devices, except those cast in precast concrete members.

Payment for anchor bolt and anchorage devices in cast-in-place concrete members and for reinforcement extending from a precast unit, cast-in-place deck, wall or bridge end panel into the rail will be included in payment made for the precast unit, cast-in-place deck, wall or end panel, as appropriate.

Payment for guardrail terminal connectors, connection plates, spacer blocks and other connection hardware will be included in the payment for the guardrail transition item according to 00810.90.

Section 00590 - Polymer Membrane

Description

00590.00 Scope - This Work consists of preparing, sealing, and resurfacing Bridge decks with a primer, a single-layer polymer membrane, an Aggregate top course, and an ACP wearing surface.

00590.02 Submittals - Submit the following at least 7 Calendar Days before the pre placement conference:

- The manufacturer's product data sheet
- The manufacturer's written installation instructions
- A Material Safety Data Sheet for each primer and epoxy polymer component
- Manufacture dates and shelf-life expiration dates for each production lot of primer and epoxy polymer components
- Tabulated data indicating the estimated cure time, in minutes, for the allowable ambient temperature range, in increments of 10 °F, for both the primer and polymer membrane
- A detailed work plan that meets the lane restriction requirements of 00220.40(e) for the membrane preparation, application, and cleanup
- The Manufacturer's recommended application rate, square feet per gallon, to achieve a minimum membrane thickness of 3/16 inch
- Names of manufacturer-approved supervisory personnel meeting the requirements of 00590.30
- An inclement weather plan according to 00590.04.

00590.04 Inclement Weather Plan - Submit an inclement weather plan when application conditions of 00556.40(b)(1) are not met. The inclement weather plan includes all Materials, Equipment, and methods to be used to heat the substrate, Aggregate, and resin. If concrete moisture content or capillary moisture is to be tested, provide Equipment information and calibration certificates.

00590.05 Pre-placement Conferences:

(a) Supervisory Personnel - Hold a pre-placement conference with the Engineer and all supervisory personnel, Subcontractors, Suppliers, and all other personnel who will be involved in the membrane work. Meet at a mutually agreed time at least 14 Calendar Days before beginning the membrane work. Present and discuss all phases of the membrane work, including ACP placement.

If the Contractor's manufacturer-approved personnel change, or if the Contractor proposes a significant revision to the work plan, hold an additional meeting before any additional Work is performed.

(b) Placement Crew - Before beginning membrane Work, hold a second pre-placement conference with the Engineer and the entire membrane work crew at the Project Site, 30 minutes before membrane Work begins, to discuss placement duties and procedures.

Materials

00590.10 Materials:

(a) Primer - Furnish a low modulus epoxy concrete and crack sealer from section 02060.10 of the QPL.

(b) Polymer Membrane - Furnish epoxy polymer from section 00556.10(a) of the QPL. Provide epoxy polymer and primer from the same manufacturer.

(c) Broadcast Aggregate - Furnish Aggregate from section 00556.10(b) of the QPL.

Sample the furnished Aggregate and test according to the following:

Property	Test Method	Requirements
Moisture Content *	AASHTO T 255	0.20% max.
Field Moisture Content **	AASHTO T 255	1.00% max.

*Test at time of packaging and shipment.
**Field test at the time of mixing the polymer resin.

Package and store all Aggregate Material so that it remains clean and meets moisture content requirements.

(d) Tack Coat - Furnish PG 64-22, PG 70-22, PG 64-28 or PG 70-28, hot asphalt cement tack coat unless otherwise approved. Do not use an Emulsified Asphalt tack coat.

Equipment

00590.20 Equipment - Provide approved Equipment to place the membrane. Remove all Equipment that leaks oil or other contaminants from the Work area until they are repaired.

(a) Tools - Furnish squeegees, heavy nap rollers, and other approved tools to apply the primer and the membrane polymer resin.

Furnish a mechanical broadcaster to uniformly apply the membrane Aggregate.

Furnish pickup type power brooms capable of removing loose Aggregate.

(b) Coring Equipment - Furnish core cutting Equipment that can produce a core 2 inches in diameter.

(c) Bond Testing Equipment - Furnish bond testing Equipment that:

- Is compatible with the core tested.
- Can exert a tensile load to the core sufficient to exceed 300 psi.
- Is equipped with a measuring device capable of reading tensile force exerted within 1 percent accuracy.

(d) Resin Conditioning Equipment - Furnish Equipment capable of conditioning resin to between 65 °F and 85 °F.

(e) Aggregate Heating Equipment - Furnish heating Equipment capable of pre-heating Aggregate to a minimum of 70 °F as measured at the time of placement.

(f) Membrane Heating Equipment - If required, furnish heating Equipment that;

- Can apply heat to ensure that the entire membrane meets the bond test requirements of 00590.50.
- Can maintain a minimum temperature of 70 °F within the heated area

- Does not segregate, shove, tear or gouge the membrane system

(g) Concrete Moisture Meter - Furnish a pin-type, instant read, concrete moisture meter meeting ASTM F2659. Provide current calibration documentation.

Labor

00590.30 Personnel Qualifications - Provide supervisory personnel who are approved by the polymer material manufacturer, in writing, as qualified and who shall oversee the placement.

Construction

00590.40 Construction:

(a) General - Do not begin membrane installation until all Materials and Equipment necessary to perform the installation and required repairs, and qualified personnel are at the Project Site.

(b) Application Conditions - Apply the membrane system on prepared surfaces when the following conditions are met:

- The deck surface has been visually dry for at least 72 hours.
- The ambient temperature and deck surface temperature are between 50 °F and 90 °F, or as specified by the resin manufacture's product data sheet, whichever is more restrictive.
- The deck surface temperature is at least 5 °F above the dew point.
- No rain is forecasted for the duration of the membrane installation and estimated cure time, based on ambient and surface temperatures.

(c) Inclement Weather Plan - When an inclement weather plan has been approved, apply membrane system on prepared surfaces when the following conditions are met:

- If the deck has been dry for less than 72 hours, mechanically heat the deck to a minimum of 300 °F and a maximum temperature of 350 °F. Perform one of the following tests after applying heat:
  - Test for capillary moisture using the plastic sheet method, according to ASTM D4263, with a minimum test time of 2 hours. Perform one test per 500 square feet.
  - Test for concrete moisture content using a pin-type moisture meter according to 00557.23(f). Maximum allowable deck moisture content is 4 percent. Perform number of tests and locations according to ASTM F2659, with a minimum of eight tests per primer placement. Test additional locations as directed by the Engineer.
- The ambient temperature and deck surface temperature are between 40 °F and 90 °F. If the temperature falls, or is forecasted to fall below 50 °F perform the following:
  - Pre-heat the Aggregate to a minimum of 70 °F.
  - Heat the membrane to a minimum of 70 °F to facilitate curing. Do not exceed 110 °F on the membrane surface.
- The deck surface temperature is at least 3 °F and rising above the dew point.
- No rain is forecasted for the duration of the membrane installation and estimated cure time, based on ambient and surface temperatures.
- Do not place membrane system when temperatures are below 40 °F.

(d) Deck and MPCO Materials Heating - Do not use manually operated propane torches to heat the deck surface or membrane material. When the deck surface is mechanically heated, do not proceed with Work until the surface temperature is less than 90 °F.

(e) Daily Report Requirements - Submit a daily written report to the Engineer by the end of each Day that Work is being performed under this Section. The daily written report shall include the following:

- Broadcast Aggregate moisture content AASHTO T 255 (00590.10(d)).
- Surface preparation process and results of ASTM E965 according to Section 00504.
- Total gallons of primer and associated application rate, for each Bridge.
- Total gallons of hot asphalt cement tack coat applied to each Bridge.
- Bond test results ASTM D4541 (00590.50).
- Size and location of repair areas with digital photographs taken both before and after placement of the membrane. Provide the digital photographs in a format acceptable to the Engineer.

00590.41 Preparing Bridge Decks - Prepare all surfaces that are to be in contact with the polymer membrane according to Section 00504.

00590.42 Installation - Install membrane according to the following:

- Condition and mix the primer and membrane resin according to the manufacturer's product data sheet and written installation instructions. Do not dilute, thin, or add foreign material to either the individual polymer resin components or the mixed polymer resin.
- After the Engineer has approved the surface preparation, completely flood the deck surface with primer at the rate recommended by the primer manufacturer, or as directed. Use heavy-nap rollers to work the primer into the concrete surface and all visible cracks. Fill all visible cracks to refusal. Allow the prime coat to pond and penetrate into the deck surface a minimum of 15 minutes. Before the resin becomes tack free, remove excess primer using a broom or heavy-nap roller to prevent ponding.
- Flood the deck with membrane resin to cover a maximum area of 50 square feet per gallon. Before gelling of the membrane resin occurs, broadcast a single layer of Aggregate to refusal (100 percent coverage) so no wet spots are visible.
- Extend the membrane to the expansion joint edges and 2 inches up the curb or rail face, to ensure the deck is sealed in those locations. Aggregate need not be placed up the curb or rail face.
- Allow the membrane enough time to cure to initial set according to the manufacturer's product data sheet before subjecting it to loads or traffic.

00590.43 Membrane Bond Test - Test the full depth membrane according to ASTM D4541, Method "E", using Type "V" tester prior to allowing traffic on the membrane. Test using 50 mm (2-inch) test dollies, at locations as directed.

Perform at least two bond tests for each Day of placement in the presence of and at locations designated by the Engineer.

Take 50 mm (2-inch) diameter cores through the Aggregate surface and 1/2 inch into the concrete substrate.

Minimum allowable bond strength is 250 psi or substrate failure, at each test location.

Repair core holes with matching membrane system materials. Avoid taking cores in the wheel tracks.

00590.44 Delamination Survey and Repair - The completed membrane surface may be inspected by the Engineer for delamination, bond failure, and other damage by use of a chain drag, coring, and other devices. If directed by the Engineer, perform additional bond tests as set forth in 00590.43, at locations directed.

Repair all surface defects, including loss of Aggregate, prior to paving by removing the defective Material and reapplying the membrane according to the Specifications, at no additional cost to the Agency. Do not damage adjacent Materials or steel substrates.

Perform bond testing on repair areas to ensure a membrane bond strength of at least 150 psi before paving and 250 psi if traffic will be allowed on the membrane. Test at locations as identified by the Engineer.

00590.45 Vehicles and Temporary Traffic Use of New Surface - Staged traffic will not be allowed on the membrane for more than 21 Calendar Days.

Do not open sections to traffic until approved by the Engineer. Before opening to traffic, remove all loose Aggregate by power brooming, and open all drains.

00590.46 ACP Paving - Prior to applying the asphalt cement tack coat, thoroughly clean the membrane surface using blowers, brooms, vacuums, or other methods to achieve a clean, dry surface.

Before placing ACP, apply a hot asphalt cement tack coat to cover a maximum area of 35 square feet per gallon to the entire membrane surface, extending 2 inches up the face of the curb or rail. Pave over the tack within 4 hours of tack placement.

Measurement

00590.80 Measurement - The quantities of Polymer membrane will be measured on the area basis. The area will be determined by measuring the actual surface area of the sealed bridge deck.

Payment

00590.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per square foot, for the item “Polymer Membrane”.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals required to complete the Work as specified.

No separate or additional payment will be made for hot asphalt cement tack coat, or heating of the substrate, Aggregate, primer or membrane.

No payment will be made for additional bond tests.

Section 00592 - Rolled Waterproofing Membrane

Description

00592.00 Scope - This Work consists of preparing bridge decks and furnishing and placing rolled bridge deck waterproofing membrane on the decks of Bridges as shown.

00592.03 Submittals - Submit the following at least 7 Calendar Days before the pre-placement meeting for each membrane proposed for use:

- The manufacturer's product data sheet for the primer and rolled membrane.
- The manufacturer's test certificate required in Section 00592.10(e).
- Submit a primer application plan according to 00592.41(h)(1), which includes a manufacturer's letter indicating primer is compatible with the rolled membrane.
- A detailed work plan for the deck preparation, membrane installation sequence, and cleanup.
- Names of manufacturer approved supervisory personnel meeting the requirements of 00592.30.
- List of Equipment proposed for use in pressure rolling laps and membrane surface.
- Proposed methods of measuring the application rate of hot asphalt cement tack coat and primer to meet the specified application rates.
- For Bridges with curbs, drains, intermediate joints, or concrete rails, submit unstamped Working Drawings, according to 00150.35, detailing membrane placement at those locations.

Do not begin any Bridge membrane Work before the work plan and submittals have been approved.

00592.04 Pre-placement Conferences:

(a) Supervisory Personnel - Hold a pre-placement conference with the Engineer and all supervisory personnel, Subcontractors, Suppliers, and all other personnel who will be involved in the membrane Work. Meet at a mutually agreed time at least 14 Calendar Days before beginning the membrane Work. Present and discuss all phases of the membrane Work, including ACP placement.

If the Contractor's manufacturer-approved personnel change, or if the Contractor proposes a significant revision to the work plan, hold an additional meeting before any additional Work is performed.

(b) Placement Crew - Before beginning membrane Work, hold a second pre-placement conference with the Engineer and the entire membrane work crew at the Project Site, 30 minutes before membrane Work begins, to discuss placement duties and procedures.

Materials

00592.10 Rolled Waterproofing Membrane System - Furnish a rolled waterproofing membrane system that is a sheet membrane conforming to ASTM D6153 Type III and meeting the following criteria:

Test	Test Method	Limit or Value
Grab Tensile Strength (for Geotextiles and Fabrics)	ASTM D4632 (Woven or Nonwoven)	200 pounds min.
Resistance to Puncture (Geotextiles and Fabrics)	ASTM E154	200 pounds min
Permeability	ASTM E96 (water method)	5.7 NG/PaSm2 (perms.0.1)Max
Pliability	ASTM D146	No Breaks

Furnish test result certificates showing physical tests for the rolled waterproofing membrane system according to 00165.35.

Provide a membrane that can be used for the maximum profile grades and super elevations shown. Profile grade and super elevation limitations are available from the manufacturer.

00592.11 Hot Asphalt Cement Tack Coat - Furnish PG 64-22, PG 70-22, PG 64-28, or PG 70-28 hot asphalt cement tack coat unless otherwise approved. Do not use an Emulsified Asphalt tack coat.

00592.12 Mastic - If shown or specified, furnish mastic to seal edges, splices, and laps meeting requirements of ASTM D4586.

00592.13 Primer - Furnish a primer compatible with the rolled membrane according to the manufacturer's recommendations.

Equipment

00592.20 Equipment - Provide approved Equipment to place the membrane. Remove all Equipment that leaks oil or other contaminants from the work area until they are repaired.

Labor

00592.30 Personnel Qualifications - Provide supervisory personnel to oversee the placement who are qualified and approved in writing, by the rolled membrane material manufacturer. Submit written qualifications to the Engineer for approval. Do not begin rolled membrane installation until after approval.

Construction

00592.40 Preparing Existing Bridge Decks - Prepare the entire deck surface, including the deck edge against the curb, to receive the membrane. Remove all grease, oil, paint, dirt, laitance, rust, and all other contaminants that would affect adhesion of the rolled membrane.

Perform surface preparation according to Section 00504, modified as follows:

- After removing the existing asphalt concrete wearing surface according to Section 00503, ensure the deck is smooth and free of obstructions. Clean the bridge deck by thoroughly sweeping and blowing compressed air immediately prior to placing the hot asphalt cement tack coat.
- Class 1 Preparation according to 00504.41(b) is not required.

00592.41 Placing Rolled Waterproofing Membrane:

(a) General - Do not begin membrane installation until qualified supervisory personnel and, all Materials and Equipment necessary to perform the installation and any required repairs are at the Project Site.

(b) Weather and Other Restrictions - Place hot asphalt cement tack coat, concrete patching, and waterproofing membrane when the deck is dry, the air temperature is between 40 °F and 90 °F, and the surface temperature of the deck is 40 °F minimum and rising. Do not place hot asphalt cement tack coat if the surface temperature exceeds 120 °F.

(c) Handling Materials - Store membrane indoors at a temperature between 60 °F and 120 °F until it is placed on the bridge deck. Do not allow the membrane to sit in direct sunlight longer than necessary.

(d) Area of Application - Apply the membrane starting at the low point working to the high point. Protect adjacent surfaces from spatter or coating.

On Bridges without curbs, apply waterproofing membrane from outside edge to outside edge of the deck, or within the limits of the AC wearing Course.

On Bridges having end panels with a saw cut and joint sealant end joints, extend the rolled membrane 5 feet beyond the bridge deck onto the end panel.

On Bridges with curbs or concrete rail, place a 12 inch continuous membrane strip, after applying hot asphalt cement tack coat, so that 2 inches is placed vertically along the curb or rail, with 10 inches placed horizontally on the deck surface.

00592.42 Installation:

(a) Tack Coat - Place hot asphalt cement tack coat as follows:

(1) Concrete Substrate - Place hot asphalt cement tack coat on the concrete substrate, below the ACP Base Course, to cover a maximum area of 60 square feet per gallon (0.15 gallons per square yard). Extend the tack coat 2 inches up the face of the curb.

(2) ACP Base Course - Place hot asphalt cement tack coat on the two inch ACP Base Course to cover a maximum area of 75 square feet per gallon (0.12 gallons per square yard). Primer may be substituted for the hot asphalt cement tack coat on the ACP Base Course according to 00592.42(e).

(3) Rolled Waterproofing Membrane - Place hot asphalt cement tack coat on the surface of the rolled membrane to cover a maximum area of 120 square feet per gallon (0.075 gallons per square yard).

(b) ACP Base Course - Place a 2 inch ACP Base Course, according to Section 00744 or Section 00745 to provide a uniform surface on which to apply the rolled membrane. Construct the ACP Base Course using the same ACP specified for the ACP wearing Course, unless otherwise shown or directed.

(c) Primer - Primer may be substituted for hot asphalt cement tack coat only for application on the ACP Base Course below the rolled waterproofing membrane, with a primer application plan, according to the following:

- When ambient temperatures are forecasted to be above 65 °F, follow minimum manufacturer primer cure times or allow primer to cure a minimum of two hours until the primer is sufficiently cured, as approved by the Engineer, prior to rolled membrane installation.

Do not use primer when ambient temperatures are forecasted to be, or fall below 65 °F at any time during rolled membrane placement.

Apply primer to cover a maximum area of 180 square feet per gallon on the Base Course by brush, roller or as approved, to result in a completely uniform wetted surface, without puddling.

(d) Rolled Waterproofing Membrane - Install rolled waterproofing membrane after the ACP Base Course, according to the following:

- Maintain 6 inches minimum overlap at all sides (longitudinal) joints or seams
- Maintain 12 inches minimum overlap at all end joints
- On Bridges with curbs or concrete rail, install the first rolled section overlapped 10 inches onto the pre-placement strip
- Roll press all lap joints
- Stagger butt splices a minimum of 10 feet
- Prior to applying hot asphalt cement tack coat, roll press the entire membrane surface with approved Equipment
- Release any bubbles or pockets of trapped air or vapor and repair with mastic or as approved
- Sewn splices are not allowed

(e) ACP Wearing Course - Construct the ACP wearing Course according to Section 00744 or Section 00745. Prior to placing the hot asphalt cement tack coat, and any ACP Course or waterproofing membrane, verify the underlying surface is free from loose rocks, or other debris. Clean the underlying surface by thoroughly sweeping and blowing compressed air immediately prior to placing the hot asphalt cement tack coat. Pave in the same direction as the membrane overlap end joints.

00592.43 Daily Report Requirements - Submit a written report to the Engineer by the end of each Day that Work is being performed under this Section. The daily written report shall include the following:

- Total gallons of hot asphalt cement tack coat applied to each Bridge
- Total gallons of primer applied to each Bridge
- Digital photographs documenting the existing bridge deck surface, application of the hot asphalt cement tack coat, installation of the membrane, the completed membrane installation, ACP paving operations
- Size and location of repair areas with digital photographs taken before and after placement of the membrane. Provide all digital photographs in a format acceptable to the Engineer.

00592.44 Protection During Construction - Traffic is not allowed on the membrane without prior written approval. Except for paving Equipment, do not allow Contractor Equipment on the membrane unless approved by the Engineer.

Immediately repair any damage to the membrane caused by the paving operation, or other Contractor operations, with mastic or as approved by the Engineer. Complete repairs before resuming paving.

Measurement

00592.80 Measurement - The quantities of waterproofing membrane will be measured on the area basis. Measurement will be the sealed surface area, excluding curb and rail faces and will be limited to the Neat Lines and dimensions shown.

Payment

00592.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per square foot, for the item “Rolled Waterproof Membrane”.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals required to complete the Work as specified.

ACP will be paid for according to 00744.90 or 00745.90 as applicable.

Section 00593 - Powder Coating Metal Structures

Description

00593.00 Scope - This Work consists of preparing and powder coating new metal Structures and features in the shop, and preparing and coating existing metal Structures at the Project Site. This includes all:

- Interior and exterior steel surfaces
- Steel railings, bridge bearings, and bridge expansion joint assemblies
- Other miscellaneous steel
- Galvanized and aluminum surfaces

00593.01 Abbreviations, Definitions, and References:

(a) Abbreviations:

AAMA - American Architectural Manufacturers Association

DFT - Dry Film Thickness

(b) Definitions:

Cleaning - Removing detrimental material in preparation for coating.

Coat - An application, or applications, of a protective material to a substrate, resulting in a layer of specified thickness.

Coating - Protective material after it is applied to a substrate.

Coating Material - Protective material in the liquid state before application.

Coating System - All specified coats applied separately in a predetermined order.

Maintenance Coating - An additional coating applied to a previously coated existing Structure to prolong the protective capability of previous coatings.

Manufacturer's Recommendation - The written specifications and instructions provided by a manufacturer of a coating material concerning the handling, mixing, and application of the coating material.

Preparation - Measures taken to provide a suitable surface ready to coat.

Solvent - Liquid used to solvate or put materials into solution, or to clean Equipment and tools.

Substrate - A surface to which a coating is to be applied. This may be the prepared surface of the metal Structure or a previous coating.

Surface Profile - Roughness of a cleaned metal surface. The height of the profile is measured from the bottom of the valleys to the top of the peaks in mils.

(c) References - In this Section, references such as SSPC-SP 1 and SSPC-PA 1 refer to Volume 2, *Systems and Specifications*, of SSPC's *Painting Manual*.

00593.03 Required Submittals:

(a) Powder Coating Plan - At least 7 Calendar Days before the date that preparation and coating operations are scheduled to begin, submit a Project-specific Powder Coating Plan for the approval of the Engineer. Include the following:

- The name, location, and contact information (mail address, phone, and e-mail) for the firm performing the powder coating operation.
- Quality assurance and quality control (QA/QC) programs established and followed by the firm performing the powder coating operation.
- A product data sheet and material safety data sheet of each type of coating material to be used, including the products to be used for field repair of damaged areas.
- A description of the cleaning, surface preparation, pre-heating, application, curing, shop and field coating repair, handling, and storage processes to be followed for Structures and items to be coated.
- A letter from the firm performing galvanizing, if other than the Contractor, certifying that neither water quenching nor a chromate conversion coating will be used on the surfaces that are to be powder coated.

Do not begin preparation or coating Work before the Powder Coating Plan has been approved.

(b) Coating Materials Certification - At least 7 Calendar Days before the date that preparation and coating operations are scheduled to begin, submit a manufacturer's certification stating that each coating material in the coating system:

- Meets the requirements of this Section.
- Meets the specifications of the manufacturer's data sheets.
- Is compatible, including coating repair materials.

Materials

00593.10 Coating Materials - Furnish coating Materials meeting the requirements of the Specifications and the applicable portions of SSPC PA 1, *Shop, Field and Maintenance Painting*, when not in conflict with the Specifications.

(a) Coating System:

(1) Steel Substrates - Provide a two-coat system for steel substrates consisting of a zinc-rich epoxy primer and a polyester topcoat, conforming to the following:

Test	Test Method	Limit or Value
Adhesion	ASTM D3359, Method B	B5 (no failure)
Flexibility	ASTM D522, Method B	Pass 1/4" Mandrel Bend
Pencil Hardness	ASTM D3363	H Plus
Specific Gravity	ASTM D792	2.30 minimum
Zinc in Dry Film	Calculated Weight	50% minimum

(2) Galvanized and Other Non-Steel Metallic Substrates - Provide a two-coat system for galvanized and non-steel metallic substrates consisting of an epoxy primer and polyester topcoat, conforming to the following:

Test	Test Method	Limit or Value
Adhesion	ASTM D3359, Method B	B5 (no failure)
Flexibility	ASTM D522, Method B	Pass 1/8" Mandrel Bend
Pencil Hardness	ASTM D3363	H Plus
Specific Gravity	ASTM D792	1.25 minimum

(3) Topcoat - Furnish a polyester topcoat meeting the requirements of the American Architectural Manufacturers Association (AAMA) Specification 2604.

(b) Color - Unless otherwise specified, furnish top-coat color that conforms to the following:

- SAE AMS-STD-595 color #20059 for weathering steel
- SAE AMS-STD-595 color #24272 for ODOT Green
- SAE AMS-STD-595 color #26357 for miscellaneous metal on concrete Bridges concrete gray
- SAE AMS-STD-595 color #27038 for black

(c) Slip-Critical Connections - The primer coat on steel-to-steel contact surfaces at all slip-critical bolted joints using high strength bolts shall conform to Class B (slip coefficient of 0.5) coating requirements in "Test Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints", as adopted by the Research Council on Structural Connections.

00593.11 Blasting Abrasives - Provide abrasives that have no corrosion products, water, oil, or any other material detrimental to the application and adherence of the coatings. Provide abrasives that conform to SSPC-AB 1. When directed, test cleanliness according to ASTM D7393 and ASTM D4940. Conductivity results from ASTM D4940 shall not exceed 100 microsiemens per centimeter.

00593.12 Caulking - Furnish structural steel caulking from the QPL and approved for use by the coating manufacturer. Unless the caulking is to be over coated, the caulking color shall be clear or shall approximate the color of the top coating.

Furnish industrial grade polystyrene or polyurethane backing Material of sufficient diameter to fill the crevices or gaps as required.

Obtain the Engineer's approval of the caulking and backing Material before using.

Construction

00593.40 General - Structures to be prepared and powder coated include new and existing steel, galvanized, and non-steel metallic substrates.

00593.41 Special Fabrication, Preparation, and Coating:

(a) Inaccessible Surfaces - Before fabrication, prepare and coat, with all coats, steel surfaces inaccessible to preparation or to coating after fabrication.

Protect from blast-cleaning, powder coatings, overspray, and drippings all contact surfaces within slip-critical joints that are not to be coated. Remove or repair unintended coatings or other damage on these surfaces to the Engineer's satisfaction at no additional cost to the Agency.

(b) Welded Areas - Schedule fabrication, preparation, and coating so that the coating system is not damaged by welding or fabricating processes.

Neutralize weld areas and remove smoke stain and spills according to SSPC-SP 1. Remove weld slag and spatter by mechanical means before blast-cleaning. Supplement blast-cleaning by other treatment as recommended by the manufacturer of the coating system and as required in 00593.42.

Do not apply coatings within 4 inches of the weld before the welding operation is complete.

00593.42 Preparation of Surfaces:

(a) Steel Structures - Clean new steel structure surfaces to be coated according to SSPC-SP 10 / NACE No. 2 *Near White Metal Blast Cleaning*, except as modified by the Specifications. The appearance of the final blast-cleaned surface shall closely approximate Pictorial Standard SP 10 of SSPC-Vis 1 and have a 1.0 to 2.5 mil profile finish.

(b) Non-Steel Metallic Substrates:

(1) Galvanized Substrates - Clean and prepare galvanized surfaces to be coated according to ASTM D6386, the approved Powder Coating Plan, and the following:

- **Newly Galvanized Steel** - Smooth and clean surfaces according to ASTM D6386, Section 5 and prepare surfaces according to ASTM D6386, Section 5.4.1.
- **Partially Weathered Galvanized Steel** - Check and prepared according to ASTM D6386, Section 6, then smooth and clean surfaces according to ASTM D6386, Section 5, then prepare surfaces according to ASTM D6386, Section 5.4.1.
- **Weathered Galvanized Steel** - Prepare according to ASTM D6386, Section 7.

(2) Aluminum, Stainless Steels, and Non-Ferrous Metals - Prepare surfaces by using one of the following methods:

- Solvent clean surfaces to be coated according to SSPC-SP 1, followed by a light brush blast according to SSPC-SP 16 *Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals* with a maximum nozzle pressure of 75 psi. The prepared surface shall have a 1.0 to 2.5 mil profile finish.
- Hand sand the surface, creating a minimum 1 mil profile.
- Clean the surface according to the manufacturer's recommendations.

(c) All Metal Structures - Remove fins, tears, slivers, sharp edges, and hardened or damaged edges according to SSPC Paint Application Guide No. 11. Clean all surfaces of material detrimental to the application of the coating system as follows:

(1) Cleaning Methods - Blast-clean surfaces using one or more of the following methods to discharge the abrasive:

- A stream of high-pressure air
- A rotating centrifugal paddlewheel

Surfaces shall be dry before cleaning. Use methods specified in SSPC-SP 1, *Solvent Cleaning*, SSPC-SP 2, *Hand Tool Cleaning*, SSPC-SP 3, *Power Tool Cleaning*, and SSPC-SP 15 *Commercial Grade Power Tool Clean*, as necessary to augment blast-cleaning.

(2) Abrasives - Perform blast-cleaning using an abrasive of a size that will continually produce an angular surface profile of at least 1 mil, but not more than 4 mils, as measured according to ASTM D4417 using replica tape on the prepared surface. Blast-cleaning shall result in a

roughened steel surface comparable to a Keane-Tator Surface Profile Comparator for sand or grit using ASTM D4417.

If a centrifugal wheel with a grit mixer is used for blast-cleaning, inspect each member after blast-cleaning, and for those members not meeting the comparator or profile requirements, perform a final blast-cleaning with high-pressure air with an abrasive to obtain the specified profile.

Use abrasives conforming to 00593.11. Wet abrasives are allowed if wet sandblasting methods are used.

(3) Air - For blast-cleaning or blowing down, use high-pressure air that is free of water, oil, or any other material detrimental to the coating system. Test compressed air cleanliness daily according to ASTM D4285, or as directed.

(4) Cleaning Procedures - Perform blast-cleaning operations and pressure washing, as required, without damaging partially or entirely completed portions of the Work. Do not blast-clean adjacent to areas being coated.

Examine blast-cleaned and pressure washed surfaces for any traces of corrosion, water, oil, grease, soluble salts, and other material deposited during the cleaning operations. If present, remove any detrimental material by solvent cleaning and blast-clean the surface again.

(5) Final Preparation - Do not begin coating before:

- Blowing down prepared surfaces using high-pressure air within the fully enclosed containment, with the specified ventilation operating, and supplemented by brushing if required.
- Determining that the prepared surfaces are free of all residues per SSPC-PA 1.
- Repairing all damaged galvanizing according to ASTM A780.
- Obtaining approval from the Engineer.

00593.43 Coating Metal Structures:

(a) Description - When not in conflict with the Specifications, perform powder coating application according to the following:

- The applicable portions of SSPC-PA 1.
- The recommendations of the coating manufacturer.
- The best practices of the trade according to *SSPC Painting Manual*, Volume 1, *Good Painting Practice*.

(b) Application of Coating Materials - Apply the powder coating system according to the following requirements:

(1) Surface Condition - Ensure that the surface to be coated is free of moisture, dust, grease, rust, or other substance that would prevent the bond of succeeding applications. Prepare contaminated surfaces to the Engineer's satisfaction before applying the coating.

(2) Application Methods - After surface preparation, apply the two-coat system according to the powder coating manufacturer's recommendations, the approved Powder Coating Plan, and the following:

- Pre-heat surface.

- Apply the epoxy primer coat, followed by a partial cure.
- Apply the polyester finish coat, followed by the finish cure.

Apply each coat in a uniform layer, completely covering the preceding coat. Furnish each individual coat in a sufficiently different shade so that skips and holidays can be easily detected. Correct skips or other deficiencies before application of succeeding coats.

(c) Coating Requirements:

(1) Minimum Dry Film Thickness - Apply all coats to the following minimum thicknesses:

- **Primer:** 2.5 mils
- **Topcoat:** 2.5 mils

(2) Coating Thickness and Coverage Requirements - Each coat shall consist of as many applications as necessary to cover the work and achieve the minimum thickness specified. Apply each coat in sufficient thickness to achieve uniform and complete coverage and appearance. If all thickness measurements are not within the specified minimum dry film thickness, or if the visual inspection does not satisfy the Engineer, make additional applications, as necessary, to meet the thickness and coverage required. Film thickness will be measured above the peaks of the profile of the anchor pattern in the substrate.

The dry film thickness will be measured for acceptance using a Type 2 gauge according to SSPC-PA 2. If a question arises about an individual coat thickness or coverage, it will be verified using a Tooke gauge, according to ASTM D4138. If the Tooke gauge shows a prime coat to be less than the specified minimum thickness the total coating system will be rejected even if the thickness of the total system equals or exceeds the total specified thickness.

(3) Additional Top Coat Requirements - Even if the total thickness of the prime coat exceeds the prime coat specified thickness, apply the top coat to at least the minimum required topcoat thickness, to provide uniform and complete coverage and appearance.

(d) Time of Application - Apply the prime coat within 4 hours of the final cleaning and before any visible rust forms.

(e) Caulking - Apply the caulk after complete application of the top coat. Fill and seal crevices and gaps between structural shapes and plates, around bolt heads or nuts, and similar areas that would retain moisture with the following:

- Caulk, if the crevice or gap cannot be filled with coating materials.
- Backing material and caulk to fill the crevices and gaps that exceed 1/4 inch. Apply caulk over the backing material to form a watertight seal.

In areas that collect or channel water, apply caulk even if coating fills the gap.

(f) Adhesion - Perform adhesion tests according to ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers, using "Test Method D, E, or F", as warranted or at the direction of the Engineer. Ensure that minimum pull-off strength of 650 psi is achieved for zinc-rich primers and based coatings, and minimum pull-off strength of 1000 psi is achieved for all other coatings, including those over a zinc-rich primer. When testing a coating or coating system with a DFT of more than 12 mils, score around the test fixture.

00593.44 Inspecting - Conduct or make arrangements for powder coating tests required in the approved Powder Coating Plan.

Aspects of the preparation and coating process to be inspected and tested include, but are not limited to:

Test	Test Method
Ionic Contamination of Abrasive Material	ASTM D4940
Cleanness of Compressed Air	ASTM D4285
Pictorial Surface Preparation Standards	SSPC-VIS 1, 3, 4, and 5
Surface Profile by Keane-Tator Comparator	ASTM D4417
Surface Profile by Replica Tape	ASTM D4417
Hardness	AAMA 2604 and ASTM D3363
Dry Film Thickness by Magnetic Gauge	SSPC-PA 2 (modified)
Dry Film Thickness by Tooke Gauge	ASTM D4138
Pull-off Strength of Coating	ASTM D4541 (Method D, E, or F)

Provide access to the Engineer, at the powder coating facility, to visually inspect the assemblies for the presence of coating holidays and other unacceptable surface imperfections, and to witness the coating thickness testing, the hardness testing, and the adhesion testing.

Provide documentation of the QA/QC testing to the Engineer. Assemblies failing these tests will be rejected. Repair and recoat the rejected assemblies as directed.

Do not ship assemblies to the Project Site without Engineer's approval.

Repair coating system damages resulting from Agency inspection and testing at no additional cost to the Agency.

00593.45 Protecting Against Damage:

(a) Contaminated Surfaces - If the prepared surface becomes contaminated by material other than rust, clean the surface in a manner satisfactory to the Engineer before making the succeeding application. If the prepared surface becomes contaminated by rust, prepare the contaminated area again according to 00593.42 and recoat with all specified coats. Clean, re-prepare and recoat at no additional cost to the Agency.

(b) Surfaces Not to Be Coated - Protect surfaces that are not to be coated from blast-cleaning, overspray, and drippings. Remove or repair unintended coatings or other damage on these surfaces to the Engineer's satisfaction at no additional cost to the Agency.

(c) Handling, Shipping, or Surface Damage - After curing and acceptance, individually wrap coated assemblies with multiple layers of bubble wrap or other protective wrapping materials specified in the approved Powder Coating Plan.

During storage and shipping, separate each wrapped assembly with expanded polystyrene spacers and other spacing materials specified in the approved Powder Coating Plan.

After erection, repair marred and damaged coated surfaces due to the Contractor's shipping, storage, handling, and erection operations according to 00593.60.

Repair marred or damaged coated surfaces at no additional cost to the Agency, with the same materials and to the same condition as specified. At the completion of all Work, the coating shall be complete and the surfaces undamaged and clean.

Maintenance

00593.60 Repair of Damaged and Unacceptable Coatings - Repair damaged surfaces and surfaces not in compliance with requirements of 00593.43 as follows:

(a) Surface Preparation - Repair localized damage, corrosion, and unacceptable coatings.

Prepare the surface according to SSPC-SP 1, SSPC-SP 2, and SSPC-SP 3. Use a solvent that is acceptable to the coating material manufacturer. Extend the prepared area at least 2 inches into adjacent, tightly adhering, intact coating.

In areas exhibiting coating defects that do not extend down to the metal substrate, remove all loose, delaminating, non-intact, non-sound or otherwise defective coating down to sound, still performing coating. Extend the prepared areas at least 2 inches into adjacent tightly adhering, intact coating.

(b) Feathering of Repair Areas - Feather the existing coating system surrounding each repair location for a distance of 1 inch to 2 inches to provide a smooth, tapered transition into the existing intact coating.

Verify that the edges of coating around the periphery of the repair area are tight and intact by probing with a putty knife according to SSPC-SP 3. Roughen the existing coating in the feathered area to ensure proper adhesion of the repair coats. Overlap the intact, still sound surface at least 2 inches.

(c) Coating Application in Repair Areas - When the bare metal substrate is exposed in the repair area, apply all coats of the system to the specified thicknesses.

When the damage does not extend to the bare metal substrate, apply only the affected coats.

Maintain the thickness of the system in overlap areas within the specified total thickness tolerances and overlap the intact, sound existing coating at least 2 inches.

Measurement

00593.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00593.90 Payment:

(a) New Metal Structures - No separate payment will be made for preparing and powder coating new metal Work. Payment for this Work, including correction of damages, will be included in payment made for furnishing and placing the new metal Structure or assembly.

(b) Existing Metal Structures - The accepted quantities for preparing and powder coating existing metal Structures will be paid for at the Contract lump sum amount for the item "Prepare and Powder Coat Existing Structures".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for correction of damages described in 00593.60.

Section 00594 - Preparing and Coating Metal Structures

Description

00594.00 Scope - This Work consists of preparing and coating new metal Structures and features in the shop and in the field, and preparing and coating existing metal Structures. This includes all:

- Interior and exterior steel surfaces
- Steel railings, bridge bearings, and bridge expansion joint assemblies
- Other miscellaneous steel
- Galvanized and aluminum surfaces

00594.01 Abbreviations, Definitions, and References:

(a) Abbreviations:

AAMA - American Architectural Manufacturers Association

DFT - Dry Film Thickness

FTMS - Federal Test Method Standard

WFT - Wet Film Thickness

(b) Definitions:

Apparent Magnetic Surface - The magnetic surface that a magnetic gauge senses, somewhere between the peaks and valleys of the profile, after the steel is roughened by abrasive cleaning.

Cleaning - Removing detrimental material in preparation for coating.

Coat - An application, or applications, of paint or other protective material to a substrate, resulting in a layer of specified thickness.

Coating - Protective material after it is applied to a Structure.

Coating Material - Protective material in the liquid state before application.

Coating System - All specified coats applied separately in a predetermined order.

Field Coating - The on-site coating of new or existing metal Structures before or after erection.

Hold Coat - A brush augmented coating that completely covers the substrate, including all complex details as described in the definition of “Stripe Coat”. Applied prior to the full prime coat to prevent flash rusting of the cleaned steel surfaces.

Hold Point - A time at which the Contractor is required to stop a particular activity until a phase of Work is inspected or tested. If the Engineer finds this phase conforms to the Specifications, the subsequent phase of Work may proceed.

Maintenance Coating - The coating of existing steel Structures that have been previously coated and need recoating.

Manufacturer's Recommendation - The written specifications and instructions provided by a manufacturer of a coating material concerning the handling, mixing, and application of the coating material.

Pack Rust - A localized form of crevice corrosion that is typical of built-up members or layered steel components. Corrosion product is formed between or along the edges of the steel components and pushes the steel components apart to form crevices, the resulting pressure from the deforming steel and the corrosion buildup compresses the corrosion product.

Paint - A pigmented liquid, applied as a thin layer, which is converted to a solid colored film after curing. This film provides a decorative and protective coating to the substrate. The binder is a resin that may or may not be modified with natural vegetable oils, fish oils, or other ingredients.

Phase - An activity or step of the preparation and coating procedures to be inspected or tested. The transition from one phase to another represents a hold point.

Preparation - Measures taken to provide a suitable surface ready to coat.

Rust-Back - Rusting that occurs when freshly exposed bare, dry, steel is exposed to conditions of high humidity, moisture, or a corrosive atmosphere.

Rust Bloom - Discoloration indicating the initiation of rusting.

Shop Coating - The coating of steel surfaces in the fabrication shop before the metal is transported to the erection site.

Skin - A solid or semi-solid membrane that forms on paint in a container.

Skimming - The process in which a film forms over a liquid coating, either during storage or after application.

Stripe Coat - Separate, independent coating that is applied to complex details and irregular surfaces before the application of the full coat. Complex details and irregular surfaces include but are not limited to edges, seams, corners, gaps, crevices, weld lines, pitted surfaces, holes, nuts, bolts, rivets, and threads.

Solvent - Liquid used to solvate or put materials into solution or to clean Equipment and tools.

Substrate - A surface to which a coating is to be applied. This may be the prepared surface of the metal Structure or a previous coating.

Surface Profile - Roughness of a cleaned metal surface. The height of the profile is measured from the bottom of the valleys to the top of the peaks in mils.

Thinner - Volatile liquids used to thin compatible coating materials. Thinners may be a blend of solvents.

Wet Film Thickness - Coating layer dimension determined with a wet film thickness gauge immediately after application and before curing.

(c) References - In this Section, references such as SSPC-SP 1 and SSPC-PA 1 refer to Volume 2, *Systems and Specifications*, of SSPC's *Painting Manual*.

In these Specifications, references are made to FTMS 141, *Paint, Varnish, Lacquers, and Related Materials: Methods of Inspection, Sampling and Testing*, which is distributed by the U.S. General Services Administration.

00594.03 Precoating Conference and Submittals - Before beginning any preparation and coating Work, meet with the Contractor's supervisory personnel and quality control manager, any preparation or coating Subcontractors' supervisory personnel, a representative from the coating manufacturer, and the Engineer at a mutually agreed upon time. At least 21 Calendar Days before the precoating conference, submit a plan for accomplishing all phases of the preparation and coating Work, including the following:

- Ventilation
- Containment
- Surface preparation
- Painting
- Coating materials
- Quality Control Plan
- Waste handling and disposal
- All other pertinent information

If the Contractor's key personnel change, or if the Contractor proposes a significant revision to the plan for accomplishing the preparation and coating Work, the Engineer may require additional precoating conferences.

Do not begin any preparation or coating Work before the plan for completing the Work has been approved.

00594.04 Notice - Notify the Engineer, in writing, at least 7 Calendar Days in advance of the date that preparation and coating operations are to begin.

00594.05 Waste Handling and Disposal - Dispose of waste material according to 00290.20, and the requirements of SSPC Guide 7 that do not conflict with 00290.20.

00594.06 Access and Containment for Field Preparation of Coating - Provide access and containment according to Section 00253.

Materials

00594.10 Materials - Furnish Materials meeting the requirements of this Section, the Special Provisions, and the applicable portions of SSPC-PA 1, *Shop, Field and Maintenance Painting*, when not in conflict with either this Section or the Special Provisions.

(a) Coating System - Furnish coating Materials from the QPL and according to the following requirements:

- For shop coating of steel or iron surfaces, furnish a three-coat system with organic or inorganic zinc primer.
- For maintenance coating of steel or iron surfaces, furnish a three-coat system with organic zinc primer.
- For field rehabilitation of coated steel or iron surfaces, furnish a three-coat system with surface tolerant organic zinc primer.
- For shop coating or maintenance coating of non-ferrous surfaces, furnish a two-coat system.
- For shop pile coating of steel pile, furnish a three-coat system with tar.

Do not apply coating materials until certifications required by 00165.35(a) and 00165.35(b) have been provided and the materials are accepted for use by the Agency.

(b) Color - Unless otherwise specified, furnish top-coat color that conforms to the following colors:

- SAE AMS-STD-595 color #24272 for ODOT Green top coat.
- SAE AMS-STD-595 color #30059 for weathering steel top coat.
- SAE AMS-STD-595 color #26357 for miscellaneous metal on concrete Bridges.

00594.11 Coating Materials:

(a) Manufacturing - Furnish coating Material meeting the following requirements:

- Prepared by the manufacturer.
- For multi-component coatings, be manufactured in separate, properly portioned containers and ready for field mixing. Do not field mix multi-component coatings unless approved by the Engineer.
- Homogeneous, free of contamination, and of a consistency suitable for the specified use.
- Does not require a pretreatment chemical or material prior to application of the prime coat, except as stipulated in the Specifications.
- Includes required tinting and coloring materials at the time of manufacturing. Do not use gray for the first prime coat.
- A sufficiently different shade for each individual coat from the manufacturer, so that skips and holidays can be easily detected. Do not tint the coating material in the field unless approved by the Engineer.
- Does not vary in composition without prior notice by the manufacturer and approval of the Engineer.
- Has sufficient time remaining on the manufacturer's recommended shelf life to allow for application before expiration of that shelf life.

(b) Packaging - Furnish unopened containers from the manufacturer that meet the following requirements:

- Constructed of new and unused materials.
- Not have a capacity of more than 6 gallons.
- Meet U.S. Department of Transportation's Hazardous Material Shipping Regulations.
- If necessary, constructed with an interior lining to prevent attack by the coating material. The lining shall not delaminate from the container wall so as to contaminate the coating.
- Labeled with a quality compliance certificate according to 00165.35, showing the following:
  - Manufacturer's name
  - Exact title of coating material
  - Manufacturer's batch number
  - Date manufactured
  - Identification of all toxic substances
  - Handling and application precautions

(c) Sampling and Testing - Have the coating material manufacturer furnish the following to the ODOT Materials Laboratory:

- One unopened 1 quart container of each coating material, each component of multi-component coating material, and each thinner, from each batch of each coat. The Agency may, at its discretion, place an Inspector at the site of manufacture and obtain check samples at the Project Site.
- Test results certification according to 00165.35 for each batch of each coat, and if the coating material is specified for use on steel-to-steel contact surfaces, certification that the coating material meets the requirements of 00594.11(d).
- A product data sheet for each type of coating material and thinner.
- A material safety data sheet or safety data sheet with the initial sample of each type of coating material and thinner.

Agency testing will include the following tests necessary to ensure that the coating materials conform to Specifications, manufacturer's product data sheet, and other testing as the Agency deems appropriate.

Test	Test Method
Density of Liquid Coatings, Inks, and Related Products	ASTM D1475
Determination of Zinc in Dry Films of Paints and Coatings	ODOT TM 614
Coarse Particles in Pigments, Pastes, and Paints	ASTM D185
Consistency of Paints Using the Stormer Viscometer	ASTM D562
Fineness of Dispersion of Pigment-Vehicle System	ASTM D1210
Drying, Curing, or Film Formation of Organic Coatings at Room Temperatures	ASTM D1640
Volatile Content of Paints	ASTM D2369
Pigment Content of Solvent-type Paints	ASTM D2371
Volume Nonvolatile Matter in Clear or Pigmented Coatings	ASTM D2697
Vehicle Solids (Ordinary Centrifuge)	FTMS 141, Method 4051
Nonvolatile vehicle Content	FTMS 141, Method 4053

Agency testing is not to be construed as determining or predicting the performance or compatibility of the individual coating material or the total coating system.

(d) Slip-Critical Connections - The primer coat on steel-to-steel contact surfaces at all slip-critical structural bolted connections using high strength bolts shall conform to Class B (slip coefficient of 0.5) coating requirements in "Test Method to Determine the Slip Coefficient for Coatings Used in Bolted Joints", as adopted by the Research Council on Structural Connections.

00594.12 Caulking - Furnish structural steel caulking from the QPL and approved for use by the coating manufacturer. The caulking color shall be clear, approximate the color of the top coating, or be over coated.

Furnish industrial grade polystyrene or polyurethane backing material of sufficient diameter to fill the crevices or gaps as required.

Obtain the Engineer's approval of the caulking and backing material before using.

00594.13 Chloride Remover - When used, furnish a chloride remover from the QPL that is fully compatible with the coating system according to the recommendations of the coating system manufacturer.

Labor

00594.30 Quality Control Personnel - Provide an on-site quality control manager who shall be responsible for managing quality control related to all preparation and coating quality control activities. The quality control manager shall not be employed in a supervisory role for any preparation or coating Work.

Construction

00594.40 General:

(a) New Steel Structures - Prepare and coat new erected steel Structures and features. Except as provided in the Specifications, perform all required preparation and coating at the fabrication shop after completion of fabrication and before transporting to the Project Site.

(b) Existing Steel Structures - Prepare and coat the existing steel Structures described in the Special Provisions.

(c) Rehabilitating Coated Steel Structures - Prepare and coat new steel members and existing steel Structures impacted by erection. This includes all existing steel surfaces uncovered by the removal of existing steel, wood, and concrete members. Impacted areas include, but are not limited to areas, where rivets or bolts are removed, and existing steel surfaces damaged during erection or other Contractor operations. Except as provided in the Specifications, perform all required preparation and coating of new steel members at the fabrication shop after completion of fabrication and before transporting to the Project Site. Perform preparation and coating of existing steel Structures impacted by erection in the field.

(d) Non-Steel Metallic Substrates - Prepare and coat new non-steel substrates and features. Except as provided in the Specifications, perform all required preparation and coating at the fabrication shop after completion of fabrication and before transporting to the Project Site. Prepare and coat existing non-steel substrates described in the Special Provisions.

(e) Lighting - Provide lighting during all periods of preparation, coating, and inspection according to SSPC-Guide 12, *Guide for Illumination of Industrial Painting Projects*.

00594.41 Special Fabrication, Preparation and Coating:

(a) Inaccessible Surfaces - Before fabrication, prepare and coat with all coats steel surfaces inaccessible to preparation and coating after fabrication.

Prepare and coat contact surfaces within slip-critical joints, constructed as part of the Work under Section 00560, according to 00594.11(d), 00594.42 and 00594.43(d)(1).

(b) Welded Areas - Schedule fabrication, preparation, and coating so that the coating system is not damaged by the welding or fabricating process.

Neutralize weld areas and remove smoke stain and spills according to SSPC-SP 1. Remove weld slag and spatter by mechanical means before blast-cleaning. Supplement blast-cleaning by other treatment as recommended by the manufacturer of the coating system and as required in 00594.42.

Do not apply coating within 4 inches of the weld before the welding operation is complete.

00594.42 Preparation of Surfaces:

(a) New Steel Structures - Clean new steel Structure surfaces to be coated according to SSPC-SP 10 / NACE No. 2 *Near White Metal Blast Cleaning*, except as modified by this Section. The appearance of the final blast-cleaned surface shall closely approximate Pictorial Standard SP 10 of SSPC-Vis 1.

(b) Existing Steel Structures - Blast-clean existing steel Structure surfaces to be coated according to SSPC-SP 10 / NACE No. 2 *Near White Metal Blast Cleaning* with the appearance of the blast-cleaned surface to closely approximate Pictorial Standard SP 10 of SSPC-Vis 1, or clean to SSPC-SP WJ-2 Waterjet Cleaning of Metals - *Very Thorough Cleaning* with the appearance of the water-jetted surface to closely approximate Pictorial Standard WJ-2 of SSPC-Vis 4.

(c) Rehabilitating Existing Coated Steel Structures - Prepare all existing steel surfaces to be coated according to SSPC-SP 15, *Commercial Grade Power Tool Cleaning*. The cleaned surface shall have a minimum surface profile of 1 mil.

Prepare all existing coated surfaces exposed by the removal of the existing components involved in the rehabilitation, all areas in which rivets, bolts, or plates are to be removed, and areas damaged by erection or other Contractor operations. Completely clean all existing lead-based coatings exposed by the removal of any structural or miscellaneous member to SSPC-SP 15 *Commercial Grade Power Tool Cleaning* requirements. Extend all prepared areas at least 2 inches into tightly adhering, intact paint. Overlap the subsequent coating and the still intact coating by a minimum of 2 inches. Lightly sand the overlap area of the intact coating to provide a profile for the subsequent repair coating to adhere to.

(d) Non-Steel Metallic Substrates:

(1) Galvanized Surfaces - Prepare surfaces to be coated according to ASTM D6386.

(2) Aluminum - Prepare aluminum surfaces by using one of the following methods:

- Solvent clean surfaces to be coated according to SSPC-SP 1, then follow by a light brush blast according to SSPC SP 16 *Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals* with a maximum nozzle pressure of 75 psi.
- Hand sand the surface, creating a minimum 1 mil profile.
- Clean the surface according to the manufacturer's recommendations.

(e) All Metal Structures - Remove fins, tears, slivers, sharp edges, and hardened or damaged edges according to SSPC Paint Application Guide No. 11.

Clean all surfaces of material detrimental to the application of the coating system as follows:

(1) Cleaning Methods - Blast-clean surfaces using one or more of the following methods to discharge the abrasive:

- A stream of high-pressure air
- A rotating centrifugal paddlewheel
- A stream of high-pressure water

Surfaces shall be dry before cleaning unless a wet blast cleaning method is used. Use methods specified in SSPC-SP 1, *Solvent Cleaning*, SSPC-SP 2, *Hand Tool Cleaning*, SSPC-SP 3,

Power Tool Cleaning, and SSPC-SP 15 *Commercial Grade Power Tool Clean*, as necessary to augment blast-cleaning.

(2) Abrasives - Perform blast-cleaning using an abrasive of a size which will continually produce an angular surface profile of at least 1 mil, but not more than 4 mils, as measured according to ASTM D4417 using replica tape on the prepared surface. The blast-cleaning shall result in a roughened steel surface comparable to a Keane-Tator Surface Profile Comparator for sand or grit using ASTM D4417.

When removing coatings with lead or chromium, use a mineral slag abrasive combined with an approved additive to render the removed coating material non-hazardous. Obtain approval for the specific abrasive blast additive before use.

If a centrifugal wheel with a grit mixer is used for blast-cleaning, inspect each member and for those members not meeting the comparator or profile requirements, perform a final blast-cleaning with high-pressure air with an abrasive to obtain the specified profile.

Provide abrasives that have no corrosion products, water, oil, or any other material detrimental to the application and adherence of the coatings. Provide abrasives that conform to SSPC-AB 1. When directed, test cleanliness according to ASTM D7393 and ASTM D4940. The conductivity results from ASTM D4940 shall not exceed 100 microsiemens per centimeter. Wet abrasives are allowed if wet sandblasting methods are used.

(3) Air - For blast-cleaning or blowing down, use high-pressure air that is free of water, oil, or any other material detrimental to the coating system. Provide adequate separators and traps. Test compressed air cleanliness daily according to ASTM D4285, or as directed.

(4) Water - Use water for water jet cleaning that is clean, potable and does not contain more than 75 milligrams per liter of chlorides or 200 milligrams per liter of sulfates. Filter, recycle, and dispose of water when surface soluble salt levels cannot consistently be kept below 70 microsiemens per centimeter, measured with a conductivity meter capable of reading to 1 microsiemen per centimeter.

Use a rust inhibitor that is recommended by the coating manufacturer. Use the rust inhibitor to prepare a test panel at least 14 Calendar Days before beginning Work, to show that the inhibitor does not cause loss of bond between the steel substrate and the primer. Do not use the rust inhibitor product if the test panel does not meet the adhesion requirements of 00594.43(g).

(5) Cleaning Procedures - Perform blast-cleaning operations and pressure washing, as required, without damaging partially or entirely completed portions of the Work. Do not blast-clean adjacent to areas being coated.

Examine blast-cleaned and pressure washed surfaces for any traces of corrosion, water, oil, grease, soluble salts, and other material deposited during the cleaning operations. If present, remove any detrimental material by solvent cleaning and blast-clean the surface again.

(6) Final Preparation - Do not begin coating before:

- Blowing down prepared surfaces using high pressure air within the fully enclosed containment, with the specified ventilation operating, and supplemented by brushing if required.
- Determining that the prepared surfaces are free of all residues, according to SSPC PA-1.
- Repairing all damaged galvanizing according to ASTM A780.
- Obtaining approval from the Engineer.

(f) Pack Rust Removal - Fully remove pack rust using either of the following methods:

- Mechanically, in combination with saturating the pack rust with water at 3,000 psi and heating to a minimum of 250 °F and a maximum of 400 °F.
- Blast with ultra-high pressure water jetting at 35,000 psi.

00594.43 Coating Metal Structures:

(a) Description - When not in conflict with this Section and the Special Provisions, perform coating application according to the following:

- The applicable portions of SSPC-PA 1.
- The recommendations of the coating manufacturer.
- The best practices of the trade according to SSPC *Painting Manual*, Volume 1, *Good Painting Practice*.

(b) Application Site Mixing, Thinning, and Storage of Coating Materials:

(1) Rejection - Reject and do not use the contents of a container if:

- The material does not arrive at the application site in the original, unopened manufacturer's containers.
- The container is punctured or has a break in the lid seal.
- The coating materials have begun to polymerize, solidify, gel, or deteriorate in any other manner.
- The recommended shelf life, as stated in the manufacturer's product data sheets, has expired.

(2) Mixing - Thoroughly mix coating materials by mechanical means to ensure a uniform composition. Do not mix coating materials by means of air stream bubbling or boxing. Mix in the original container and continue until all pigment or metallic powder is in suspension. Ensure that all solid coating material that may have settled to the bottom of the container is thoroughly dispersed. After mixing, inspect the coating materials for uniformity and to ensure that no unmixed pigment or lumps are present.

Add separately packaged catalysts, curing agents, hardeners, initiators or dry metallic powders to the base coating material only after the base coating material is thoroughly mixed to achieve a uniform mixture with all particles wetted. Add the proper volume of curing agent to the correct volume of base with constant agitation. Use the mixture within the pot life specified by the manufacturer. Discard unused portions at the end of each workday.

(3) Thinning - Do not add additional thinner at the application site unless approved by the Engineer. If allowed, furnish the amount and type of thinner conforming to the manufacturer's recommendations.

(4) Straining - Strain all coating materials after mixing to remove undesirable matter, but not pigment or metallic powder.

(5) Agitation - If recommended by the manufacturer, constantly agitate coating materials during application by using paint pots equipped with mechanical agitators.

(6) Storage - Store the coating material and solvents in original containers. Store the containers in a weather-tight space where the temperature is maintained between 40 °F and 100 °F or according to the manufacturer recommendations, whichever is more restrictive.

(c) Application of Coating:

(1) Surface Condition - Ensure that surfaces to be coated are free of moisture, dust, grease or other substances that would prevent the bonding of succeeding applications. Protect freshly coated surfaces from contamination by abrasives, dust or foreign materials from any source. Do not apply succeeding coats until the Engineer has approved the prepared surface.

(2) Application Methods - Apply coating materials by air or airless spray, brush, roller, any combination of these methods, or as recommended by the coating material manufacturer, unless otherwise specified. If air is used for application, ensure that it is free of water, oil, or any other material detrimental to the coating system. Provide adequate separators and traps and test air cleanliness daily according to ASTM D4285, or as directed. Regardless of which application method is used to apply the coating, use brushes to push the coating into complex details, crevices, gaps, areas difficult to access, and where spraying does not adequately cover or penetrate. All application techniques shall conform to Section 7 in SSPC-PA 1 and the applicable sections of SSPC Paint Application Guide No. 11.

Apply subsequent coats of paint in sufficiently different shades so that skips and holidays can be easily detected.

Apply each coat in a uniform layer, completely covering the preceding coat. Correct runs, sags, skips or other deficiencies before application of succeeding coats. Perform re-cleaning, application of additional coating, or other measures, as directed by the Engineer, at no additional cost to the Agency.

For each applicator, perform at least one WFT test 15 minutes after beginning coating application and one WFT test per hour thereafter. Test immediately after coating application and report results.

(d) Coating Requirements:

(1) Number of Coats and Film Thickness - Apply all coats to the minimum thickness specified in the manufacturer's product data sheet for the coatings.

Apply the coating system in the number of coats specified in the QPL, with each coat consisting of as many applications as necessary to cover the Work and achieve the minimum thickness specified for the coat.

On steel-to-steel contact surfaces, apply only zinc primer coating. On steel-to-concrete contact surfaces, apply the full coating system so that it extends 1 inch into the steel-to-concrete contact surface if accessible. On steel-to-wood contact surfaces, apply all coatings specified.

The dry film thickness of the primer on steel-to-steel contact surfaces shall not be less than 3 mils nor more than the manufacturer's class "B" certification allows.

Do not assemble coated joints before the coatings have cured for at least the time used in the qualifying test, or as recommended by the manufacturer.

(2) Stripe Coats - On maintenance coating projects, apply a prime stripe coat by hand before applying the full prime coat and apply an intermediate stripe coat by hand before applying the full intermediate coat. Apply the stripe coat by brush only. Use brushes to push the coating

around and into complex details and irregular surfaces. Make each stripe coat a different color than the preceding and subsequent full coat, extending a minimum of 1 inch from the irregular surface, and completely hiding the substrate. The stripe coat shall be a different color and be approximately 3 mils thick. Each stripe coat will have its own hold point and shall not be used to correct deficiencies in the preceding or subsequent coats. Apply stripe coats according to the applicable sections of SSPC Paint Application Guide No. 11 that do not conflict with this Section or the Special Provisions.

A brush-augmented hold coat may be applied prior to the full prime coat as the stripe coat to prevent rust-back of the cleaned steel surfaces, if approved by the Engineer. Submit hold coat procedure to the Engineer prior to hold coat operations. If rust-back, rust bloom, or rust stains are present on the surface after the hold coat application prior to full prime coat, re-prepare the surface according to 00594.42 and re-submit the hold coat procedure to the Engineer.

(3) Coating Thickness and Coverage Requirements - The Engineer will take dry coating thickness measurements after the application of each coat and before application of the succeeding coat. In addition to coating thickness measurements, a visual inspection for complete coverage will be made by the Engineer after each coat. Apply each coat in sufficient thickness to achieve uniform and complete coverage and appearance. If all thickness measurements are not within the specified minimum dry film thickness, or if the visual inspection does not satisfy the Engineer, make additional applications, as necessary, to meet the thickness and coverage required. Film thickness will be measured above the peaks of the profile of the anchor pattern in the metal substrate.

The Engineer will take dry film thickness measurements with a type 2 gauge according to SSPC-PA 2. The minimum dry film thickness measurements and frequency of measurements will be according to SSPC-PA 2, modified as follows:

- A single gauge reading will be taken for each 10 square feet of surface area.
- A spot measurement is only taken at locations where a gauge reading is less than 100 percent of the Project's specified minimum DFT.
- All spot measurements shall meet 100 percent of the Project's specified minimum DFT.
- Additional readings may be required to identify the limits of the non-compliant areas.

If a question arises about an individual coat thickness or coverage, it will be verified using a Tooke gauge, according to ASTM D4138. If the Tooke gauge shows a prime coat to be less than the specified minimum thickness, or reveals a missing intermediate coat, the total coating system will be rejected even if the thickness of the total system equals or exceeds total specified thickness.

In areas where dry film thickness measurements are impracticable, wet film thickness measurements will be made according to ASTM D4414.

(4) Additional Top Coat Requirements - Even if the total thicknesses of prime and intermediate coats exceed the specified thicknesses of the prime and intermediate coats, apply the top coat to at least the minimum required topcoat thickness, to provide uniform and complete coverage and appearance.

(e) Time of Application - Unless otherwise approved by the Engineer, prime existing steel Structure surfaces according to one of the following methods:

- Prime on the same Day that the surfaces are cleaned.
- Apply an approved rust inhibitor to the entire surface on the same Day as cleaning, and prime within 48 hours after inhibitor application.

- Reblast all surfaces prior to coating.

Before priming surfaces prepared by waterjetting, ensure that the surfaces do not exceed "Light" flash rust as defined by the *Wipe Test* in SSPC-SP WJ-2. Ensure that all other surfaces are dry and free of flash rust before priming.

Apply each coat over the preceding coat as soon as possible, allowing for drying time of the preceding coat, weather, temperature, and similar factors, as well as the manufacturer's recommendations. Re-prepare a primer coat that exhibits freckle rust or is exposed to the weather for more than 60 days, according to 00594.42.

Allow each coat to dry and sufficiently cure before recoating so the succeeding or additional coat can be applied without delamination, blistering, wrinkling, or loss of adhesion or cohesion. Conform to the manufacturer's recommendations for recoat times unless they conflict with this Section or any coating problems develop. Do not revise recoat times without receiving approval from the Engineer.

(f) Caulking - Apply caulk after complete application of the top coat. Fill and seal crevices and gaps between structural shapes and plates, around bolt heads and nuts, and similar areas that would retain moisture, with the following:

- Caulk, if the crevice or gap cannot be filled with coating materials.
- Backing material and caulk to fill the crevices and gaps that exceed 1/4 inch.

Apply caulk over the backing material to form a watertight seal.

In areas that collect or channel water, apply caulk even if coating fills the gap.

(g) Adhesion - Perform adhesion tests according to ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers, using "Test Method D, E, or F", as warranted or at the direction of the Engineer. Ensure that a minimum pull-off strength of 650 psi is achieved for zinc-rich primers and tar based coatings, and that a minimum pull-off strength of 1,000 psi is achieved for all other coatings, including those over a zinc-rich primer. When testing a coating or coating system with a DFT of more than 12 mils, score around the test fixture.

(h) Environmental Conditions - Test environmental conditions according to ASTM E337 and apply coating materials only during periods when:

- Air temperature is above 45 °F
- Steel surface temperature is:
  - Greater than 45 °F
  - Less than 115 °F
  - At least 5 °F above the dew point
- Relative humidity is within the manufacturer's recommended range

Do not apply coating materials if the Engineer determines that conditions are not favorable for proper application and performance of the coating.

If fresh coatings are damaged by the elements, replace or repair at no additional cost to the Agency.

If a coating system allows application in environmental conditions different from those specified, submit a letter from the manufacturer stating the conditions under which the coatings can be

applied. Application under conditions other than specified will not be allowed without the Engineer's written approval.

Cover and protect the metal if coating is to be applied in adverse weather conditions. Heat the metal and surrounding air to the temperature specified in this Subsection. Continue protecting the newly coated surfaces until the coating achieves proper cure.

(i) Stenciling - Stencil the month and year of application and the type of coating used in block letters 2 inches high at a location on each end of each span on the Structure being coated. The exact location of stenciling will be determined by the Engineer. Use flat black color stenciling unless otherwise directed.

00594.44 Inspecting - The Engineer will inspect each phase of preparation and coating. Do not proceed with succeeding phases until approved. Provide the Inspector timely access to areas where Work is being performed. Allow adequate time for inspection at each hold point. Hold points are the following:

- Before cleaning operations begin
- After cleaning operations are completed and before application of any coating materials
- After each stripe coat
- After each full coat
- After cleaning in conjunction with coating repairs
- After application of each coat in coating repairs
- After application of last coat, before moving work platforms and containment structures

Repair coating system damages resulting from Agency inspection and testing at no additional cost to the Agency.

Aspects of the preparation and coating process to be inspected and tested include, but are not limited to:

Test	Test Method
Environmental Conditions for Coating	ASTM E337
Oil in the Abrasive Material	ASTM D7393
Ionic Contamination of Abrasive Material	ASTM D4940
Cleanness of Compressed Air	ASTM D4285
Pictorial Surface Preparation Standards	SSPC-VIS 1, 3, 4, and 5
Surface Profile by Keane -Tator Comparator	ASTM D4417
Surface Profile by Replica Tape	ASTM D4417
Wet Film Thickness	ASTM D4414
Dry Film Thickness by Magnetic Gauge	SSPC-PA2 (modified)
Dry Film Thickness by Tooke Gauge	ASTM D4138
Pull-off Strength of Coating	ASTM D4541 (Method D, E, or F)
Nonvolatile Vehicle Content	FTMS 141, Method 4053

00594.45 Protecting Against Damage:

(a) Contaminated Surfaces - If the prepared surface becomes contaminated by material other than rust, clean the surface in a manner satisfactory to the Engineer before making the succeeding application. If the prepared surface becomes contaminated by rust, prepare the contaminated area again according to 00594.42 and recoat with all specified coats. Clean, re-prepare, and recoat at no additional cost to the Agency.

(b) Surfaces Not to Be Coated - Protect surfaces that are not to be coated from blast-cleaning, overspray and drippings. Remove or repair unintended coatings or other damage on these surfaces to the Engineer's satisfaction at no additional cost to the Agency.

Do not clean or coat galvanized steel members such as ladders, safety rails and stanchions unless otherwise directed in the Special Provisions. Protect them from damage during preparation and application operations. Repair damaged galvanizing at no additional cost to the Agency.

Protect navigation lights and conduits. If navigation lights or lenses are damaged by preparation or coating operations, immediately repair or replace at no additional cost to the Agency. Keep navigation lights operating and visible at all times.

(c) Handling, Shipping, or Surface Damage - Exercise care in moving or handling metal in the shop, during shipping, and during erection. Do not move or handle coated metal until the coating has cured.

Repair marred or damaged coated surfaces at no additional cost to the Agency, with the same materials and to the same condition as specified. At the completion of all Work, the coating shall be complete and the surfaces undamaged and clean.

(d) Other Damage - Prevent, at no additional cost to the Agency, damage resulting from preparation and coating Work, including:

- Damage to marine or vehicular traffic or harm to pedestrians in the vicinity of the Work.
- Abrasive material or debris falling into an area which would create a traffic hazard.
- Damage to the Bridge Substructure, Superstructure or motorized Equipment.
- Damage to other property as a result of the Contractor's operations.

Maintenance

00594.60 Repair of Damaged and Unacceptable Coatings - Repair damaged surfaces and surfaces not in compliance with requirements of 00594.43 as follows:

(a) Surface Preparation - Repair localized damage, corrosion, and unacceptable coatings.

Prepare areas exhibiting coating defects down to the metal substrate, whether exhibiting visible corrosion or not, according to SSPC-SP 10 / NACE No. 2 *Near White Metal Blast Cleaning*.

If approved by the Engineer, prepare small areas according to SSPC-SP 15, taking care not to damage adjacent areas.

In areas exhibiting coating defects that do not extend down to the metal substrate, remove all loose, delaminating, non-intact, non-sound coatings, or otherwise defective coating, down to sound, still-performing coating. Extend the prepared areas at least 2 inches into adjacent tightly adhering, intact coating.

(b) Feathering of Repair Areas - Feather the existing coating system surrounding each repair location. Feather the existing coating for a distance of 1 to 2 inches to provide a smooth, tapered transition into the existing intact coating.

Verify that the edges of the coating around the periphery of the repair area are tight and intact by probing with a putty knife according to SSPC-SP 3. Roughen the existing coating in the feathered

area to ensure proper adhesion of the repair coats. Overlap the intact, still-sound surfaces at least 2 inches.

(c) Coating Application in Repair Areas - When the bare metal substrate is exposed in the repair area, apply all coats of the system to the specified thicknesses.

When the damage does not extend to the bare metal substrate, apply only the affected coats.

Maintain the thickness of the system in overlap areas within the specified total thickness tolerances and overlap the intact, sound existing coating at least 2 inches.

Finishing and Cleaning Up

00594.75 Coating System Warranty and Supplemental Warranty Performance Bond - When the Special Provisions identify that a coating system warranty and a supplemental warranty performance bond are required, provide them according to 00170.85(b)(1) and the following:

(a) Coating System Warranty - Unconditionally warrant to the Agency that all coating Work and the coating systems, above deck and below deck, performed and applied on this Project are and shall be free of all defects for a period of 36 months. Provide a written 36-month warranty using the Agency-supplied coating system warranty form that is included near the front of the Special Provisions booklet. Furnish the written warranty 30 Calendar Days before the precoating conference. "Unconditionally warrant" means that the warranty covers all defects, regardless of the source or cause of the defect, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of materials.

For purposes of the warranty, coating system defects are defined as any one or more of the following conditions:

- Visible rust or rust breakthrough
- Blistering, cracking or alligatoring
- Chalking or fading
- Loss of adhesion
- Cohesive failure

The Agency inspection of any portion of the Work during the Contract and during the coating system application, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the Contractor of its obligations under this warranty. Within 60 Calendar Days of written notification of defects, submit a repair plan to the Engineer. Within 120 Calendar Days of written notification of defects, or within such other time as the Engineer may agree in writing, correct all defects at no additional cost to the Agency.

The 36 month coating system warranty will begin on the date of Second Notification. During this warranty period, the Agency will inspect the coating system for defects three times; at approximately 12, 24, and 36 months after issuance of the Second Notification. The Contractor will be notified in advance of each inspection and will be permitted to accompany the Agency Inspector. Make repairs and correct all defects to the coating system. Make all corrections and repairs according to the Contract requirements.

(b) Supplemental Warranty Performance Bond - Provide a supplemental warranty performance bond, in addition to the regular Performance Bond for the Contract, executed by a Surety authorized to do business in the State of Oregon. Furnish the supplemental warranty performance bond 30 Calendar Days before the precoating conference. The supplemental warranty performance bond dollar amount will be listed in the Special Provisions.

The bond is to secure the performance by the Contractor of correction Work on any coating system defects that the Contractor may be directed by the Agency to perform. Use the Agency-provided form included near the front of the Special Provisions booklet, except when the Surety is a multiple Surety, obtain a co-Surety execution form from the Agency. The supplemental warranty performance bond shall be signed by the Surety's authorized Attorney-in-Fact with the Surety's seal affixed to the bond. Attach a power of attorney for the Attorney-in-Fact to the bond, include the bond numbers, and affix the Surety's original seal to the power of attorney. If executed by co-Sureties, each Surety shall sign, seal, and attach the power of attorney.

The supplemental warranty performance bond shall become effective on the date of Second Notification and continue, in full force and effect, until the Agency has advised the Contractor of either of the following:

- There are no coating system defects at the end of the full warranty period.
- The Contractor has been notified that there are coating system defects, the defects have been repaired by the Contractor to the satisfaction of the Agency as specified under the coating system warranty, and the full warranty period has expired.

Supplemental warranty performance bonds cannot be canceled nor be released due to possible claims.

Measurement

00594.80 Measurement - Except for pack rust removal, no measurement of quantities will be made for Work performed under this Section.

Pack rust removal will be measured on the length basis.

Payment

00594.90 Payment:

(a) New Metal Structures - No separate payment will be made for preparing and coating new metal Work. Payment for this Work, including correction of damages, will be included in payment made for structural steel according to 00560.90 and metal sign supports according to 00930.90, as appropriate.

(b) Existing Metal Structures - The accepted quantities of preparing and coating existing metal Structures will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Surface Preparation	Lump Sum
(b)	Coating Application	Lump Sum
(c)	Coating Materials	Lump Sum
(d)	Pack Rust Removal	Foot

Item (a) includes preparing existing metal surfaces and disposal of spent abrasives, paint waste and other debris from the surface preparation Work.

Item (b) includes coating existing metal surfaces.

Item (c) includes the coating Material.

Partial payments for items (a), (b), and (c) will be made only for portions of the Structure that have been prepared and coated with all coats specified. The partial payment will represent an estimate of the Work completed as a percentage of the total coating system Work to be done.

No payment for Work will be made until the supplemental warranty performance bond and the written 36 month coating system warranty, if required under 00594.75, have been furnished to the Agency.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for correction of damages described in 00594.45 and 00594.60.

Section 00595 - Reinforced Concrete Box Culverts

Description

00595.00 Scope - This Work consists of constructing cast-in-place reinforced concrete box culverts, precast reinforced concrete box culverts, precast segmental reinforced concrete box culverts, and precast reinforced concrete three-sided structures to the lines, grades, and dimensions shown or directed. Each of these configurations of reinforced concrete box culvert is referred to as RCBC herein.

00595.02 Definitions :

Box Section - For precast reinforced concrete box culverts, the Box Section is the individual precast box culvert piece. For precast segmental reinforced concrete box culverts, the Box Section is made of a top and bottom segment adjoined to form a complete box cross section unit. For precast reinforced concrete three-sided structures, the Box Section is the individual precast three-sided structure piece. Box Sections are placed and joined together to construct the reinforced concrete box culvert.

Box Segment - For precast segmental reinforced concrete box culverts, the Box Segment is the individual piece (top slab, bottom slab, or U-shape) that is adjoined to the mating Box Segment to form a Box Section.

00595.03 Design of Precast Sections - Perform design according to the ODOT *Bridge Design Manual* and the current edition of AASHTO *LRFD Bridge Design Specifications*.

Unless otherwise shown or specified, precast RCBC may be substituted in place of cast-in-place RCBC. Precast substitution is not permitted for headwalls, wing walls, or for features shown as using cast-in-place concrete.

Submit stamped design calculations and stamped Working Drawings, prepared by the manufacturer, according to 00150.35. Include the following information:

- Structural analysis methods,
- Structural design criteria and calculations,
- Structure detail shop drawings,
- Detailed plans including culvert geometry,
- Line and grade layout,
- Joint and connection details, and
- Lifting devices.

Submit a stamped installation plan, according to 00150.35. Ensure the installation plan is consistent with the Plans, Specifications and the manufacturer's design. Include the following information:

- Methods and equipment to be used for handling,
- Methods to ensure uniform bearing of the RCBC base,
- Culvert installation, and
- Requirements for construction loads.

Do not begin precast culvert fabrication or construction before receiving written approval from the Engineer.

Materials

00595.10 Cast-in-Place Materials - For cast-in-place RCBC, cast-in-place ends, and cast-in-place wing walls and aprons, furnish Materials meeting the following requirements:

Reinforcement.....00530
Concrete.....00540

Unless otherwise shown, provide Class 3300 - 1 1/2" or 3/4" portland cement concrete.

00595.11 Precast Materials - Furnish Materials meeting the following requirements:

Concrete.....02001
Deformed Bar Reinforcement.....02510.10
Precast Reinforced Concrete Box Culverts..... ASTM C1577
Precast Segmental Reinforced Concrete Box Culverts..... ASTM C1786
Precast Reinforced Concrete Three-Sided Structures ..... ASTM C1504

Unless otherwise shown furnish joint sealing material per manufacturer design and meeting one or more of the following requirements:

External Sealing Band..... ASTM C877
Preformed Flexible Joint Sealant ..... ASTM C990
Rubber Gaskets ..... ASTM C1677
Elastomeric Joint Sealant..... ASTM C920

Unless otherwise shown, provide portland cement concrete according to the following:

Property	Value
Air Entrainment	4.5 - 7.5%
Compressive Strength	5000 psi
Concrete Temperature	50 - 90 °F

Construction

00595.40 Cast-in-Place - Construct cast-in-place RCBC, cast-in-place ends, and cast-in-place wing walls and aprons according to the following:

(a) Reinforcement - Place reinforcing steel according to Section 00530.

(b) Portland Cement Concrete - Place portland cement concrete according to Section 00540 and the following:

(1) Placing Concrete - Allow base slabs or box culvert footings to set at least 12 hours before constructing the remainder of the box culvert.

When constructing box culverts 4 feet or less in height, the sidewalls and top slab may be constructed as a monolith, with sidewalls constructed full height. If this method is used, place construction joints vertical and at right angles to the axis of the culvert.

When constructing box culverts more than 4 feet in height, place concrete in the walls to at least the bottom elevation of the top slab. Allow 3 days before placing the top slab according to 00595.40(b)(2).

Construct each wing wall as a monolith.

(2) Removal of Forms and Falsework and Subsequent Loading - Remove forms and falsework and place subsequent loading according to Table 00540-1.

(3) Concrete Finish - Finish all exposed concrete surfaces with a general finish according to 00540.53(a).

00595.41 Precast - Fabricate precast boxes according to the following requirements unless detailed otherwise:

Precast Reinforced Concrete Box Culverts ..... ASTM C1577
Precast Segmental Reinforced Concrete Box Culverts ..... ASTM C1786
Precast Reinforced Concrete Three-Sided Structures ..... ASTM C1504

Prepare at least three acceptance test cylinders per Day for each concrete strength used in the production of Box Sections.

Expose cylinders to the same curing conditions as the manufactured Box Sections and keep cylinders and Box Sections together until tested.

Transport members from the casting yard only after the following conditions have been met:

- Not less than 7 Calendar Days after casting,
- Not less than 7 Calendar Days after all concrete patching and repairing is complete, and
- After 28 Calendar Days compressive strengths have been achieved.

When the compressive strength of the cylinders tested does not conform to the acceptance criteria stated in ASTM C1577, ASTM C1786, or ASTM C1504, as applicable to the precast culvert type, the Engineer may allow retesting based on compression testing of cores, reject the sections, or assess a price reduction according to 00150.25.

Be responsible for the safety of precast members during all stages of construction.

Provide structural connections at joints between all segments that fit together to form a complete Box Section unit with a structural key or doweled connection. Provide a structural keyway joint between all mating surfaces of adjacent Box Sections including adjacent top slabs.

Align all joints. Staggered joints are not allowed.

Place a continuous flexible watertight seal in the joint, on the sides and top, between each precast reinforced concrete Box Section. Install according to manufacturer's recommendations.

Provide a 3/4 inch chamfer on all concrete edges unless otherwise noted.

00595.42 Precast Fabrication Tolerances - Shop assemble adjacent full RCBC sections and match-mark adjacent sections before shipping. Sections not meeting the following tolerances will be rejected:

- **Precast Reinforced Concrete Box Culverts** - Provide RCBC sections that meet the permissible variations listed in ASTM C1577.
- **Precast Segmental Reinforced Concrete Box Culverts** - Provide RCBC sections that meet the permissible variations listed in ASTM C1786.
- **Precast Reinforced Concrete Three-Sided Structures** - Provide RCBC sections that meet the permissible variations listed in ASTM C1504.

00595.43 Defects in Precast Sections - Provide repair materials from the QPL according to 02015.30.

Submit proposed repair plans and revised installation plan to the Engineer for review and acceptance before performing the repairs. Provide written confirmation from the RCBC Design Engineer of Record that the repair methods are appropriate.

Repair or replace damaged precast sections at no additional cost to the Agency, according to the following criteria:

(a) Repair Cracked or Damaged RCBC - Repair cracked or damaged RCBC sections when:

- Cracks 0.01 inch or wider and less than 12 inches long that do not pass through the wall or slab thickness.
- Surface defects including honeycomb, bleedout, or spalls less than 4 percent of surface area of the Box Section face where the defect is located, or multiple surface defects with cumulative area less than 10 percent of the Box Section surface where the defect is located.
- Chipped or spalled edges 1 inch and greater in depth from the end of the bell or spigot and not exceeding the depth of the joint provided the cumulative length of chip or damage is not more 50 percent of the RCBC span or rise, whichever is greater, and no individual length of chip or damage is more than 25 percent of the structure's span or rise, whichever is greater. The repaired sealing surface shall be free of spalls, cracks, or imperfections that would adversely affect the performance of the joint. Sections with chipped or spalled edges exceeding these values must be replaced.

(b) Replace Cracked or Damaged RCBC - Replace damaged RCBC sections having defects that that cannot be adequately repaired to full function or design life. Rejectable defects include:

- Inadequate reinforcing cover.
- Cracks that are full depth of the slab or wall thickness.
- Any crack that would prevent making a satisfactory joint.
- Surface defects including honeycomb, bleedout, or spalls having depth greater than the size of the coarse aggregate, exposing reinforcing steel, and having a defect area greater than 4 percent of surface area of the face where the defect is located, or multiple surface defects with cumulative area greater than 10 percent of the surface where the defect is located are cause for rejection.

(c) Minor Defects - Acceptable minor defects not requiring repair:

- A single end crack that does not exceed the depth of the joint.
- Cracks less than 0.01 inch wide and not passing through the wall or slab thickness.
- A crack greater than 0.01 inch wide and less than 12 inches long that does not pass through the wall or slab thickness.

00595.44 Precast Installation :

- Perform excavation, bedding and leveling course preparation, and backfill according to 00510 and 00405 as applicable.
- Cushion RCBC installed over unyielding foundation, including concrete, to prevent non-uniform bearing with a minimum 3 inch deep bedding and leveling course of granular material meeting

00405.12. Spread the leveling course the width and length of the RCBC plus a minimum 6 inches all around. A concrete slab as leveling course is not allowed.

- Use lifting, lowering, and pulling construction equipment according to the written installation plan. Do not use excessive force or unapproved equipment to push Box Sections into place. Handle Box Sections with care and prevent damage from cracking, dragging, and impact.
- Ensure the prepared foundation surface provides uniform bearing and proper line and grade for the RCBC. Do not rut or disturb the prepared foundation bedding and leveling course. If bearing, line and grade are not achieved, remove the RCBC section and make foundation corrections.
- Maintain the ends of Box Sections free of any deleterious materials that would prevent proper joining or sealing of adjacent sections.
- Assemble Box Sections within the following tolerances:
  - Horizontal and Vertical Joint Variation - The maximum variation between mating surfaces in any assembled transverse joint, between Box Sections before grouting, shall be no more than 1/2 inch. The joint width shall vary no more than 3/8 inch over the length of the joint.
  - Longitudinal Surfaces - Fit Box Sections together to form a smooth, uniform line of sections. The variation between internal surfaces of two adjoining precast Box Sections shall not be more than 1/4 inch, measured with a 12-foot straight edge across joints.

Measurement

00595.80 Measurement - The quantities of cast-in-place RCBC will be measured on the length basis, along the centerline of the RCBC, from end to end as shown.

The quantities of precast RCBC will be measured on the length basis along the centerline of the RCBC from end to end as shown, including cast in place ends.

No measurement of quantities will be made for wing walls and aprons. Estimated quantities of concrete and reinforcement for wing walls and aprons will be listed in the Special Provisions.

Payment

00595.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Cast-In-Place Reinforced Concrete Box Culverts	Foot
(b)	Precast Reinforced Concrete Box Culverts	Foot
(c)	Precast Split Reinforced Concrete Box Culverts	Foot
(d)	Precast Reinforced Concrete Three-Sided Structures	Foot
(e)	Wing Walls	Lump Sum
(f)	Aprons	Lump Sum

Item (a) includes cast-in-place ends regardless of the type of box culvert constructed.

Items (b), (c), and (d) includes cast-in-place ends.

No separate or additional payment will be made for closure pours, weldments, or structure connection systems; this Work is included in payment made for the applicable items in which they are used.

Payment will be payment in full for furnishing and placing all Materials, including reinforcement and concrete, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00596A - Mechanically Stabilized Earth Retaining Walls

Description

00596A.00 Scope - This Work consists of furnishing and constructing mechanically stabilized earth (MSE) retaining walls as shown and specified.

00596A.01 Proprietary MSE Walls - The Special Provisions will list the types and locations of preapproved proprietary MSE retaining wall systems to be constructed.

00596A.02 Cost Reduction Proposals - According to 00140.70, cost reduction proposals will be considered for proprietary retaining wall systems that are preapproved by the Agency before Advertisement of the Project.

00596A.03 Definitions:

Alternate Gabion Basket Joint Fasteners - Spiral binders, high tensile locking spring steel clips, or clamp-on ring type fasteners that are alternates to tie wire for assembling and joining gabion units.

Appurtenances - Traffic barriers, guardrail, fences, non-standard coping, drainage Structures, sign supports, lighting supports, sound barriers, foundations, and utilities that are not part of the retaining wall system but are connected to, resting on, or passing through the retaining wall system.

Batter - The Slope of the wall facing from vertical that is expressed as degrees, or as a ratio of the horizontal change in inches for each 12 inches of vertical change. A vertical face has a zero batter.

Extensible Tensile Reinforcements - Geosynthetic reinforcement where the deformation under load is equal to or greater than that of the reinforced backfill.

Inextensible Tensile Reinforcements - Steel reinforcement where the deformation under load is significantly less than that of the reinforced backfill.

Manufacturer - The fabricator having exclusive production rights for a proprietary retaining wall system.

Mechanically Stabilized Earth Retaining Wall System - A gravity retaining wall system composed of wall facing and granular backfill reinforced with either extensible or inextensible Soil reinforcements connected to the facing elements.

Nonproprietary Retaining Wall System - A retaining wall system that is not patented or trademarked and is shown on the Plans.

Piecemark - An alpha-numeric marking that identifies a specific type of retaining wall component. All components with the same piecemark are considered identical. Piecemarks shown on the Working Drawings identify placement of the component.

Preapproved Proprietary Retaining Wall System - A wall system that is listed in Appendix 15-D of the *Geotechnical Design Manual* (GDM).

Preapproved Proprietary Retaining Wall System Options - Acceptable preapproved proprietary retaining walls listed in the Special Provisions when proprietary retaining wall systems are required.

Preapproved Proprietary Retaining Wall System Alternates - Acceptable preapproved proprietary retaining walls listed in the Special Provisions when non-proprietary retaining wall systems are shown.

Proprietary Retaining Wall System - A retaining wall system that is protected by trademark, patent, or copyright and is produced or distributed by a manufacturer having exclusive rights.

Retained Backfill - Unreinforced backfill behind the back of MSE reinforced backfill.

Retaining Wall System - An engineered system of structural and geotechnical components that restrains a mass of earth. The terms "retaining wall system", "retaining Structure", and "retaining wall" are used interchangeably.

00596A.04 Proprietary Retaining Walls - Submit the following at least 30 Calendar Days before beginning construction of proprietary retaining walls:

- Complete stamped Working Drawings and design calculations prepared by the manufacturer, according to 00150.35.
- Manufacturer's field construction manual, according to 00150.37.
- Manufacturer's field representative's name and qualifications.

Field verify existing ground elevations and bottom of wall elevations before preparing and submitting Working Drawings.

Obtain the Engineer's written approval before beginning construction of the wall system.

(a) Working Drawings - Working Drawings shall meet the requirements of the Project documents and the AASHTO *LRFD Bridge Design Specifications*, as modified by the ODOT GDM, and shall be consistent with the preapproved retaining wall system.

Include the following items in the Working Drawings, as applicable:

(1) General Notes - Information for design and construction of the retaining wall.

(2) Plan View:

- Construction centerline and related horizontal curve data.
- Centerline station and offset to the wall control line or face of wall including the beginning and end points of the retaining wall.
- Location, type, and size of all appurtenances.
- Location of Right-of-Way and easement boundaries, staged construction, designated Wetlands, and all other Highway Structures, features, or facilities, or other construction constraints.
- Length, size, number, and layout of Soil reinforcements.
- Wall stations where changes in the Soil reinforcement length occur.

(3) Elevation View:

- Wall vertical curve data and wall elevations at a sufficient number of points along the top of wall that defines the top of wall alignment.
- Field-verified elevations of original and final ground lines along face of the wall and top of leveling pad.
- Vertical dimensions of steps along the top of leveling pad.
- Centerline stations and elevations at the beginning and end of the wall.
- Horizontal offsets.

- Changes in the top of wall Slope.
- Type and size of facing components.
- Layout of MSE wall panels, including wall finish pattern.

(4) Typical Sections:

- Typical sections at intervals of 50 feet or less along the wall.
- Wall construction and limits of reinforced backfill.
- Locations, length, size, and number of Soil reinforcements.
- Original and final ground lines across Typical Sections, including Roadways, Highway Structures, and other facilities.
- Construction centerline stationing at each Typical Section.

(5) Structural and Geometric Details:

- Leveling pad details, showing depths and limits of proposed excavation beyond the Neat Lines of the wall.
- Top of wall elements such as coping, traffic barrier, and impervious membrane.
- Panel details.
- Final front face batter.
- Details of wedges, shims, clamps, or bracing.
- Reinforcing bar bend details.
- Surface and subsurface drainage details for the wall, including drainage swale, filters, drains, and collector and outlet pipes.
- Wall facing and Soil reinforcement construction details at Utility and drainage facilities, overhead sign support footings, bridge abutments, piles, shafts, and other Structures.
- Wall initiations and terminations.
- Details for wall slip joints, curves, and for external, internal, and acute angle corners.
- Maximum inclinations of wall backslope and foreslope.
- Elevation, Slope, and width of wall bench in front of wall.
- Locations of anticipated shoring.

(6) Appurtenances:

- Wall appurtenance details needed to construct the wall.
- Wall appurtenance details that are required but not fully detailed on the Plans.

(7) Facing Components:

- Dimensions, including thickness.
- Details necessary to construct the facing components.
- Reinforcing steel in the component.
- Location of tensile Soil reinforcement attachment devices embedded in the facing.
- Class of concrete finish.
- Architectural treatment, if applicable.

(8) Soil Reinforcements - Soil reinforcement dimensions and details necessary to construct the wall.

(9) Wall Construction Methods and Construction Sequence:

- Wall construction methods.
- Construction sequence.
- Locations of all shoring.

(10) Materials and Quantity Summary List - All items of each wall.

(b) Design Calculations - Design calculations shall meet the requirements of the Project documents and AASHTO *LRFD Bridge Design Specifications*, as modified by the ODOT GDM, and shall be consistent with the preapproved retaining wall system. Retaining wall design parameters will be listed in the Special Provisions.

Include the following items in the design calculations, as applicable:

(1) Design Limits:

- Structural and geotechnical design input parameters and design assumptions.
- Wall design loads, load combinations, load factors, and resistance factors for each limit state.

(2) Methodology:

- Design steps with a detailed design narrative explaining the design and demonstrating how the design meets all applicable design requirements.
- Explanation of all symbols and variables used in the calculations.
- Hand calculations verifying results of computer generated wall design. Hand calculations are not required if the MSEW® version 3.0 or later software program is used to design the wall.

(3) External Stability Calculations - Calculations showing that the retaining wall system meets external stability requirements, including overturning, sliding, and bearing capacity.

(4) Internal Stability Calculations:

- Calculations showing that the retaining wall meets internal stability requirements at each level of the wall.
- Calculations showing adequate resistance against Soil reinforcement rupture, pullout, and, reinforcement-facing connection failure.
- Calculations showing adequate structural resistance of facing elements.
- Calculations showing all structural details meet internal stability requirements, including construction details to accommodate vertical and horizontal obstructions in the reinforced backfill.

(5) Compound Stability - Calculations showing that the retaining wall meets compound stability requirements.

(6) Appurtenances:

- Design calculations for wall appurtenances that are required but not fully detailed on the Plans.
- Calculations for all appurtenance load effects on the wall.

(c) Manufacturer's Field Construction Manual - The manufacturer shall prepare a field construction manual that includes detailed instructions for constructing the retaining wall.

00596A.05 Nonproprietary Retaining Wall - Submit complete unstamped Working Drawings according to 00150.35 at least 30 Calendar Days before beginning construction of nonproprietary retaining walls. Field verify existing ground elevations and bottom of wall elevations before preparing and submitting Working Drawings. Obtain the Engineer's written approval before beginning construction of the wall system.

Materials

00596A.10 General:

(a) Proprietary Retaining Wall Systems - Provide all proprietary retaining wall system components from the same wall manufacturer. If there are conflicts between the manufacturer's requirements and the Agency's requirements, the Agency's requirements prevail.

(b) Nonproprietary Retaining Wall Systems - Provide Materials according to the applicable material Specifications.

(c) Quality Control - Provide quality control according to Section 00165.

00596A.11 Backfill:

(a) Gravel Leveling Pads Backfill - Furnish dense graded 1" - 0 or 3/4" - 0 Aggregate base Material for leveling pads meeting the requirements of 02630.10.

(b) MSE Granular Wall Backfill - Furnish dense graded 3/4" - 0 Aggregate base Material for walls meeting the requirements of 02630.10 and the following:

(1) Material Passing No. 200 Sieve - The amount of Material passing the No. 200 sieve shall not exceed 15 percent by weight. Test according to AASHTO T 11.

(2) Plasticity Index - The plasticity index of the Material passing the No. 40 sieve shall not exceed 6. Test according to AASHTO T 90.

(3) Electrochemical Properties:

a. Backfill with Steel Soil Reinforcement:

Property	Limits	Test Procedure
pH	5.0 - 10.0	AASHTO T 289
Resistivity*	5,000 Ω-cm (min.)	AASHTO T 288
* Backfill Material with resistivity between 5,000 Ω-cm and 3,000 Ω-cm is acceptable if it meets the following:		
Property	**Limits**	**Test Procedure**
Chlorides	100 PPM (max.)	AASHTO T 291
Sulfates	200 PPM (max.)	AASHTO T 290

b. Backfill with Geosynthetic Soil Reinforcement:

Property	Limits	Test Procedure
pH	4.5 - 9.0*	AASHTO T 289
* 3.0 - 10.0 for temporary retaining walls.		

(4) Organic Content - The organic content of material finer than the No. 10 sieve shall not exceed 1.0 percent. Test according to AASHTO T 267.

(c) Modular Block Core and Drainage Backfill - Furnish 3/4" - No. 4 PCC Aggregate Material meeting the requirements of 02690.20(a) through (d) and 02690.20(f).

(d) Pipe Drain Backfill - Furnish granular drain backfill Material for drainage pipes meeting the requirements of 00430.11.

(e) Gabion Basket Fill - Furnish a durable 4 to 8 inch size Rock Material meeting the requirements of 00390.11(b).

00596A.12 Concrete:

(a) Cast-in-Place Concrete for Leveling Pads - Furnish Commercial Grade Concrete for leveling pads meeting the requirements of Section 00440.

(b) Dry Cast Concrete Modular Block Facing - Furnish dry cast concrete blocks with the following properties:

(1) Aggregate, Strength, Freeze-Thaw Durability, Unit Weight, and Water Absorption:

- Aggregate meeting the requirements of ASTM C33.
- Blocks meeting the requirements of ASTM C1372.
- The average of three coupons or cores have a minimum compressive strength of 4,000 psi as tested according to ASTM C140.
- Individual coupons or cores have a minimum compressive strength of 3,500 psi as tested according to ASTM C140.
- A minimum oven-dry unit weight of 125 pcf as tested according to ASTM C140.

- Test, no longer than 18 months before delivery, freeze-thaw durability of five test specimens made with the same materials, concrete mix design, manufacturing process, and curing method that will be used on the Project. At least four of the five test specimens shall have a weight loss of not more than 1 percent of the block's initial weight after 150 freeze-thaw cycles as tested according to ASTM C1262.
- A maximum water absorption of 1 percent above the water absorption of the sublot of blocks that were produced and passed the freeze thaw test. For the water absorption testing, do not use the same blocks used for the freeze-thaw test.

(2) Portland Cement - Portland cement meeting the requirements of 02010.10.

(3) Blended Hydraulic Cement - Blended hydraulic cement meeting the requirements of 02010.20.

(4) Tolerances - Manufacture within the following geometric tolerances:

- Molded length and width dimensions within ± 1/8 inch of the block manufacturer's nominal length and width dimensions.
- Molded height dimension within ± 1/16 inch of the block manufacturer's nominal height dimension.
- Rear height does not exceed the front height.
- Top and bottom face groove dimensions within the tolerances specified by the manufacturer.

(5) Color - Consistent natural color of dry cast concrete.

(6) Finish - Split-face units that, when viewed from a distance of 10 feet under diffused light, chips, cracks, and other imperfections are not detectable.

(7) Acceptance of Blocks - Acceptance will be determined on tolerances, visual inspection, compressive strength, water absorption, freeze-thaw durability, and unit weight. Acceptance of compressive strength, water absorption, and unit weight will be based on production sublots. The maximum number of blocks per production sublot is 2,000 blocks. Test blocks at the frequency of one set for each production sublot. Acceptance of freeze-thaw durability will be based on the freeze-thaw testing requirements of 00596A.12(b)(1).

(8) Marking - Indicate the date of manufacture and the production sublot number on each sublot of dry cast concrete blocks.

(9) Handling, Storing, and Shipping - Do not allow chipping, discoloration, cracks, or fractures during handling, storing and shipping.

(10) Rejection - Blocks not meeting the requirements of this Subsection will be rejected.

(c) Wet Cast Concrete Modular Block Facing - Furnish wet cast concrete blocks with the following properties:

(1) Concrete - Commercial Grade Concrete meeting the requirements of Section 00440.

(2) Marking - The rear face of each block is scribed with the date of manufacture, the production sublot number, and the piecemark.

(3) Color - Consistent natural color of wet cast concrete.

(4) Finish - Smooth-face units that, when viewed from a distance of 10 feet under diffused light, chips, cracks, and other imperfections are not detectable.

(5) Tolerance - Molded length and width dimensions within 1/4 inch of the manufacturer's dimensions. Molded height dimension within 1/8 inch of the manufacturer's dimension.

(6) Handling, Storing, and Shipping - Do not allow chipping, discoloration, cracks, or fractures during handling, storing, and shipping.

(7) Acceptance of Blocks - Acceptance will be determined by tolerances, visual inspection, and concrete strength. Concrete strength will be based on production sublots. A production sublot is 20 blocks or a single Day's production, whichever is less. The production sublot will be represented by a single compressive strength sample of one set of cylinders.

(8) Rejection - Blocks not meeting requirements of this Subsection, or that exhibit any of the following defects, will be rejected:

- Honeycombed or open texture concrete.
- Extreme color variation on front face of block.

(d) Cast-in-Place Concrete Panel Facing - Furnish Class 4000 - 3/4 structural concrete for cast-in-place concrete panel facings meeting the requirements of Section 02001.

(e) Precast Concrete Panel Facing - Furnish precast concrete panel facings with the following properties:

(1) Portland Cement Concrete - Furnish structural concrete as directed in the Special Provisions.

(2) Casting - Set Soil reinforcement connection devices on the rear face of the precast panel and secure them for concrete placement and consolidation. Do not allow loop embeds, tie strips, or other devices used to connect Soil reinforcements to facing panels to contact the face panel reinforcement steel. Place concrete in each panel without interruption and consolidate with an approved vibrator. Use a release agent throughout the casting operation.

(3) Supporting and Curing - Maintain full support, cure the panels, and do not strip or remove the forms from the units until the concrete has obtained a minimum compressive strength of at least 1,000 psi.

(4) Finish - Finish the panel front face with a general surface finish according to 00540.53(a). Screed the panel back face to eliminate surface distortions and open pockets of Aggregate.

(5) Tolerance - Manufacture within the following tolerances:

a. Panel Dimensions - Within ± 1/2 inch between diagonals. Within ± 3/16 inch for all other panel dimensions.

b. Soil Reinforcement Connection Devices:

- Tie strip connection devices within ± 1 inch of the plan location.
- Loop embeds within ± 3/16 inch of the plan location.
- Retention slots within ± 1 inch of the plan location. Slot openings shall not exceed 1/8 inch. Check all slot openings with a manufacturer supplied feeler gauge according

to the manufacturer's recommendations. Panels from which the feeler gauge is pulled from the slot will be rejected.

c. Panel Face - Smooth formed surfaces within ± 3/32 inch when measured with a 3-foot straightedge. Textured-finish surfaces within ± 3/16 inch when measured with a 3-foot straightedge.

d. Rear Face - Rear surface distortions within ± 1/4 inch.

(6) Acceptance of Panel Concrete Strength - Acceptance will be according to 00540.17 except:

- Acceptance of concrete strength will be determined based on production sublots. A production sublot will consist of either 40 panels or a single Day's production, whichever is less. Cast one set of cylinders for each production sublot.
- Precast panel concrete strength may be conditionally accepted if the 7-Day initial strength exceeds 85 percent of the required 28-Day strength. Final acceptance of precast panel concrete strength will be based on the required 28-Day test results.

(7) Marking - On the rear face of each panel scribe the date of manufacture, the production sublot number, and the piecemark.

(8) Handling, Storing, and Shipping - Do not allow chipping, discoloration, cracks, fractures, and connecting device damage during handling, storing, and shipping. Support stored panels on firm blocking.

(9) Rejection - Panels not meeting the requirements of this Subsection will be rejected.

(f) Cast-In-Place Concrete Coping - Furnish Class 3300 - 3/4 structural concrete for cast-in-place concrete coping meeting the requirements of Section 02001.

00596A.13 Steel:

(a) Steel Reinforcement for Concrete - Furnish steel reinforcement for concrete meeting the requirements of Section 00530.

(b) Steel Components - Furnish steel components meeting the requirements of Section 00560 and the following:

(1) Soil Reinforcing Strips - Hot rolled from bars to the required shape and dimensions meeting the requirements of AASHTO M 223 Grade 65 (ASTM A572) and galvanized according to AASHTO M 111 (ASTM A123) to a minimum thickness of 3.4 mils.

(2) Soil Reinforcing Mesh:

- Shop fabricated welded wire reinforcement from cold drawn steel wire meeting the requirements of AASHTO M 32 (ASTM A82), welded into the finished mesh according to AASHTO M 55 (ASTM A185) and galvanized after fabrication according to AASHTO M 111 (ASTM A123) to a minimum thickness of 3.4 mils.
- Twisted mesh Soil reinforcing mesh meeting the requirements of Section 02340.

(3) Tie Strips - Shop-fabricated hot rolled steel meeting the requirements of ASTM A1011 Grade 50 and galvanized according AASHTO M 111 (ASTM A123) to a minimum thickness 3.4 mils.

(4) Fasteners - Galvanized high-strength bolts meeting the requirements of 02560.20.

(5) Connector Pins and Mat Bars - Fabricated from cold drawn steel wire meeting the requirements of AASHTO M 32 (ASTM A82) and galvanized according to AASHTO M 111 (ASTM A123) to a minimum thickness of 3.4 mils.

(c) Gabion Baskets - Furnish gabion baskets meeting the requirements of Section 02340.

00596A.14 Geosynthetics:

(a) Geotextile Filter Layer for Subsurface Drainage Systems - Furnish Type 1 drainage geotextile according to Section 02320.

(b) Gabion Facing Geotextile Filter - Furnish Type 2 riprap geotextile for gabion wall filter according to Section 02320.

(c) Precast Concrete Facing Panel Joint Cover - Furnish Type 1 drainage geotextile for concrete wall facings according to Section 02320.

(d) Modular Block Drainage Fill Geotextile Filter - Furnish Type 1 drainage geotextile according to Section 02320.

(e) Welded Wire Facing Geotextile Filter - Furnish Type 1 drainage geotextile according to Section 02320.

(f) Geosynthetic Soil Reinforcements:

(1) Geotextile - Provide geotextile according to Section 02320.

(2) Geogrid - Provide geogrid according to Section 02320.

00596A.15 Elastomeric Bearing Pads for Precast Concrete Facing Panels - In horizontal and diagonal joints between precast concrete panels, furnish either preformed ethylene propylene diene monomer (EPDM) rubber pads meeting the requirements of ASTM D2000 Grade 2, Type A, Class A, with a Durometer Hardness of 70, or preformed high density polyethylene (HDPE) pads with a minimum density of 0.946 grams per cubic centimeter according to ASTM D1505. Determine the stiffness, size, and number of bearing pads so that the final joint opening is 3/4 inch ± 1/8 inch or as shown.

00596A.16 Concrete Modular Block Facing Connection Devices - Furnish concrete modular block connection devices as directed in the Special Provisions.

Labor

00596A.30 Quality Control Personnel - Provide technicians with CAgT, CDT, and CEBT certifications.

00596A.31 Manufacturer's Representative Qualifications and Duties - Provide a manufacturer's representative meeting the following qualifications:

- Is a licensed Professional Engineer in the State of Oregon or, when the licensed Professional Engineer is in "responsible charge" of the Work, an unlicensed designee assigned by the licensed Professional Engineer.

- Has been trained by the manufacturer in the construction, installation, and inspection of the selected proprietary retaining wall system.

The manufacturer's representative is required to perform the following duties:

(a) Preconstruction Conference - Meet with the Engineer and all Contractor supervisory personnel and Subcontractors involved in construction of the proprietary retaining wall at the preconstruction conference to discuss methods of accomplishing all phases of Work required to construct the proprietary retaining wall.

(b) Initial Wall Construction - Be present at the retaining wall construction site and provide technical assistance to the Contractor and Engineer during all wall construction activities from the beginning of wall construction until at least 10 percent of the total wall length is successfully installed and backfilled to a height of at least 10 feet, or the actual wall height, whichever is less.

Submit daily field observation reports no later than noon of the next Day of wall construction. Include the following information in the daily field observation reports:

- Date of observation.
- Description of wall construction observed and on-site technical assistance provided to the Contractor for proper construction procedures according to the manufacturer's field construction manual.
- Documentation of all communications with the Contractor and Engineer.
- Name and signature.

(c) Remaining Wall Construction - Be available by phone or in person as needed throughout the remaining construction of the proprietary retaining wall to provide technical assistance to the Contractor and Engineer.

(d) Final Field Observation Meeting - Conduct a final field observation meeting after completing retaining wall construction with the Engineer and Contractor. Submit a final field observation meeting report that includes the following information within 5 Calendar Days after the final field observation meeting:

- Date of observation.
- Documentation of all retaining wall deficiencies.
- Recommendation to accept or reject the retaining wall construction.

Provide a stamped final report to the Engineer no later than 10 Calendar Days after the final field observation meeting. Include the following information in the final report:

- Preconstruction meeting minutes.
- All daily field observation reports.
- Transcripts of all communications with the Contractor and the Engineer during the remaining wall construction phase.
- Final field observation report.

Construction

00596A.40 General:

(a) Proprietary Retaining Walls - Construct proprietary retaining walls according to Agency requirements, manufacturer's Working Drawings, and the manufacturer's field construction manual. If the manufacturer's Working Drawings or the manufacturer's field construction manual conflict with Agency requirements, Agency requirements take precedence.

Follow instructions and recommendations of the representative if approved by the Engineer.

(b) Nonproprietary Retaining Walls - Construct nonproprietary retaining walls as shown.

00596A.41 Excavation and Foundation Preparation - Perform excavation and prepare and backfill wall foundations according to Section 00510 and the following:

- Grade the foundation level for a width equal to the combined width of the bottom Soil reinforcements plus the facing component thickness plus 1.0 foot on each side.
- Place backfill material in nearly horizontal layers not more than 8 inches thick. Compact the entire surface of each layer with at least three coverages, using Equipment made specifically for compaction. Routing hauling and grading Equipment over the surface is not acceptable for compaction.
- Do not construct backfill when the backfill, the foundation, or the embankment on which it would be placed is frozen, or unstable.

00596A.42 Leveling Pads:

(a) Cast-in-Place Leveling Pads - Construct cast-in-place leveling pads with:

- Unreinforced concrete.
- A width of at least the block front face to block back face plus 12 inches (6 inches on each side of the facing units).
- A thickness of 6 inches ± 1/4 inch.
- A location tolerance of ± 1 inch of the design location.
- A top pad tolerance of ± 1/8 inch of the design elevation.

Cure cast-in-place leveling pads at least 12 hours before placing the wall facing.

(b) Gravel Leveling Pads - Construct gravel leveling pads with:

- A width of at least the width of the facing plus 12 inches (6 inches on each side of the facing units).
- A thickness of at least 6 inches.
- A location tolerance of ± 1 inch of the design location.
- A top pad tolerance of ± 1/8 inch of the design elevation.

Compact gravel leveling pads in 3 to 4 inch Lifts using a minimum of three passes of a walk behind vibratory plate compactor with a gross static weight of not less than 125 pounds and a total compaction static plus dynamic force of not less than 2,000 pounds.

(c) Leveling Pad Types - Construct the following types of leveling pads:

- **Leveling Pads for Precast Concrete Panel Facing** - Unreinforced cast-in-place concrete leveling pad at each facing foundation level.

- **Leveling Pads for Dry Cast Modular Concrete Block Facing** - Unreinforced cast-in-place concrete leveling pad or a gravel leveling pad at each facing foundation level.

- **Leveling Pads for Wet Cast Modular Concrete Block Facing** - Unreinforced cast-in-place concrete leveling pad or a gravel leveling pad at each facing foundation level.

- **Leveling Pads for Gabion Unit Facing** - Unreinforced cast-in-place concrete leveling pad or a gravel leveling pad at each facing foundation.

- **Leveling Pads for Welded Wire Facing** - Unreinforced cast-in-place concrete leveling pad or a gravel leveling pad at each facing foundation level.

- **Leveling Pads for Cast-in-Place Concrete Facing** - Unreinforced cast-in-place concrete leveling pad at each facing foundation level.

00596A.43 Subsurface Drainage - Install subsurface drainage before constructing walls.

00596A.44 Erecting Wall Facing:

(a) Dry Cast Modular Concrete Block Facing:

(1) Placement - Begin placing the first course of blocks on top of and in full contact with the lowest foundation level of the leveling pad. Level and align all blocks. Lay blocks as close together as possible and parallel to the straight or curved line of the wall face. Place blocks in vertical or battered positions as shown. Level each course block-to-block and front-to-back. Set each block on the blocks below without rocking. Correct high areas by grinding or shimming with approved shims. Do not use shims within 1 inch of the front face. Do not exceed a shim stack thickness of 1/16 inch. Stack all blocks in a running bond pattern with each block spanning the joint below.

Place MSE granular wall backfill with each course of blocks. When shown, place modular block core backfill and drainage fill backfill, and install drainage fill geotextile and shear pins with each course of blocks. Install Soil reinforcements and connect them to the facing. Remove all backfill that is on top of the blocks before installing the next course of blocks or Soil reinforcements. Attach the top row of dry cast concrete blocks or cap blocks to the underlying blocks with an adhesive from the QPL. Clean the finished exposed wall face of all foreign material deposits.

(2) Tolerances:

- First course of wall facing located within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity of the front face within ± 3/4 inch in 10 feet.
- Final deviation from the design batter within ± 1 1/4 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Each course of blocks within ± 1/16 inch of level when checked with a 4-foot straightedge level.
- Out of plane offset between consecutive rows within 3/4 inch of the planned offset.
- Finished top of wall elevation within ± 1 inch of the design elevation.

(b) Wet Cast Modular Concrete Block Facing:

(1) Placement - Begin placing the first course of blocks on top of and in full contact with the lowest foundation level of the leveling pad. Level and align all blocks. Lay blocks as close together as possible and parallel to the straight or curved line of the wall face. Place blocks in vertical or battered positions as shown. Level and set each block on the blocks below without rocking. Correct high areas by grinding or shimming with approved shims. Do not use shims within 1 inch of the front face. Do not exceed a shim stack thickness of 1/8 inch. Stack all blocks in a running bond pattern with each block spanning the joint below.

Place MSE granular wall backfill with each course of blocks. When shown, place modular block core backfill and drainage fill backfill, and install drainage fill geotextile with each course of blocks. Install Soil reinforcements and connect them to the facing. Remove all backfill that is on top of the blocks before installing the next course of blocks or Soil reinforcements. Install Soil reinforcements and connect them to the facing. Clean the finished exposed wall face of all foreign material deposits.

(2) Tolerances:

- First course of wall facing located within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity of the front face within ± 3/4 inch in 10 feet.
- Final deviation from the design batter within ± 1 1/4 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Each course of blocks within ± 1/8 inch of level when checked with a 4-foot straightedge level.
- Front-to-back tilting within ± 1/4 inch of the design batter when measured with a straightedge level long enough to span the entire front-to-back distance of the block.
- Out of plane offset between consecutive rows within ± 3/4 inch from the planned offset.
- Finished top of wall elevation within ± 1 inch of design elevation.

(c) Precast Concrete Panel Facing:

(1) Placement - Maintain vertical alignment with temporary wedges, clamps, or bracing when placing fill material. Use at least two, but not more than three rows of panel wedges in place at all times during wall construction. Place panel joint geotextile and MSE granular wall backfill with each level of panels. Install Soil reinforcements and connect them to the facing.

(2) Tolerances:

- First course of wall facing located within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity of the front face within ± 3/4 inch in 10 feet.
- Final deviation from the design batter within ± 1/2 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Out of plane offset at panel joints within ± 1/2 inch.
- Final joint openings between adjacent facing panel units within ± 1 inch.
- Finished top of wall elevation within ± 1 inch of design elevation.

Reconstruct wall sections not conforming to these tolerances at no additional cost to the Agency.

(d) Cast-in-Place Concrete Fascia with Welded Wire Walls:

(1) Placement - Place cast-in-place concrete fascia after the welded wire walls and backfill are completed to full height, and after anticipated settlement has taken place. Construct cast-in-place fascia and connect to welded wire wall as shown. Maintain vertical and continuous alignment of all expansion joints and deep score joints from bottom to top of wall. Horizontal joints are not allowed.

(2) Tolerances:

- First course of wall facing located within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity within ± 3/4 inch in 10 feet.
- Final deviation from the design batter within ± 1 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Out of plane offset at panel joints within ± 1/2 inch.
- Finished top of wall elevation within ± 1 inch of design elevation.

(e) Welded Wire Facing:

(1) Placement - Erect welded wire wall facing including Soil reinforcements and other associated elements according to the wall manufacturer's field construction manual. Begin placing the first course of welded wire reinforcement on top of and in full contact with the lowest foundation level of the leveling pad. Level and align all welded wire reinforcement. Place welded wire wall geotextile filter and MSE granular wall backfill with each level of welded wire facing. Install Soil reinforcements and connect them to the facing. Place remaining courses in vertical or battered positions as shown.

(2) Tolerances:

- First course of wall welded wire reinforcement facing located within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity within ± 2 inches in 10 feet.
- Final deviation from the design batter within ± 1 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Out of plane offset between consecutive rows within ± 1 inch of the planned offset.
- Finished top of wall elevation within ± 1 inch of design elevation.

(f) Gabion Basket Facing:

(1) Placement - Use the same style of mesh for the gabion panel bases, ends, sides, diaphragms, and lids. Use the same method of joining the edges of a single gabion unit. Use the same method of tying successive gabion units and Soil reinforcement together throughout each Structure. Place gabion facing geotextile filter and MSE granular wall backfill with each level of gabion facing. Install Soil reinforcements and connect them to the facing. Place remaining courses in vertical or battered positions as shown.

(2) Tolerances:

- First course of gabion basket facing within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity within ± 2 inches in 10 feet.
- Final deviation from the design batter within ± 1 inch for each 10 feet of wall height.
- Outward leaning batter is zero.

- Out of plane offset between consecutive rows within ± 1 inch from the planned offset.
- Finished top of wall elevation within ± 1 inch of design elevation.

(g) Wrapped-Face Construction (Temporary Geotextile Reinforced Wrapped-Face MSE Retaining Wall):

(1) Placement - Geotextile wrapped-face construction shall be according to Section 00350 and the ODOT GDM.

(2) Tolerances:

- Along base, construct face of wall within 2 inches (horizontally) of location staked on the ground.
- Place geotextile Soil reinforcement and tail geotextile sheets vertically within 1 inch of elevation shown on Plans.
- Maximum outward bulge of the face between Soil reinforcement layers shall not exceed 6 inches.
- Final out of plane concavity or convexity within 5 inches in 10 feet.
- Final deviation from the design batter within 3 inches for each 10 feet of wall height.
- Outward leaning batter is zero.
- Finished top of wall elevation within 2 inches of design elevation.

00596A.45 Geotextile Placement:

(a) Precast Concrete Facing Panel Joint Cover Geotextile - Cover all joints, gaps, and openings on the back side of walls with at least 12 inch wide precast concrete facing panel joint cover geotextile centered over the joints, gaps, and openings. Attach with an approved adhesive. Apply adhesive to the wall panel before applying the geotextile to the panel. Overlap geotextile seams at least 4 inches.

(b) Gabion Facing Riprap Geotextile Filter - Install gabion facing riprap geotextile filter according to Section 00350 except place geotextile against the back of the gabion wall before placing backfill material and provide at least 12 inch overlaps.

(c) Modular Block Facing Drainage Fill Geotextile Filter - Install modular block facing drainage fill geotextile according to 00350.41.

(d) Welded Wire Wall Geotextile Filter - Install welded wire wall facing geotextile according to 00350.41.

00596A.46 Soil Reinforcement Placement - Connect all Soil reinforcement to the wall facing units as shown. Field cut Soil reinforcement only when shown. Submit stamped Working Drawings and calculations according to 00150.35 if field conditions require splaying or skewing of Soil reinforcement or for other obstruction avoidance methods. Do not misalign wall facings or damage Soil reinforcements when placing reinforced backfill material. Remove and replace all misaligned wall facings or damaged Soil reinforcements at no additional cost to the Agency.

(a) Inextensible Soil Reinforcement Components - Place the Soil reinforcement components normal to the face of the wall. Connect all reinforcements to the wall facing units as shown. At each Soil reinforcement level, level and compact backfill to the grade of the connection before placing the next level of Soil reinforcement. Install the Soil reinforcement no lower than the

connection elevation but no more than 2 inches above the connection elevation. Maintain at least 3 inches of vertical separation between overlapping Soil reinforcements.

To avoid vertical obstructions along a horizontal plane at the reinforcing level, a deviation up to 15 degrees from normal to the wall face (splay angle) may be allowed for strip reinforcements with bolted connections. Grid reinforcements may be splayed up to 15 degrees if the connection is properly designed and fabricated to accommodate the splay and is approved by the Agency.

To avoid horizontal obstructions, it is permissible to deflect Soil reinforcements up to 15 degrees along a vertical plane normal to the wall face (vertical skew). Soil reinforcement deflections shall be gradual and smooth to avoid damage to the steel galvanization.

(b) Extensible Soil Reinforcement Components - Orient geogrid Soil reinforcements with the highest strength axis perpendicular to the face of the wall. Connect all reinforcements to the wall facing units as shown. Use geogrid Soil reinforcements that are continuous throughout their embedment lengths. Do not splice connections along the highest strength axis. Do not cut geogrid Soil reinforcements unless approved.

Place geogrid Soil reinforcement directly on the compacted backfill horizontal surface. Before placing a subsequent layer of backfill, pull the geogrid Soil reinforcement taut and maintain tautness until the layer of backfill is placed. Install the geogrid Soil reinforcement no lower than the connection elevation but no more than 2 inches above the connection elevation. Maintain at least 3 inches of vertical separation between overlapping geogrid Soil reinforcement where geogrid Soil reinforcement layers overlap.

00596A.47 Reinforced Backfill Placement and Compaction:

(a) Concrete Modular Block Facing - Complete all drainage fill, core fill, and block opening fill before proceeding to the next level. Do not construct backfill higher than the installed facing blocks.

(b) Soil Reinforcement - Place backfill material by moving Equipment parallel to or away from the wall facing. Do not brake suddenly or make sharp turning movements.

On extensible Soil reinforcement:

- Maintain the reinforcement in a taut condition.
- Do not operate Equipment on it until at least 6 inches of backfill is placed over it.

On inextensible Soil reinforcement:

- Maintain reinforcement perpendicular to the wall face.
- Do not operate Equipment on it until at least 3 inches of backfill is placed over it.

(c) Compaction - Meet the following requirements:

(1) Maximum Density and Optimum Moisture Content - Determine maximum density and optimum moisture content of the MSE granular backfill material according to AASHTO T 99 Standard Proctor Method A, with coarse particle correction according to ODOT TM 223.

(2) Moisture Content - Prepare the reinforced backfill material to within minus 4 percent to plus 2 percent of optimum moisture content at the time of compacting. Add water to material that does not contain sufficient moisture and thoroughly mix. Remove excess moisture by manipulation, aeration, drainage, or other means before compacting.

(3) Density:

a. Reinforced Backfill Placed 3 Feet or More Behind Wall Facing Units - Compact reinforced backfill that is placed 3 feet or more behind wall facing units to 95 percent of maximum density determined by the nuclear gauge testing method.

b. Reinforced Backfill Placed Within 3 Feet Behind Wall Facing Units - Compact reinforced backfill that is placed within 3 feet behind wall facing units to 95 percent of maximum density determined by the test pad testing method. Use walk-behind vibratory rollers or vibratory plate compactors that have sufficient static and dynamic forces to achieve compaction without causing distortion of the wall facing units and keeping the wall facing units within the tolerances listed in 00596A.44. Compact backfill within this zone by making at least three compaction Equipment passes.

c. Spread Footing for Bridge Abutment on MSE Retaining Wall - Compact reinforced backfill that is placed in the spread footing foundation support zone to 100 percent of maximum density determined by the nuclear gauge testing method.

The spread footing foundation support zone is defined by the following limits:

- Extends to a depth which is twice the footing width or 6 feet, whichever is greater.
- Extends laterally the width of the footing beyond the bottom edge of the footing in all directions. When the bridge spread footing is located less than the width of one spread footing from the MSE wall, the spread footing foundation support zone between the spread footing and MSE wall may be reduced to:
  - A minimum of 18 inches when steel Soil reinforcements are used.
  - A minimum of 36 inches when geogrid Soil reinforcements are used.

(4) Testing Methods and Frequency:

a. Nuclear Gauge Method - Test in-place field density according to AASHTO T 310. Test at the frequency required in the ODOT *Manual of Field Test Procedures*.

b. Test Pad Method - Determine the number of compaction Equipment passes necessary to achieve the specified density by constructing a test pad that is at least 5 feet wide, 15 feet long, and 2 feet deep. Construct test pad fill in layers no more than 8 inches thick using the same Equipment and methods that will be used to compact the wall backfill. Perform at least one density test according to AASHTO T 310 on each test pad layer. Construct and test a new test pad when changes in material occur or different Equipment is used during the construction of the wall backfill.

(5) Deflection Requirement - Conduct at least one deflection test, witnessed by the Engineer, on each compacted layer of backfill placed 3 feet or more behind wall facing units according to ODOT TM 158. If the tested layer exhibits yielding, deflection, reaction, or pumping, rework the area to provide acceptable test results before placing the next layer.

Maintenance

00596A.60 Protecting Work - Protect and repair Work as follows:

- Do not allow runoff from adjacent areas to enter the wall construction site during construction operations.
- At the end of each Day's operation, direct potential runoff away from the wall by sloping the last Lift of backfill away from the wall facing.

- Rework and repair all damaged Subgrade areas to the depth where undamaged Work is encountered.

Measurement

00596A.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

No measurement of quantities will be made for retaining walls. Estimated quantities of nonproprietary retaining walls will be listed in the Special Provisions.

The quantities of Type "F" traffic barrier coping with moment slab will be measured on the length basis, from end to end of coping.

The quantities of sidewalk coping will be measured on the area basis, from end to end and from top of curb to exterior edge of coping.

Excavation below elevations shown will be measured according to 00510.80(b).

Payment

00596A.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Retaining Wall, MSE	Lump Sum
(b)	____ Inch Type "F" Traffic Barrier Coping with Moment Slab	Foot
(c)	Sidewalk Coping	Square Foot

In item (b), the height of barrier will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Excavation below elevations shown will be paid for according to 00510.90(c).

No separate or additional payment will be made for:

- manufacturer's representative
- excavation, shoring, leveling pads, and specified backfill
- wall drainage and filter systems
- Soil reinforcement
- cast-in-place and precast standard coping

Section 00596B - Prefabricated Modular Retaining Walls

Description

00596B.00 Scope - This Work consists of furnishing and constructing prefabricated modular gravity retaining walls as shown and specified.

00596B.01 Proprietary Prefabricated Modular Walls - The Special Provisions will list the types and locations of preapproved proprietary prefabricated modular proprietary retaining wall systems to be constructed.

00596B.02 Cost Reduction Proposals - According to 00140.70, cost reduction proposals will be considered for proprietary retaining wall systems that are preapproved by the Agency before Advertisement of the Project.

00596B.03 Definitions:

Alternate Gabion Basket Joint Fasteners - Spiral binders or high tensile locking spring steel clip or clamp-on ring type fasteners specified as an alternate to tie wire for assembling and joining gabion units.

Appurtenances - Traffic barriers, guardrail, fences, non-standard coping, drainage Structures, sign supports, lighting supports, sound barriers, foundations, and utilities that are not part of the retaining wall system but are connected to, resting on, or passing through the retaining wall system.

Batter - The Slope of the wall facing from vertical that is expressed as degrees, or as a ratio of the horizontal change in inches for each 12 inches of vertical change. A vertical face has a zero batter.

Bin Wall - A prefabricated modular gravity retaining wall system type composed of metal or precast concrete modules backfilled with granular material.

Crib Wall - A prefabricated modular gravity retaining wall system type composed of interlocking longitudinal and transverse beams made of precast reinforced concrete and backfilled with granular material.

Dry Cast Concrete Block Gravity Wall - A prefabricated modular gravity retaining wall system type composed of dry cast concrete blocks without Soil reinforcements.

Gabion Gravity Wall - A prefabricated modular gravity retaining wall system type composed of assembled wire baskets that are connected together and filled with specified Rock.

Manufacturer - The fabricator having exclusive production rights for a proprietary retaining wall system.

Nonproprietary Retaining Wall System - A retaining wall system that is not patented or trademarked and is shown on the Plans.

Piecemark - An alpha-numeric marking that identifies a specific type of retaining wall component. All components with the same piecemark are considered identical. Piecemarks shown on the Working Drawings identify placement of the component.

Preapproved Proprietary Retaining Wall System - A wall system that is listed in Appendix 15-D of the *Geotechnical Design Manual* (GDM).

Preapproved Proprietary Retaining Wall System Options - Acceptable preapproved proprietary retaining walls listed in 00596B.01 when proprietary retaining wall systems are required.

Preapproved Proprietary Retaining Wall System Alternates - Acceptable preapproved proprietary retaining walls listed in 00596B.01 when non-proprietary retaining wall systems are shown.

Prefabricated Modular Retaining Wall System - A basic gravity retaining wall system type composed of solid or hollow prefabricated concrete or steel modules. Hollow modules are typically backfilled with granular material. Prefabricated modular retaining walls include metal and precast concrete bin, precast concrete crib, gabion, dry cast concrete block, and wet cast concrete block gravity retaining walls.

Proprietary Retaining Wall System - A retaining wall system that is protected by trademark, patent, or copyright and is produced or distributed by a manufacturer having exclusive rights.

Retained Backfill - Unreinforced backfill within a distance of H/2 behind the back of the wall, where H is the total height of the wall excluding the leveling pad or footing.

Retaining Wall System - An engineered system of structural and geotechnical components that restrains a mass of earth. The terms "retaining wall system", "retaining Structure", and "retaining wall" are used interchangeably.

Wet Cast Concrete Block Gravity Wall - A gravity retaining wall system type composed of wet cast concrete blocks without Soil reinforcements.

00596B.04 Proprietary Retaining Walls - Submit the following at least 30 Calendar Days before beginning construction of proprietary retaining walls:

- Complete stamped Working Drawings and design calculations prepared by the manufacturer, according to 00150.35.
- Manufacturer's field construction manual, according to 00150.37.
- Manufacturer's field representative's name and qualifications.

Field verify existing ground elevations and bottom of wall elevations before preparing and submitting Working Drawings.

Obtain the Engineer's written approval before beginning construction of the wall system.

(a) Working Drawings - Working Drawings shall meet the requirements of the Project documents and the AASHTO *LRFD Bridge Design Specifications*, as modified by the ODOT GDM, and shall be consistent with the preapproved retaining wall system.

Include the following items in the Working Drawings, as applicable:

(1) General Notes - Information for design and construction of the retaining wall.

(2) Plan View:

- Construction centerline and related horizontal curve data.
- Centerline station and offset to the wall control line or face of wall including the beginning and end points of the retaining wall.
- Location, type and size of all appurtenances.

- Location of Right-of-Way and easement boundaries, staged construction, designated Wetlands, and all other Highway Structures, features, or facilities or other construction constraints.

(3) Elevation View:

- Wall vertical curve data and wall elevations at a sufficient number of points along the top of wall that defines the top of wall alignment.
- Field verified elevations of original and final ground lines and foundation bearing elevation along face of the wall.
- Vertical dimensions of steps along the wall base (foundation bearing elevation).
- Centerline stations and elevations at the beginning and end of the wall.
- Horizontal offsets.
- Changes in the top of wall Slope.
- Layout of prefabricated modular units.
- Architectural treatment.

(4) Typical Sections:

- Typical sections at intervals of 50 feet or less along the wall.
- Wall construction limits.
- Original and final ground lines across Typical Sections, including Roadways, Highway Structures, and other facilities.
- Construction centerline stationing at each Typical Section.

(5) Structural and Geometric Details:

- Leveling pad details, showing depths and limits of proposed excavation beyond the Neat Lines of the wall.
- Prefabricate modular unit details.
- Final front face batter.
- Reinforcing bar bend details.
- Surface and subsurface drainage details for the wall.
- Prefabricated modular unit construction details at Utility and drainage facilities, overhead sign support footings, guardrails, traffic barriers, piles, shafts, or other Structures.
- Maximum inclinations of wall backslope and foreslope.
- Elevation, Slope, and width of wall bench in front of wall.
- Locations of anticipated shoring.

(6) Appurtenances:

- Wall appurtenance details needed to construct the wall.
- Wall appurtenance details that are required but not fully detailed on the Plans.

(7) Wall Construction Methods and Construction Sequence:

- Wall construction methods.

- Construction sequence.
- Locations of all shoring.

(8) Materials and Quantity Summary List - All items of each wall.

(b) Design Calculations - Design calculations shall meet the requirements of the Project documents and AASHTO *LRFD Bridge Design Specifications*, as modified by the ODOT GDM, and shall be consistent with the preapproved retaining wall system.

Include the following items in the design calculations, as applicable:

(1) Design Limits:

- Structural and geotechnical design input parameters and design assumptions.
- Wall design loads, load combinations, load factors, and resistance factors for each limit state.

(2) Methodology:

- Design steps with a detailed design narrative explaining the design and demonstrating how the design meets all applicable design requirements.
- Explanation of all symbols and variables used in the calculations.
- A set of hand calculations verifying typical computer generated output.

(3) External Stability Calculations - Calculations showing that the retaining wall system meets external stability requirements, including overturning, sliding, and bearing capacity.

(4) Internal Stability Calculations:

- Calculations showing that the retaining wall meets internal stability requirements at each level of the wall.
- Calculations showing adequate structural resistance of prefabricated modular units.

(5) Compound Stability - Calculations showing that the retaining wall meets compound stability requirements.

(6) Appurtenances:

- Design calculations for wall appurtenances that are required but not fully detailed on the Plans.
- Calculations for all appurtenance load effects on the wall.

Retaining wall design parameters will be listed in the Special Provisions.

(c) Manufacturer's Field Construction Manual - The manufacturer shall prepare a field construction manual that includes detailed instructions for constructing the retaining wall.

00596B.05 Nonproprietary Retaining Wall Submittals - Submit complete unstamped Working Drawings according to 00150.35 at least 30 Calendar Days before beginning construction of nonproprietary retaining walls. Field verify existing ground elevations and bottom of wall elevations before preparing and submitting Working Drawings. Obtain the Engineer's written approval before beginning construction of the wall system.

Materials

00596B.10 General:

(a) Proprietary Retaining Wall Systems - Provide all proprietary retaining wall system components from the same wall manufacturer. If there are conflicts between the manufacturer's requirements and the Agency's requirements, the Agency's requirements prevail.

(b) Nonproprietary Retaining Wall Systems - Provide Materials according to the applicable material Specifications.

(c) Quality Control - Provide quality control according to Section 00165.

00596B.11 Backfill:

(a) Gravel Leveling Pads Backfill - Furnish dense graded 1" - 0 or the 3/4" - 0 Aggregate base Material for leveling pads meeting the requirements of 02630.10.

(b) Modular Block Core and Drainage Backfill - Furnish 3/4" - No. 4 PCC Aggregate Material meeting the requirements of 02690.20(a) through (d) and 02690.20(f).

(c) Gabion Basket Fill - Furnish a durable well graded 4 to 8 inch size Rock Material meeting the requirements of 00390.11(b).

(d) Retaining Wall Granular Backfill - Furnish dense graded 1" - 0 or 3/4" - 0 Aggregate base Material meeting the requirements of 02630.10 and the following:

(1) Material Passing No. 200 Sieve - The amount of material passing the No. 200 sieve shall not exceed 15 percent by weight. Test according to AASHTO T 11.

(2) Plasticity Index - The plasticity index of the material passing the No. 40 sieve shall not exceed 6. Test according to AASHTO T 90.

(e) Pipe Drain Backfill - Furnish granular drain backfill Material for drainage pipes meeting the requirements of 00430.11.

00596B.12 Concrete:

(a) Cast-in-Place Concrete for Leveling Pads - Furnish Commercial Grade Concrete for leveling pads meeting the requirements of Section 00440.

(b) Precast Concrete Bin Units - Furnish precast concrete bin units with the following properties:

(1) Portland Cement Concrete - Class 4000 - 3/4 structural concrete meeting the requirements of Section 00540.

(2) Casting - Place concrete in each bin unit without interruption and consolidate with an approved vibrator. Use a release agent throughout the casting operation.

(3) Supporting and Curing - Maintain full support, cure the units, and do not strip or remove the forms from the units until the concrete has obtained a minimum compressive strength of at least 1,000 psi.

(4) Finish - Finish the bin unit front face with a general surface finish according to 00540.53(a).

(5) Tolerances - Manufacture units within the following tolerances:

a. Unit Dimensions - Within ± 1/2 inch between diagonals. Within ± 3/16 inch for all other unit dimensions.

b. Unit Face - Smooth formed surfaces within ± 3/32 inch when measured with a 3-foot straightedge. Textured-finished surfaces within ± 3/16 inch when measured with a 3-foot straightedge.

(6) Acceptance of Bin Unit Concrete Strength - Acceptance will be according to 00540.17, except acceptance of concrete strength will be determined based on production sublots. A production sublot will consist of either 10 units or a single Day's production, whichever is less. Cast one set of cylinders for each production sublot. The concrete strength of a production sublot will be represented by a single compressive strength test on a cylinder.

(7) Marking - On the rear face of each unit scribe the date of manufacture, the production sublot number, and the piecemark.

(8) Handling, Storing, and Shipping - Do not allow chipping, discoloration, cracks, fractures and connecting device damage during handling, storing, and shipping. Support stored units on firm blocking.

(9) Rejection - Units not meeting the requirements of this Subsection will be rejected.

(c) Dry Cast Concrete Blocks - Furnish dry cast concrete blocks with the following properties:

(1) Aggregate, Strength, Freeze-Thaw Durability, Unit Weight, and Water Absorption:

- Aggregate meeting the requirements of ASTM C33.
- Blocks meeting the requirements of ASTM C1372.
- The average of three coupons or cores have a minimum compressive strength of 4,000 psi as tested according to ASTM C140.
- Individual coupons or cores have a minimum compressive strength of 3,500 psi as tested according to ASTM C140.
- A minimum oven-dry unit weight of 125 pcf as tested according to ASTM C140.
- Test, no longer than 18 months before delivery, freeze-thaw durability of five test specimens made with the same materials, concrete mix design, manufacturing process, and curing method that will be used on the Project. At least four of the five test specimens shall have a weight loss of not more than 1 percent of the block's initial weight after 150 freeze-thaw cycles as tested according to ASTM C1262.
- A maximum water absorption of 1 percent above the water absorption of the sublot of blocks that were produced and passed the freeze-thaw test. For the water absorption testing, do not use the same blocks used for the freeze-thaw test.

(2) Portland Cement - Portland cement meeting the requirements of 02010.10.

(3) Blended Hydraulic Cement - Blended hydraulic cement meeting the requirements of 02010.20.

(4) Tolerances - Manufacture within the following geometric tolerances:

- Molded length and width dimensions within ± 1/8 inch of the block manufacturer's nominal length and width dimensions.

- Molded height dimension within ± 1/16 inch of the block manufacturer's nominal height dimension.
- Rear height does not exceed the front height.
- Top and bottom face groove dimensions within the tolerances specified by the manufacturer.

(5) Color - Consistent natural color of dry cast concrete.

(6) Finish - Split-face units that when viewed from a distance of 10 feet under diffused light, chips, cracks, and other imperfections are not detectable.

(7) Acceptance of Blocks - Acceptance will be determined on tolerances, visual inspection, compressive strength, water absorption, freeze-thaw durability, and unit weight. Acceptance of compressive strength, water absorption, and unit weight will be based on production sublots. The maximum number of blocks per production sublot is 2,000 blocks. Test blocks at the frequency of one set for each production sublot. Acceptance of freeze-thaw durability will be based on the freeze-thaw testing requirements of 00596B.12(c)(1).

(8) Marking - Indicate the date of manufacture and the production sublot number on each sublot of dry cast concrete blocks.

(**9) Handling, Storage, and Shipping** - Do not allow chipping, discoloration, cracks, or fractures during handling, storing and shipping.

(10) Rejection - Blocks not meeting the requirements of this Subsection will be rejected.

(d) Wet Cast Concrete Blocks - Furnish wet cast concrete blocks with the following properties:

(1) Concrete - Commercial Grade Concrete meeting the requirements of Section 00440.

(2) Marking - The rear face of each block is scribed with the date of manufacture, the production sublot number, and the piecemark.

(3) Color - Consistent natural color of wet cast concrete.

(4) Finish - Smooth-face blocks that, when viewed from a distance of 10 feet under diffused light, chips, cracks, and other imperfections are not detectable.

(5) Tolerances - Molded length and width dimensions within 1/4 inch of the manufacturer's dimensions. Molded height dimension within 1/8 inch of the manufacturer's dimension.

(6) Handling, Storing, and Shipping - Do not allow chipping, discoloration, cracks, or fractures during handling, storing, and shipping.

(7) Acceptance of Blocks - Acceptance will be determined by tolerances, visual inspection, and concrete strength. Concrete strength will be based on production sublots. A production sublot is 20 blocks or a single Day's production, whichever is less. The production sublot will be represented by a single compressive strength sample of one set of cylinders.

(8) Rejection - Blocks not meeting the requirements of this Subsection, or that exhibit any of the following defects will be rejected:

- Honeycombed or open texture concrete.
- Extreme color variation on front face of block.

(e) Precast Concrete Crib Walls - Furnish precast concrete crib walls with the following properties:

(1) Portland Cement Concrete - Furnish Class 4000 - 3/4 structural concrete meeting the requirements of Section 00540.

(2) Color - Consistent natural color of wet cast concrete.

(3) Finish - Smooth crib wall members that, when viewed from a distance of 10 feet under diffused light, chips, cracks, and other imperfections are not detectable.

(4) Tolerances - Manufactured within ± 1/8 inch of the manufacturer's nominal dimensions.

(5) Handling, Storing, and Shipping - Do not allow chipping, discoloration, cracks, or fractures during handling, storing, and shipping.

(6) Acceptance of Concrete Strength - Acceptance of concrete strength will be determined based on production sublots. A production sublot will consist of either 100 crib wall members or a single Day's production, whichever is less. Cast one set of cylinders for each production sublot. The concrete strength of a production sublot will be represented by a single compressive strength test on a cylinder.

(7) Rejection - Crib units not meeting the requirements of this Subsection will be rejected.

00596B.13 Steel:

(a) Steel Reinforcement for Concrete - Furnish steel reinforcement for concrete meeting the requirements of Section 00530.

(b) Metal Bin Gravity Walls - Furnish metal bin walls meeting the requirements of Section 02350.

(c) Gabion Baskets - Furnish gabion baskets meeting the requirements of Section 02340.

00596B.14 Geosynthetics:

(a) Geotextile Filter Layer for Subsurface Drainage Systems - Furnish Type 1 drainage geotextile according to Section 02320.

(b) Geotextile Filter Layer Between Backfill and Gabion Walls - Furnish Type 2 riprap geotextile according to Section 02320.

(c) Geotextile Filter Layer Between Backfill and Other Prefabricated Modular Walls - Furnish Type 1 or Type 2 drainage geotextile according to Section 02320.

(d) Modular Block Drainage Fill Geotextile Filter - Furnish Type 1 drainage geotextile according to Section 02320.

Labor

00596B.30 Quality Control Personnel - Provide technicians with CAgT and CDT certifications.

00596B.31 Manufacturer's Field Representative Qualifications and Duties - Provide a manufacturer's field representative meeting the following minimum qualifications:

- Is a licensed Professional Engineer in the State of Oregon.
- Has been trained and certified by the manufacture in the construction, installation, and inspection of the selected proprietary retaining wall system.

The times that the manufacturer's field representative is required to be present or available and the duties of the manufacturer's field representative are:

(a) Preconstruction Conference - Meet with the Engineer and all Contractor supervisory personnel and Subcontractors involved in construction of the proprietary retaining wall at the preconstruction conference to discuss methods of accomplishing all phases of Work required to construct the proprietary retaining wall.

(b) Initial Wall Construction - Be present at the retaining wall construction site and provide technical assistance to the Contractor and Engineer during all wall construction activities from the beginning of wall construction until at least 10 percent of the total wall length is successfully installed and backfilled to a height of at least 10 feet, or the actual wall height, whichever is less.

Submit daily field observation reports no later than noon of the next Calendar Day. Include the following information in the daily field observation reports:

- Date of observation.
- Description of all Work observed and whether or not the Work was acceptable.
- Documentation of all communications with the Contractor and Engineer.
- Name and signature.

(c) Remaining Wall Construction - Be available by phone or in person as needed throughout the remaining construction of the proprietary retaining wall to provide technical assistance to the Contractor and Engineer.

(d) Final Field Observations - Conduct a final field observation of the completed retaining wall construction with the Engineer and Contractor. Submit a final field observation report that includes the following information 1 Calendar Day after the final field observation:

- Date of observation.
- Documentation of all retaining wall deficiencies.
- Recommendation to accept or reject the retaining wall construction.

Provide a stamped final report to the Engineer no later than 10 Calendar Days after the final field observation of the retaining wall. Include the following information in the final report:

- Preconstruction meeting minutes.
- All daily field observation reports.
- Transcripts of all communications with the Contractor and the Engineer during the remaining wall construction phase.
- Final field observation report.

Construction

00596B.40 General:

(a) Proprietary Retaining Walls - Construct proprietary retaining walls according to Agency requirements, manufacturer's Working Drawings, and the manufacturer's field construction manual. If the manufacturer's Working Drawings or the manufacturer's field construction manual conflict with Agency requirements, Agency requirements shall take precedence.

Follow instructions and recommendations of the representative if approved by the Engineer.

(b) Nonproprietary Retaining Walls - Construct nonproprietary retaining walls as shown.

00596B.41 Excavation and Foundation Preparation - Perform excavation and prepare and backfill wall foundations according to Section 00510 and the following:

- Grade the foundation level for a width equal to the width of the wall base plus 1.0 foot on each side. Do not reinforce backfill for over-excavated foundations without prior approval.
- Place backfill material in nearly horizontal layers not more than 8 inches thick. Compact the entire surface of each layer with at least three coverages, using Equipment made specifically for compaction. Routing hauling and grading Equipment over the surface is not acceptable for compaction.
- Do not construct backfill when the backfill, the foundation, or the embankment on which it would be placed is frozen, or unstable.

00596B.42 Leveling Pads:

(a) Cast-in-Place Leveling Pads - Construct cast-in-place leveling pads with:

- Unreinforced concrete.
- A width of at least the block front face to block back face plus 12 inches (6 inches on each side of the facing units).
- A thickness of 6 inches ± 1/4 inch.
- A location tolerance of ± 1 inch of the design location.
- A top pad tolerance of ± 1/8 inch of the design elevation.

Cure cast-in-place leveling pads at least 12 hours before placing the wall units.

(b) Gravel Leveling Pads - Construct gravel leveling pads with:

- A width of at least the width of the wall facing plus 12 inches (6 inches on each side of the facing units).
- A thickness of at least 6 inches.
- A location tolerance of ± 1 inch of the design location.
- A top pad tolerance of ± 1/8 inch of the design elevation.

Compact gravel leveling pads in 3 to 4 inch Lifts using a minimum of three passes of a walk behind vibratory plate compactor with a gross static weight of not less than 125 pounds and a total compaction static plus dynamic force of not less than 2,000 pounds.

00596B.43 Subsurface Drainage - Install subsurface drainage before constructing walls.

00596B.44 Erecting Walls:

(a) Dry Cast Concrete Block Walls:

(1) Placement - Begin placing the first course of blocks on top of and in full contact with the lowest foundation level of the leveling pad. Level and align all blocks. Lay blocks as close together as possible and parallel to the straight or curved line of the wall face. Place blocks in vertical or battered positions as shown. Level each course block-to-block and front-to-back. Set each block on the blocks below without rocking. Correct high areas by grinding or shimming with approved shims. Do not use shims within 1 inch of the front face. Do not exceed a shim stack thickness of 1/16 inch. Stack all blocks in a running bond pattern with each block spanning the joint below.

Place retaining wall granular backfill with each course of blocks. When shown, place modular block core backfill and drainage fill backfill, and install drainage fill geotextile and shear pins with each course of blocks. Remove all backfill that is on top of the blocks before installing the next course of blocks or Soil reinforcements. Attach the top row of dry cast concrete blocks or cap blocks to the underlying blocks with an adhesive from the QPL. Clean the finished exposed wall face of all foreign material deposits.

(2) Tolerances:

- First course of wall blocks located within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity of the front face within ± 3/4 inch in 10 feet.
- Final deviation from the design batter within ± 1 1/4 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Each course of blocks within ± 1/16 inch of level when checked with a 4-foot straightedge level.
- Out of plane offset between consecutive rows within 3/4 inch of the planned offset.
- Finished top of wall elevation within ± 1 inch of the design elevation.

(b) Wet Cast Concrete Block Walls:

(1) Placement - Begin placing the first course of blocks on top of and in full contact with the lowest foundation level of the leveling pad. Level and align all blocks. Lay blocks as close together as possible and parallel to the straight or curved line of the wall face. Place blocks in vertical or battered positions as shown. Level and set each block on the blocks below without rocking. Correct high areas by grinding or shimming with approved shims. Do not use shims within 1 inch of the front face. Do not exceed a shim stack thickness of 1/8 inch. Stack all blocks in a running bond pattern with each block spanning the joint below.

Place retaining wall granular backfill with each course of blocks. When shown, place modular block core backfill and drainage fill backfill, and install drainage fill geotextile and shear pins with each course of blocks. Remove all backfill that is on top of the blocks before installing the next course of blocks or Soil reinforcements. Clean the finished exposed wall face of all foreign material deposits.

(2) Tolerances:

- First course of wall blocks located within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity of the front face within ± 3/4 inch in 10 feet.
- Final deviation from the design batter within ± 1 1/4 inch for each 10 feet of wall height.

- Outward leaning batter is zero.
- Each course of blocks within ± 1/8 inch of level when checked with a 4-foot straightedge level.
- Front-to-back tilting within ± 1/4 inch of the design batter when measured with a straightedge level long enough to span the entire front-to-back distance of the block.
- Out of plane offset between consecutive rows within ± 3/4 inch from the planned offset.
- Finished top of wall elevation within ± 1 inch of design elevation.

(c) Gabion Walls:

(1) General - Select and use:

- The same style of mesh for the gabion panel bases, ends, sides, diaphragms, and lids.
- The same method of joining the edges of a single gabion unit.
- The same method of tying successive gabion units together throughout each Structure.

Place riprap geotextile according to Section 00350 and the following:

- Minimum overlap shall be 12 inches.
- Against the back of the gabion wall before placing backfill material.

(2) Assembly - Assemble each style of gabion by rotating the panels into position and joining the vertical edges with tie wire or alternate fasteners.

If twisted wire panels are tied with tie wire, join the selvage vertical edges with alternating single and double loops at 4 inch nominal spacing.

If welded wire panels are tied with tie wire, pass the tie wire through each mesh opening along the vertical edges joint and secure with a half hitch locked loop.

Leave no openings greater than 4 3/4 inches (line dimension) along the edges or at corners of tied or spiral bound gabions of either mesh style. Crimp the edges of spiral binding wire to secure the spiral in place.

If high tensile fasteners are used instead of tie wire, install one fastener in each mesh opening according to the manufacturer's recommendations.

(3) Placement - Set the empty gabions in place and connect each gabion to the adjacent gabion along the top and vertical edges with tie wire or spiral binders. Connect each layer of gabions to the underlying layer along the front, back and sides with tie wire or spiral binders in the same manner as specified for assembly of baskets. Common wall construction will not be allowed.

Before filling each gabion with Rock, remove all kinks and folds in the wire fabric and properly align all baskets. Remove all temporary clips and fasteners. The assembled gabion baskets may be placed in tension before filling.

Concurrently with the filling of the baskets, place retaining wall granular backfill around the assembled baskets to the limits shown. Maintain the outside backfill approximately level with the inside fill.

(4) Basket Filling - Place Rock by hand or machine. Maintain basket alignment, avoiding bulges, and fill with minimum voids. Provide an exposed Rock surface that is smooth, neat appearing, and has no sharp edges projecting through the wire mesh.

Place the Rock in layers to allow placement of internal connecting wires in each outside cell of the Structure or when directed at the following intervals:

- None required for 1 foot high baskets.
- At the one half point for 1 1/2 foot high baskets.
- At one third points for 3 foot high baskets.

Fill the basket so the lid will bear on the Rock when it is closed. Secure the lid to the sides, ends, and diaphragms with tie wire or spiral binders in the same manner as assembling the baskets.

(5) Repairs - During construction, repair and secure all breakage of the wire mesh that results in mesh or joint openings larger than 4 3/4 inches (line dimension). Make repairs using 13 1/2 gauge galvanized tie wire as directed.

Repair damaged PVC coated wire in a manner that provides the same degree of corrosion resistance as the undamaged wire, according to the manufacturer's recommended repair procedures and as approved.

(6) Tolerances:

- First course of gabion units within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity within ± 2 inches in 10 feet.
- Final deviation from the design batter within ± 1 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Out of plane offset between consecutive rows within ± 1 inch from the planned offset.

(d) Metal Bin and Precast Concrete Bin Walls:

(1) Placement - Begin placing the first course of bin wall units on top of and in full contact with the prepared leveling pad surface. Concurrently with the assembly of the bins, place retaining wall granular backfill within and around the bins of the assembled wall to the limits shown. Maintain the outside backfill approximately level with the inside backfill.

(2) Tolerances:

- First course of units within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity within ± 1 1/4 inches in 10 feet.
- Final deviation from the design batter within ± 1 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Out of plane offset between consecutive rows within ± 1 inch from the planned offset.

(e) Precast Concrete Crib Walls:

(1) Placement - Begin placing the first course of crib wall units on top of and in full contact with the prepared leveling pad surface. Concurrently with the assembly of the cribs, place retaining wall granular backfill within and around the cribs of the assembled wall to the limits shown.

Maintain the outside backfill approximately level with the inside backfill. Fill depressions of stringers and spacers and compact without displacing them from line and batter.

(2) Tolerances:

- First course of units within ± 1/4 inch of the design horizontal alignment.
- Final out of plane concavity or convexity within ± 1 1/4 inches in 10 feet.
- Final deviation from the design batter within ± 1 inch for each 10 feet of wall height.
- Outward leaning batter is zero.
- Out of plane offset between consecutive rows within ± 1 inch from the planned offset.

00596B.45 Geotextile Placement - Install geotextiles according to Section 00350 and as shown.

00596B.47 Backfill Placement:

(a) General - Do not misalign wall units or damage wall components when placing backfill material. Remove and replace all misaligned or damaged wall materials at no additional cost to the Agency.

(b) Compaction - Meet the following requirements:

(1) Equipment - Provide the following compaction Equipment:

a. Backfill In and Within 3 Feet Behind Wall Units - Walk behind vibratory roller compactor with a single smooth drum, vibratory plate compactor, or rammer/tamper plate compactor; each with a gross static weight of not more than 1,000 pounds and a total compaction static plus dynamic force of not more than 5,000 pounds.

b. Backfill More Than 3 Feet Behind Wall Units - Vibratory roller compactor with a single smooth drum, vibratory plate compactor, or rammer/tamper plate compactor.

(2) Maximum Density and Optimum Moisture Content - Determine maximum density and optimum moisture content of the retaining wall granular backfill material according to AASHTO T 99 Standard Proctor Method A, with coarse particle correction according to ODOT TM 223.

(3) Moisture Content - Prepare backfill material to within minus 4 percent to plus 2 percent of optimum moisture content at the time of compacting. Add water to material that does not contain sufficient moisture and thoroughly mix. Remove excess moisture by manipulation, aeration, drainage, or other means before compacting.

(4) Density:

a. Backfill In and Within 3 Feet Behind Wall Units - Compact to 95 percent of maximum density using the required number of passes determined according to 00596B.47(b)(5)(a).

b. Backfill More Than 3 Feet Behind Wall Units - Compact to 95 percent of maximum density determined according to 00596B.47(b)(5)(b).

(5) Testing Methods and Frequency:

a. Test Pad Method - Before placing the wall backfill, determine the number of passes necessary to achieve the specified density by constructing a test pad that is at least 5 feet wide, 15 feet long, and 3 feet in final depth. Construct test pad fill in layers no more than 8 inches thick using the same Equipment and methods that will be used to compact the wall

backfill. Perform at least one density test according to AASHTO T 310 on each test pad layer. Construct and test a new test pad when changes in material occur or different Equipment is used during the construction of the wall backfill, except a new test pad is not required for modular block drainage backfill.

b. Nuclear Gauge Method - Test in-place field density according to AASHTO T 310. Test at the frequency required in the ODOT *Manual of Field Test Procedures*.

(6) Deflection Requirement - Conduct at least one deflection test, witnessed by the Engineer on each compacted layer of backfill according to ODOT TM 158. If the tested layer exhibits yielding, deflection, reaction, or pumping, rework the area to provide acceptable test results before placing the next layer.

Maintenance

00596B.60 Protecting Work - Protect and repair Work as follows:

- Do not allow runoff from adjacent areas to enter the wall construction site during construction operations.
- At the end of each Day's operation, direct potential runoff away from the wall by sloping the last Lift of backfill away from the wall.
- Rework and repair all damaged Subgrade areas to the depth where undamaged Work is encountered.

Measurement

00596B.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

No measurement of quantities will be made for retaining walls. Estimated quantities of nonproprietary retaining walls will be listed in the Special Provisions.

The quantities of Type "F" traffic barrier coping with moment slab will be measured on the length basis, from end to end of coping.

The quantities of sidewalk coping will be measured on the area basis, from end to end and from top of curb to exterior edge of coping.

Excavation below elevations shown will be measured according to 00510.80(b).

Payment

00596B.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Retaining Wall, Prefabricated Modular Gravity	Lump Sum
(b)	____ Inch Type "F" Traffic Barrier Coping with Moment Slab	Foot
(c)	Sidewalk Coping	Square Foot

In item (b), the height of barrier will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Excavation below elevations shown will be paid for according to 00510.90(c).

No separate or additional payment will be made for:

- manufacturer's representative
- excavation, shoring, leveling pads, and specified backfill
- wall drainage and filter systems
- cast-in-place and precast standard coping

Section 00596C - Cast-In-Place Concrete Retaining Walls

Description

00596C.00 Scope - This Work consists of furnishing and constructing nonproprietary cast-in-place concrete retaining walls as shown and specified.

00596C.02 Cost Reduction Proposals - According to 00140.70, cost reduction proposals will be considered for proprietary retaining wall systems that are preapproved by the Agency before Advertisement of the Project.

00596C.03 Definitions:

Batter - The Slope of the wall face from vertical that is expressed as degrees or as a ratio of the horizontal change in inches for each 12 inches of vertical change. A vertical face has a zero batter.

Nonproprietary Retaining Wall System - A retaining wall system that is not a patented or trademarked and is shown on the Plans.

Proprietary Retaining Wall System - A retaining wall system that is protected by trademark, patent, or copyright and is produced or distributed by a manufacturer having exclusive rights.

Retained Backfill - Backfill within a distance of H/2 behind the rear face of a retaining wall. H is the total height of the wall excluding the footing.

Retaining Wall System - An engineered system of structural and geotechnical components that restrains a mass of earth. The terms retaining wall system, retaining Structure, and retaining wall are used interchangeably.

Rigid Gravity Retaining Wall System - A retaining wall composed of monolithic cast-in-place concrete with a nominal amount of reinforcement placed near exposed faces that depends on concrete self-weight for stability.

Semi-Gravity Cantilever Retaining Wall System - A retaining wall composed of a cast-in-place reinforced concrete flexural stem and base slabs that resist the moments and shears to which they are subjected and depends on concrete self-weight and from the weight of backfill over its heel for stability.

00596C.05 Submittals - Submit complete Working Drawings according to 00150.35 at least 30 Calendar Days before beginning construction of cast-in-place retaining walls, including the following:

- Unstamped Working Drawings for the cast-in-place walls.
- Stamped Working Drawings and calculations for excavation shoring.
- Stamped Working Drawings and calculations for wall formwork.

Field verify existing ground elevations and bottom of wall elevations before preparing and submitting Working Drawings. Obtain the Engineer's written approval before beginning construction of the wall system.

Materials

00596C.10 Quality Control - Provide quality control according to Section 00165.

00596C.11 Backfill:

(a) Retaining Wall Granular Backfill - Furnish dense graded 1" - 0 or 3/4" - 0 Aggregate base Material for walls meeting the requirements of 02630.10 and the following:

(1) Material Passing No. 200 Sieve - The amount of material passing the No. 200 sieve shall not exceed 15 percent by weight. Test according to AASHTO T 11.

(2) Plasticity Index - The plasticity index of the material passing the No. 40 sieve shall not exceed 6. Test according to AASHTO T 90.

(b) Pipe Drain Backfill - Furnish granular drain backfill Material for drainage pipes meeting the requirements of 00430.11.

00596C.12 Concrete:

(a) Cast-in-Place Concrete for Rigid Gravity Retaining Walls - Furnish Commercial Grade Concrete meeting the requirements of to Section 00440.

(b) Cast-in-Place Concrete for Semi-Gravity Cantilever Retaining Walls - Furnish Class 4000 - 3/4 structural concrete meeting the requirements of Section 00540.

00596C.13 Steel - Furnish steel reinforcement for concrete meeting the requirements of Section 00530.

00596C.14 Geosynthetics - Furnish Type 1 drainage geotextile for subsurface drainage systems according to Section 02320.

00596C.15 Piles - Furnish piling meeting the requirements of Section 00520.

Labor

00596C.30 Quality Control Personnel - Provide technicians with CAgT and CDT certifications.

Construction

00596C.40 General - Construct cast-in-place concrete retaining walls as shown.

00596C.41 Excavation and Foundation Preparation - Perform excavation and prepare backfill wall foundations according to Section 00510 and the following:

- Grade the foundation level for a width equal to the combined width of the wall footing plus 1.0 foot on each side.
- Place backfill material in nearly horizontal layers not more than 8 inches thick.
- Do not construct backfill when the backfill, the foundation, or the embankment on which it would be placed is frozen, or unstable.

00596C.42 Compaction - Compact according to the following:

(a) Equipment - Provide the following compaction Equipment:

(1) Backfill Within 3 Feet Behind Wall - Walk behind vibratory roller compactor with a single smooth drum, vibratory plate compactor, or rammer/tamper plate compactor; each with a gross

static weight of not more than 1,000 pounds and a total compaction static plus dynamic force of not more than 5,000 pounds.

(2) Backfill More Than 3 Feet Behind Wall - Vibratory roller compactor with a single smooth drum, vibratory plate compactor, or rammer/tamper plate compactor.

(b) Maximum Density and Optimum Moisture Content - Determine maximum density and optimum moisture content of the retaining wall granular backfill material according to AASHTO T 99 Standard Proctor Method A, with coarse particle correction according to ODOT TM 223.

(c) Moisture Content - Prepare the retaining wall granular backfill material to within minus 4 percent to plus 2 percent of optimum moisture content at the time of compacting. Add water to material that does not contain sufficient moisture and thoroughly mix. Remove excess moisture by manipulation, aeration, drainage, or other means before compacting.

(d) Density:

(1) Backfill Within 3 Feet Behind Wall - Compact to 95 percent of maximum density using the required number of passes determined according to 00596C.42(e)(1).

(2) Backfill More Than 3 Feet Behind Wall - Compact to 95 percent of maximum density determined according to 00596C.42(e)(2).

(e) Testing Methods and Frequency:

(1) Test Pad Method - Before placing the wall backfill, determine the number of passes necessary to achieve the specified density by constructing a test pad that is at least 5 feet wide, 15 feet long, and 3 feet in final depth. Construct test pad fill in layers no more than 8 inches thick using the same Equipment and methods that will be used to compact the wall backfill. Perform at least one density test according to AASHTO T 310 on each test pad layer. Construct and test a new test pad when changes in material occur or different Equipment is used during the construction of the wall backfill.

(2) Nuclear Gauge Method - Test in-place field density according to AASHTO T 310. Test at the frequency required in the ODOT *Manual of Field Test Procedures*.

(f) Deflection Requirement - Conduct at least one deflection test, witnessed by the Engineer on each compacted layer of backfill according to ODOT TM 158. If the tested layer exhibits yielding, deflection, reaction, or pumping, rework the area to provide acceptable test results before placing the next layer.

00596C.43 Wall Construction:

(a) Wall Drainage - Construct wall drainage according to Section 00430.

(b) Cast-in-Place Concrete Gravity Retaining Walls - Construct cast-in-place concrete gravity retaining walls as shown.

(c) Cast-in-Place Semi-Gravity Cantilever Retaining Walls - Construct cast-in-place concrete semi-gravity retaining walls as shown.

Measurement

00596C.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

No measurement of quantities will be made for retaining walls. Estimated quantity of retaining walls will be listed in the Special Provisions.

The quantities of Type "F" traffic barrier coping with moment slab will be measured on the length basis, from end to end of coping.

The quantities of sidewalk coping will be measured on the area basis, from end to end and from top of curb to exterior edge of coping.

Excavation below elevations shown will be measured according to 00510.80(b).

Payment

00596C.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Retaining Wall, Cast-In-Place Concrete Rigid Gravity	Lump Sum
(b)	Retaining Wall, Cast-In-Place Concrete Semi-Gravity Cantilever	Lump Sum
(c)	____ Inch Type "F" Traffic Barrier Coping with Moment Slab	Foot
(d)	Sidewalk Coping	Square Foot

In item (c), the height of barrier will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Excavation below elevations shown will be paid for according to 00510.90(c).

No separate or additional payment will be made for:

- excavation, shoring, and specified backfill
- wall drainage and filter systems
- concrete and reinforcement for concrete

Section 00597 - Sound Walls

Description

00597.00 Scope - This Work consists of furnishing and constructing sound walls at the locations shown or as directed.

Use one of the following sound wall types:

- Concrete block walls
- Precast concrete panel walls
- Concrete panel fence walls

00597.01 Variables - The amount and kind of Work required to construct a sound wall varies according to the type of wall selected. Be responsible for determining the Work required for each wall type and for the variables in quantities, including shoring, excavation, backfilling, excess material, staging Work and other details of the Work.

Materials

00597.10 Materials - Obtain all manufactured materials for the selected sound wall type from the same company. Only one type of wall will be allowed on the Project unless otherwise specified.

Store concrete masonry units and cementitious materials at the Project Site in a manner which will protect the materials from contact with Soil and weather. Store mortar and grout materials in original unbroken packages.

00597.11 Concrete Block Sound Walls:

(a) Concrete Blocks - Furnish concrete blocks meeting the following requirements:

- Hollow, load-bearing blocks, graded N-1, f'm = 1,300 psi with 2,000 psi 28-Day strength on net cross sectional area, according to ASTM C90
- Kiln dried to 33 percent total absorption
- Split ribbed (York) pattern on exposed areas
- Standard block on unexposed areas
- Nominal 8 by 8 by 16-inch size

Do not tint concrete blocks. Use uniform colored blocks along the length of individual walls.

(b) Concrete Caps - Construct concrete caps meeting the following requirements:

- Nominal 4 by 8 by 16-inch size
- Same color as concrete blocks

(c) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(d) Concrete - For pile footings, furnish concrete according to Section 00440. For all other components, including spread footings, furnish concrete according to Section 00540.

(e) Mortar and Grout - Furnish mortar meeting the requirements of ASTM C270 that attains an ultimate compressive strength of at least 2,500 psi at 28 days. Furnish coarse grout meeting the

requirements of ASTM C476 with a suitable consistency for pouring without segregation of materials.

(f) Preformed Expansion Joint Filler - Furnish expansion joint filler meeting the requirements of 02440.10.

(g) Fillers, Sealers and Damp-proofing - Furnish fillers, sealers, and damp-proofing Materials from the QPL.

00597.12 Precast Concrete Panel Sound Walls:

(a) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(b) Concrete - For footings, furnish Commercial Grade Concrete meeting the requirements of Section 00440. For all other components, furnish concrete meeting the requirements of Section 00540.

00597.13 Concrete Panel Lock Fence Sound Walls:

(a) General - Furnish concrete panel lock fence Material and necessary components. Provide the manufacturer's test results and certificate of compliance according to 00165.35.

(b) Reinforcement - Furnish reinforcement meeting the requirements of Section 00530.

(c) Concrete - For footings, furnish Commercial Grade Concrete meeting the requirements of Section 00440. For all other components, furnish concrete meeting the requirements of Section 00540.

Construction

00597.40 General - Perform structure excavation according to Section 00510 to the limits and stages shown. All sound walls, regardless of type, shall conform to the top of wall profile shown. Provide footings as shown or approved.

00597.41 Concrete Block Sound Walls:

(a) General - Construct all masonry walls plumb, level and true. Build walls in running bond pattern. Place masonry according to accepted standards of good practice and Work in masonry construction and as shown.

If Work is discontinued, protect the top of the wall with a well-secured waterproof cover.

Do not perform masonry Work when the surrounding temperature is less than 35 °F unless provisions are made for heating and drying materials and for protecting the Work.

Do not backfill walls until at least 24 hours after damp-proofing is applied.

Use clean, dry, ice-free, and frost-free masonry units. Do not dampen units before or during laying unless approved.

Place the first course of masonry on the footing in a full mortar bed. Mortar joints between units shall be 3/8 inch thick with full mortar coverage on vertical and horizontal face shells only. Vertical joints shall be shoved tight.

Discard mortar when:

- Not used within 2 hours of initial mixing
- Stiffened due to hydration past initial set
- Stiffened due to evaporation
- Allowed to stand 1 hour without mixing

Grout all cells containing reinforcing bars. Walls and crosswebs forming cells to be filled shall be full-bedded in mortar to prevent leakage of grout. Grout may stop in cells containing bars where, and if, the reinforcement stops. Position vertical steel in the center of the cell and securely tie in place at intervals of not more than 5 feet. Use grout that is sufficiently fluid to flow into all grout spaces, leaving no voids. Perform grouting according to either "low-lift grouting" or "high-lift grouting" as follows:

(1) Low-Lift Grouting - When the wall is grouted as the wall is laid up, do the following:

- Do not exceed 4 feet high wall construction before placing grout.
- Construct vertical cores or cells of a clear, unobstructed size measuring not less than 2 inches by 3 inches.
- Rod or vibrate grout when placed.
- Position reinforcing steel and tie in place.
- Do not proceed with constructing the wall above a bond beam course until the vertical cells below the bond beam course and the bond beam course itself have been filled with grout.
- When the time interval between Lifts will exceed 1 hour, stop the Lifts 1 1/2 inches below the top of the course.

(2) High-Lift Grouting - When the wall is to be grouted full height or if the height to be grouted will exceed 4 feet, do the following:

- Leave cleanouts, with a minimum opening of 3 inches by 4 inches as shown, in the bottom course of the placement at each vertical cell. Keep cleanouts open until all mortar droppings have been removed and vertical reinforcing steel has been placed and inspected.
- Remove excess mortar from vertical cores and expose an unobstructed vertical hole with a dimension of at least 2 inches and a cross-sectional area of at least 10 square inches.
- Do not start grout Work until 24 hours after the portion of the wall to be grouted has been constructed.
- Do not place grout in Lifts greater than 4 feet in height. Rod or vibrate grout not later than 10 minutes after placing and before the preceding Lift takes its permanent set. Extend rodding or vibrating 12 inches to 18 inches into the preceding Lift.
- Do not begin grouting successive Lifts until at least 30 minutes have elapsed after rodding or vibrating the preceding Lift.
- If the time interval between Lifts will exceed 1 hour, stop the Lifts 1 1/2 inch below the top of the course.
- Place wire screen, small mesh, expanded metal lath or other approved material in mortar joints under each bond beam course to prevent filling vertical cells not intended to be filled.

(b) Waterproofing - Treat all masonry wall cap surfaces with a waterproofing application of a high-build filler and rubber sealer. Treat at least 14 Calendar Days after the wall is completed. Apply filler by spraying or rolling according to the manufacturer's recommendations. Apply two

coats of sealer to a minimum thickness of 10 mils. The finished product shall be the color "Summer Gray".

(c) Damp-Proofing - After the cap is waterproofed, damp-proof the vertical surfaces of the masonry walls. Apply damp-proofing at least 14 Calendar Days after the walls are completed and according to the manufacturer's recommendations.

00597.42 Precast Concrete Panel Sound Walls - Construct precast concrete panel sound walls plumb, level and true. Panels shall be free of major cracks. Cracks in panels will be measured after the panel is placed and walls have been backfilled. Cracks greater than 0.02 inch may require repairs or panel replacement, at the discretion of the Engineer.

00597.43 Concrete Panel Lock Fence Sound Walls - Construct concrete panel lock fence walls according to the manufacturer's recommendations.

Measurement

00597.80 Measurement - The quantities of sound walls will be measured on the area basis. Field measurement of each sound wall will not be made. The quantity will be the quantity shown in the Schedule of Items for each sound wall unless changes are ordered in writing by the Engineer. The area of sound wall in the Schedule of Items is based on the following:

- Vertical limits between the top and bottom of the wall panel or masonry units, exclusive of pilasters but including cap blocks.
- If the sound wall contains pilasters, the horizontal limits are between the centerline of pilasters shown in the Contract Plans wall elevation.
- If the sound wall does not contain pilasters, the horizontal limits are between changes in wall height or the ends of the wall.

If changes are ordered, an adjustment will be made only for the quantity difference involved in the ordered plan changes and will be limited to the area of the change, determined using the vertical and horizontal area limits described in this Subsection.

Payment

00597.90 Payment - The accepted quantities of sound walls will be paid for at the Contract unit price, per square foot, for the item "Sound Walls".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for excavation, backfill, footings, concrete, reinforcement, waterproofing, or damp-proofing.

Section 00599 - Concrete Slope Paving

Description

00599.00 Scope - This Work consists of constructing concrete slope paving on bridge end slopes as shown, specified, or directed.

Materials

00599.10 Materials - Furnish Materials meeting the following requirements:

Commercial Grade Concrete.....00440
Grout.....02080.40
Reinforcement.....02510

Construction

00599.40 Slope Preparation - Grade the slopes for slope and berm paving, and curbs to the lines and grades established. Finish the area to a smooth, firm, compacted condition.

Dispose of excess materials according to 00330.41(a)(4).

If slopes constructed under a separate contract require additional materials to prepare slopes to the established lines and grades, furnish such materials according to 00140.30.

00599.42 Slope Paving - Pave slopes with precast or cast-in-place blocks as the Contractor elects. Give the tops of blocks a wood float and brush finish parallel with the long dimension of the block.

(a) Precast Blocks - Manufacture precast blocks according to the Plans and Section 00440.

(b) Cast-in-place Blocks - Place concrete for cast-in-place blocks according to Section 00440.

00599.43 Berm Paving - Construct berm paving according to the Plans and Section 00440, except finish the berm paving to a neat, smooth surface.

00599.44 Slope Paving Curbs - Construct slope paving curbs according to the Plans and to Section 00440 and Section 02510.

Measurement

00599.80 Measurement - The quantities of Work performed under this Section will be measured according to the following:

(a) Slope Paving - Concrete slope paving will be measured on the area basis, on the slope paving surface for each bridge end slope.

(b) Berm Paving - Berm paving will be measured on the area basis, on the berm paving surface for each berm.

(c) Slope Paving Curbs - Slope paving curbs will be measured on the length basis.

Payment

00599.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Concrete Slope Paving	Square Foot
(b)	Berm Paving	Square Foot
(c)	Slope Paving Curbs	Foot

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Payment for furnishing additional embankment Materials required for slope preparation constructed under a separate contract will be made according to 00195.20.

PART 00600 - BASES

Section 00610 - Reconditioning Existing Roadway

Description

00610.00 Scope - This Work consists of reconditioning and preparing existing Subgrades, Bases, Surfacings and Pavements on which an additional layer or Course of material is to be placed, under the Contract. The Work includes existing Shoulders, cut ditches, road connections, approach roads, ramps, bridge decks if not provided for elsewhere, and other Roadbed areas on which construction Work under the Contract is to be performed.

Materials

00610.10 Materials - Materials required for reconditioning and preparation Work may consist of selected Soil, sand and gravel, Aggregate Subbase or base Material, water, asphalt, asphalt and portland cement concrete Surfacing, and other Material as directed. Furnish the Materials meeting the requirements of the Specifications of the applicable Sections.

00610.15 Quality Control - Provide quality control according to Section 00165.

Labor

00610.30 Quality Control Personnel - Provide technicians having CEBT, CAgT, and CDT technical certifications.

Construction

00610.40 Removal and Replacement of Unsuitable Materials - Remove unstable or Unsuitable Materials in the Subgrade, Subbase, Base, Surfacing or Pavement areas as directed and dispose of according to 00330.41(a)(3). Perform the removal and disposal according to 00140.30. Replace the removed materials with successive Courses of materials furnished for other purposes under the Contract. Furnish, place and finish these materials as specified or as directed. If no materials are available for replacement, perform the replacement Work according to 00140.30.

00610.41 Ditches and Subgrades - Clean, trim and restore existing cut ditches to designated Cross Section and condition. Reshape, water, process and prepare the existing Subgrade to the lines, grades, Slopes and Cross Sections established. Compact according to 00330.43.

00610.42 Aggregate Subbase, Base, and Surfacing - Reshape, water, process and prepare the upper layer of existing Subbases, Bases and Surfacings to lines, grades and Cross Sections established. Compact to densities required for similar new Work.

00610.43 Surfacings - Clean Existing Surfacings of all loose material, dirt and dust by brooming, flushing with water or other approved methods.

Measurement

00610.80 Measurement - No measurement of quantities will be made for reconditioning and preparation Work.

Materials used in the replacement of Unsuitable Materials according to 00610.40 will be measured in the manner applicable to the Pay Item under which the Materials are furnished.

Payment

00610.90 Payment - Payment for reconditioning and preparation Work will be made at the Contract lump sum amount for the item "Reconditioning Existing Roadway".

Payment will be payment in full for furnishing all Material, Equipment, labor, and Incidentals necessary to complete the Work as specified.

Removal and disposal of Unsuitable Materials will be paid for according to 00140.30.

Materials used for replacement of Unsuitable Materials according to 00610.40 will be paid for at the Contract unit price for the Material involved. If the Contract Schedule of Items does not identify Pay Items for the Material, payment will be made according to 00140.30.

Water furnished and used in the watering Work and in the flushing of surfaces and Pavements will be paid for according to Section 00340. If the Contract Schedule of Items does not identify a watering Pay Item, no separate or additional payment will be made for water furnished and used in the watering Work and in the flushing of surfaces and Pavements.

When the Contract Schedule of Items does not indicate payment for the Work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00620 - Cold Plane Pavement Removal

Description

00620.00 Scope - This Work consists of removing existing Pavement to prepare a foundation for placing new Surfacing.

Equipment

00620.20 Equipment - Provide self-propelled planing machines or grinders:

- Capable of loosening Pavement material.
- Capable of accurately establishing profile grades within a tolerance of 0.02 foot by reference from either the existing Pavement or from independent grade control.
- With a positive means for controlling cross-slope elevations.
- With a totally enclosed cutting drum with replaceable cutting teeth.
- With an effective means of removing loosened material from the surface and preventing dust from escaping into the air.
- Capable of providing a true cross-slope grade that will allow placement of overlay Pavement to a uniform thickness.

Construction

00620.40 Pavement Removal:

(a) General - Remove the existing Pavement to the depth, width, grade and Cross Section shown or as directed. The use of a heating device to soften the Pavement is not allowed.

(b) Depth 1 inch to 2 inches - If the depth of the existing Pavement to be removed is 2 inches or less, but more than 1 inch and the section will be under traffic, schedule the Work so the full width and length of travel lanes Pavement can be removed during the same shift. Remove the Shoulder area within 24 hours.

(c) Depth over 2 inches - If the depth of the existing Pavement to be removed is over 2 inches and the section will be under traffic, schedule the Work so the full width and length of the travel lanes and Shoulders can be removed, leaving no longitudinal or transverse drop-offs, during the same shift.

(d) Pavement Removal Alternative - If unable to complete the Pavement removal according to 00620.40(b) and (c), then within the same Day construct a wedge of asphalt concrete, at a Slope of 1V:10H or flatter along each exposed longitudinal drop-off, and 1V:50H or flatter along each exposed transverse drop-off. Place wedges completely across the milled area at intersections, points of beginning and ending of the milling operation, and around manholes, valve boxes and other Structures. Longitudinal drop-offs of 1 inch or less do not require a wedge. Maintain wedges as long as the area remains under traffic or until Pavement is replaced. Remove and dispose of wedges before placing new Pavement.

(e) Warning Signs - Provide warning signs as required where abrupt or sloped drop-offs occur at the edge of the existing or new surface according to Section 00222.

00620.41 Surface Tolerance - Test with a 12-foot straightedge furnished and operated by the Contractor, as directed. The variation of the top of the ridges from the testing edge of the straightedge, between any two ridge contact points, shall not exceed 1/4 inch.

00620.42 Disposal of Materials - Dispose of all materials according to 00290.20.

00620.43 Maintenance Under Traffic - If the cold planed Pavement surface will be exposed to traffic, sweep and clean prior to allowing traffic to use the Roadway.

Measurement

00620.80 Measurement - The quantities of cold plane Pavement removal will be measured on the area basis, in place.

When the depth of Pavement to be removed is variable, the depth as shown is an estimate and is approximate only. No guarantee is made that the actual depth will be the same as the estimated depth.

Payment

00620.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per square yard, for the item "Cold Plane Pavement Removal, ____ Deep".

The depth will be inserted in the blank. If the depth is variable, the depth range will be inserted in the blank.

Payment will be payment in full for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for temporary wedges constructed, maintained, and removed under 00620.40(d), or for replacement of cutting teeth.

Section 00622 - Grinding Concrete Pavement

Description

00622.00 Scope - This Work consists of grinding existing portland cement concrete Pavement.

Equipment

00622.20 Grinding Equipment - Provide self-propelled grinding Equipment that:

- Has diamond embedded grinding blades that will produce a smooth textured surface.
- Is able to grind a strip at least 4 feet wide.
- Can remove slurry and residue during the grinding operation.

00622.21 Smoothness Testing Equipment:

(a) Straightedge - Provide one 12-foot straightedge.

(b) Profilograph - Provide a California-type profilograph that:

- Can determine the profile index of the Pavement according to ODOT TM 770.
- Is either computerized or not computerized.
- Is equipped with a recording device.
- Is calibrated, in good working condition, and ready for operation before concrete Pavement grinding begins.

(c) Profilometer - Provide a profilometer that:

- Is capable of generating the equivalent California-type profilograph plot and values according to ODOT TM 770.
- Employs an accelerometer established inertial profiling reference and a laser height sensing instrument to produce a true profile of the Pavement surface.
- Is capable of reporting elevations with a resolution of 0.004 inch or finer at an interval of 6 inches or less.
- Is able to generate the locations and heights of all bumps and dips.
- Is calibrated, in good working condition, and ready for operation before performing smoothness measurements.

Before beginning smoothness measurements, have the profilograph or profilometer operators meet with the Engineer at a mutually agreed upon time to discuss all aspects of smoothness measurements on the Project.

Labor

00622.30 Smoothness Testing Operators - Provide operators for the profilograph and the profilometer that are experienced in the operation of the Equipment.

Construction

00622.41 Grinding - Taper grind to match the elevation of bridge decks, bridge approach slabs, and at the ends of the grind area.

Provide positive lateral drainage by maintaining a constant cross slope between grinding extremities in each lane. Grind transition, auxiliary or ramp lane from the mainline edge as shown.

Schedule and proceed with the grinding operation that will produce a uniform finished surface. Grind the Pavement in a longitudinal direction beginning and ending at lines normal to the Pavement centerline.

Do not grind roadway Shoulders unless shown. Do not encroach on traffic movement outside the work area. Do not damage underlying surfaces, cause fractures, or spall joints.

Perform grinding within one of the following Aggregate hardness tolerances:

	Aggregate Hardness Tolerance	
	Moderately Hard Aggregate	**Hard Aggregate**
Abrasion (AASHTO T96)	> 20.0	≤ 20.0
Blade segment thickness	0.100" to 0.125"	0.100" to 0.125"
Land area between grooves*	0.100" to 0.135"	0.080" to 0.110"
Texture depth**	Target of 1/16" with averages between 1/32" to 3/32"	

* Based on an average of a minimum of 10 measurements across the ground width for one Pass.

** Based on an average of a minimum of 6 measurements across the ground width for one Pass.

The Project's Aggregate hardness tolerance will be listed in the Special Provisions.

00622.42 Removal and Disposal of Material - Remove all grinding materials as the grinding operation is performed. Dispose of all materials according to 00290.20.

00622.43 Surface Finish - Provide a Pavement surface that:

- Meets the Aggregate hardness tolerances of 00622.41.
- Is true to grade.
- Has a longitudinal line-type texture with corrugations parallel to the outside Pavement edge which present a narrow ridge corduroy type appearance.
- Has at least 95 percent of the Pavement surface textured. When approved, depressed Pavement areas and other localized depressed areas will not require texturing.

Extra depth grinding is not required where minor depressions are detected in the existing Pavement.

Provide at least a 2.0 inch longitudinal overlap when producing multiple Passes but keep overlaps over 2.0 inches to a minimum.

Maintenance

00622.60 Correction of Defects - Correct the following deficiencies at no additional cost to the Agency:

- Pavement corrugation due to "out-of-round" wheels on grinding Equipment.
- Improper cutting head operations that cause the head to ride in and out of the Pavement when encountering light and heavy cuts.
- Depressions created from improper starting and stopping during the cutting operation.
- Unground ridges left in the Pavement from defective blades in the grinding head.

Regrind the entire lane width in areas that require corrective Work.

Finishing and Cleaning Up

00622.70 Pavement Smoothness - Perform smoothness testing under the observation of the Engineer. If the Contractor performs smoothness measurements on a Day other than the Day Pavement grinding is performed, all additional traffic control required for the smoothness testing, but not required for other Work, will be at no additional cost to the Agency.

(a) Straightedge Testing and Tolerance - Test the surface with a 12-foot straightedge perpendicular to the centerline. The Pavement surface shall not vary by more than 1/4 inch. Straightedge testing is not required across longitudinal joints or outside the ground area.

(b) Graphic Profile Testing and Tolerance:

(1) General - Test the longitudinal surface of textured surfaces for smoothness by the graphic profile testing (GPT) method according to ODOT TM 770. Before beginning grinding on the Project, demonstrate the profilograph and profilometer operation by conducting a calibration test according to ODOT TM 770, and running the machine twice over a 0.1 mile section of Pavement with repeating results.

The Pavement shall have a profile index of 7.0 inches per mile or less for each wheel path in each 0.1 mile segment or partial segment, and shall have no individual deviation of 0.3 inch or more.

(2) Surface Test - Provide a complete graphic profile by running the profilograph or profilometer over the full length of the lanes ground and 50 feet beyond the ends. Provide a profile in each vehicle wheel path by running profiles on the Pavement surface along lines parallel to and approximately 3 feet from each edge of the Pavement and 3 feet from each side of longitudinal joints.

(3) Determining Profile Index:

a. General - Determine the profile index of Pavement in 0.1 mile segments and partial segments. A segment will end and will be considered a partial segment and a new segment will begin when the segment sequence is interrupted by stage construction or by profiled areas excluded from the GPT smoothness requirements.

The following profiled areas of Pavement are excluded from the GPT smoothness requirements:

- Profiles extending beyond the Project ends
- Bridge decks and bridge panels
- First and last 13 feet at the Project ends and bridge end panels
- Pavement on horizontal curves with radii less than 1,000 feet

Include and analyze separately those areas in the profile charts that are not subject to the GPT smoothness profile index requirements.

b. Method of Analysis - Determine the profile index and individual deviations of 0.3 inch or more by analyzing the profile charts according to ODOT TM 770. Provide the profile charts and results to the Engineer.

(c) Failure To Meet Graphic Profile Requirements - Correct all segments or partial segments that exceed the requirements of 00622.70(b) in either wheel path by regrinding to the specified limits except correct deviations of 0.3 inch or more at least to the edge of the blanking band. The Engineer will determine and mark the areas to be profiled.

Retest all segments requiring corrective Work for the entire length according to 00622.70(b) under the observation of the Engineer. All corrective Work and graphic profiling, including traffic control, will be at no additional cost to the Agency.

Measurement

00622.80 Measurement - The quantities of concrete Pavement grinding will be measured on the area basis.

Payment

00622.90 Payment - The accepted quantities of concrete Pavement grinding will be paid for at the Contract unit price per square yard for the item "Grind Concrete Pavement".

Payment will be payment in full for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00640 - Aggregate Base and Shoulders

Description

00640.00 Scope - This Work consists of furnishing and placing one or more Courses of Aggregate Base and/or Shoulders on a prepared surface to the lines, grades, thicknesses and Cross Sections shown or established.

Materials

00640.10 Materials - Furnish Aggregates of either 1" - 0 or 3/4" - 0 as the Contractor elects. Use clean, hard, durable Aggregates, reasonably well-graded from the maximum size to dust.

00640.16 Acceptance of Aggregates - Acceptance will be visual by the Engineer.

Construction

00640.40 Preparation of Foundation - Provide a firm surface on which Aggregates are to be placed according to 00641.40.

00640.41 Hauling and Placing - Transport the Aggregate to the Project Site, add water to obtain proper moisture content, and place on the prepared surface or material by means acceptable to the Engineer.

Do not place shoulder Aggregates on the top Lift of newly constructed EAC or open-graded Pavement.

00640.42 Thickness and Number of Layers:

(a) Base - If the required compacted depth of the Base Course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

Place each layer in spreads as wide as practicable and to the full width of the Course before a succeeding layer is placed.

(b) Shoulders - Place shoulder Aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.

00640.43 Shaping and Compacting - Compact each layer of material placed in Shoulder and Base areas by rollers conforming in general to 00641.24 or as directed.

Shape and maintain the surface of each layer during the compaction operations to meet the requirements of 00640.44. Produce a uniform texture and firmly key the Aggregates.

Apply water over the materials for proper compaction according to Section 00340, and as directed.

Continue the compactive effort until there is no reaction or yielding observed under the compactor.

00640.44 Surface Tolerance - The finished surface and the surface of each underlying layer of the Aggregate shall parallel the established grade and Cross Section for the finished surface within 0.04 foot.

The finished surface of the compacted Aggregate Base, when tested with a 12-foot straightedge, shall not vary from the testing edge by more than 1/2 inch at any point. Furnish and operate the straightedge as directed.

Maintenance

00640.60 Care of the Work - After construction of each layer and completion of Base, maintain the layer to specified conditions and prevent or repair segregation, raveling, or rutting, until it is covered with a following layer or until all Work is completed.

Measurement

00640.80 Measurement - The quantities of Aggregate will be measured on the weight basis, in the hauling vehicle.

Payment

00640.90 Payment - The accepted quantities of Aggregates will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Aggregate Base	Ton
(b) Aggregate Shoulders	Ton

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for water used to obtain proper compaction and in the care of the Work.

Section 00641 - Aggregate Subbase, Base, and Shoulders

Description

00641.00 Scope - This Work consists of furnishing and placing one or more layers of Aggregates, mixed with water, on a prepared surface to the lines, grades, thicknesses and Cross Sections shown or established.

Materials

00641.10 Materials:

(a) Base and Shoulder Aggregate - Aggregate for bases and Shoulders shall be sized as specified. Base Aggregate shall be dense-graded unless otherwise specified. Shoulder Aggregates shall be either 1" - 0 or 3/4" - 0 size as the Contractor elects.

Furnish base and shoulder Aggregates meeting the following requirements:

Dense-Graded Base Aggregate 02630.10
Open-Graded Aggregate.....02630.11
Shoulder Aggregate 02640

(b) Subbase Aggregate - Aggregate for Subbases shall be crushed or uncrushed, including sands, reasonably well graded from coarse to fine.

Maximum size Aggregate shall not exceed 75 percent of the compacted thickness of the layer in which it is incorporated. Aggregates passing the 1/4 inch sieve shall not be less than 10 percent nor more than 50 percent of the whole, by weight. No more than 10 percent of the Aggregate shall pass the No. 100 sieve. Within these limits, the Subbase Aggregate gradation shall be adequate to produce a dense, firm Base when placed and compacted.

(1) Grading - All of the grading requirements are given as percentages by weight. The gradation will be determined by sieve analysis according to AASHTO T 27.

(2) Abrasion - The source materials for Aggregate Subbase shall not exceed 45 percent wear when tested according to AASHTO T 96 unless otherwise approved.

(3) Sand Equivalent - Aggregate Subbase will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 25.

00641.11 Stockpiling - If the produced Aggregates are to be stockpiled, prepare the stockpile site and pile the materials according to 00680.40 and 00680.41.

00641.12 Limits of Mixture - Provide a mixture of Aggregate and water having a uniform moisture content sufficient to obtain the required compaction. Proportions will be in percentages by weight and will be known as the Mix Design. Determine the proportion of Aggregate and water according to the MFTP. The amount of water for the Mix Design will be based on the dry weight of the Aggregate.

When introducing water at the mixing plant, furnish the mixture with a tolerance of $\pm$ 2 percent of the optimum water content at the time of mixing. If approved, excess percentage of water may be allowed. The Agency will treat excess percentage of water according to 00641.80(d).

00641.15 Quality Control:

(a) Aggregate Production Quality Control - Have a CAgT perform sampling and testing of Aggregates according to Section 00165 and the MFTP. Statistically evaluate the Aggregates according to Section 00165.

(b) Preproduced Aggregate - Compliance of Aggregates produced and stockpiled before issuance of Notice to Proceed will be determined according to (1) or (2) below.

(1) Continuing production records meeting the requirements of Section 00165 and the MFTP.

(2) Sampling and testing the entire stockpile according to Section 00165 and the MFTP.

In addition, the material shall meet the requirements of 00641.10.

00641.16 Acceptance of Aggregates - Acceptance will be according to Section 00165.

(a) Stockpiled Aggregate for Aggregate Base and Shoulders - Acceptance will be based on the Contractor's quality control testing, if verified, as required in Section 00165.

(1) Aggregate Gradation - A stockpile contains specification Aggregate gradation when the Quality Level (QL) for each sieve size, calculated according to 00165.40, is equal to or greater than the QL in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the QL in Table 00165-2 yields a PF of less than 1.00 for any sieve size, the material is non-specification.

(2) Non-specification Aggregate Gradation - Stockpiled Aggregates having non-specification Aggregate gradation will be rejected unless the non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material has been removed so that the QL for each sieve size is equal to or greater than the QL in Table 00165-2 for a 1.00 PF.

No payment will be made for non-specification materials.

(b) Aggregate Base and Shoulder Mixture - Acceptance testing will be performed on random samples obtained immediately following mixing with water according to the MFTP. For non-specification mixture the Engineer will determine the appropriate price reduction or order its removal from the Work according to 00150.25.

(c) Aggregate Subbase - Aggregate Subbase will be accepted based on the Engineer's visual inspection. Samples will be obtained and tested for compliance with 00641.10 by the Engineer if it is suspected that the material does not meet Specifications.

Equipment

00641.20 Mixing Plant - Mix Aggregate and water by one of the following methods:

(a) Mixing Plant - Mix with a pug mill, rotary mixer, or other Equipment at a mixing plant that:

- Has adjustable weighing or calibrated feeders, and other Equipment that produces uniform, non-segregated, specified mixtures.
- Discharges water into the mixer by weighing or metering. The device shall be adjustable and shall assure uniform water content in the mixture.

- Has mixing blades or paddles of proper size, adjustment and clearance to provide uniform mixture.

(b) Road Mix - Motor grader or other suitable Equipment.

00641.21 Hauling Equipment - Provide mixture hauling vehicles capable of hauling and depositing the mixture with a minimum of mix segregation.

00641.22 Spreading Equipment - Provide Equipment capable of spreading the material and striking it off to designated line, grade, and transverse Slope without segregation, dragging, or fracture of Aggregate.

00641.24 Compacting Equipment - Provide self-propelled rollers and compactors capable of reversing without backlash. Rollers and compactors shall have a gross static weight of at least 8 tons, and shall be capable of compacting to specified density while the mix is still moist.

Labor

00641.30 Quality Control Personnel - Provide technicians having CEBT, CAgT, and CDT technical certifications.

Construction

00641.40 Preparation of Foundation - Provide a firm surface or material, on which Aggregates are to be placed, according to Sections 00320, 00330, or 00610 as applicable.

00641.41 Mixing, Hauling, and Placing - Add water to the Aggregate while mixing to provide a moisture content according to 00641.12.

Thoroughly mix the combined Aggregate and water for as long as necessary to produce a homogenous mixture with all Aggregate particles uniformly coated with water. Mix, haul and place the material by one of the following methods:

(a) Stationary Mixing Plant - Combine materials in a pug mill or rotary mixer.

Deliver and deposit the mixture without delay. Deliver the mixture to the spreading Equipment by direct deposit into its receiving device, or by placing in uniform windrows in front of the Equipment.

(b) Road Mix - Place materials for each layer, add water and mix with motor grader until homogeneous mixture is achieved.

Do not place Aggregate shoulder material on the top Lift of newly constructed EAC or open-graded Pavement.

00641.42 Placing Aggregate Base or Subbase on Geotextile - When Subgrade or drainage geotextile is required between the Subgrade and Base, place the first Lift of material directly on the fabric, without road mixing.

00641.43 Thickness and Number of Layers:

(a) Aggregate Base Courses - If the required compacted depth of the Base Course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches unless approved.

Place each layer in spreads as wide as practicable and to the full width of the Course before a succeeding layer is placed.

(b) Aggregate Subbase Courses - The maximum compacted thickness of any one layer shall not exceed 9 inches unless approved.

(c) Shoulder Courses - Place Aggregates in Shoulder areas, other than as part of the Base Course, in one layer, or in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.

00641.44 Shaping and Compacting:

(a) Aggregate Base Courses:

(1) Dense-graded Aggregates - Begin compaction of each layer of dense-graded Aggregates immediately after the material is spread and continue until a density of not less than 95 percent of the maximum density has been achieved when tested according to the MFTP.

(2) Open-graded Aggregates - Compact the surface of each layer of open-graded Aggregates using rollers conforming to 00641.24. Roll until there is no appreciable reaction or yielding under the compactor.

Shape and maintain the surface of each Aggregate layer during the compaction operations to produce a finished surface meeting the requirements of 00641.45.

Apply additional water over the materials for proper compaction, according to Section 00340 and as directed.

(b) Aggregate Subbase and Shoulder Courses - Compact each layer of Aggregate Subbase and shoulder material until no reaction or yielding is observed under the compactor.

00641.45 Surface Tolerance - The finished surface of the Aggregate and the surface of each underlying layer shall parallel the established grade and Cross Section for the finished surface within 0.04 foot.

The finished surface of the compacted Aggregate, when tested with a 12-foot straightedge, shall not vary from the testing edge by more than 1/2 inch at any point. Furnish and operate the straightedge as directed.

Maintenance

00641.60 Care of the Work - After construction of each layer and completion of Base, maintain the layer to specified conditions and prevent or repair segregation, raveling, or rutting until it is covered with a following layer or until all Work is completed.

Measurement

00641.80 Measurement - The quantities of Aggregate mixture will be measured on the weight basis, on the volume basis, or on the area basis according to the following:

(a) Weight Basis - When measurement is by weight, quantities will be measured in the hauling vehicle, after mixing.

(b) Volume Basis - When measurement is by volume, quantities will be measured in the hauling vehicle.

(c) Area Basis - When measurement is by area, the quantity will be the number of square yards of Aggregate Base constructed to the full thickness. The surface area will be determined by horizontal measurements. Each area constructed with varying thicknesses, as directed or shown, will be adjusted by converting it to an equivalent area at the Pay Item thickness on a proportionate volume basis.

(d) Adjustment of Water in Mixture - If the water in the Aggregate mixture placed according to 00641.41(a) exceeds the percentage established in the mix design by more than 2 percent, the excess percentage of water will be deducted from the measurement of the mixture. Determination of excess water will be made by the same procedure used in setting the water content of the Mix Design under 00641.12 or converted to the equivalent volume.

If Aggregates are stationary plant mixed, no separate measurement will be made for water added at the plant to bring the material to optimum moisture content.

If Aggregates are road mixed, water used to bring the mixture to optimum moisture content will be measured according to 00340.80.

Payment

00641.90 Payment - The accepted quantities of Aggregates will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Aggregate Subbase	Ton or Cubic Yard
(b)	Aggregate Base	Ton or Cubic Yard
(c)	____ Aggregate Base	Ton or Cubic Yard
(d)	Plant Mix Aggregate Base	Ton or Cubic Yard
(e)	Plant Mix ____ Aggregate Base	Ton or Cubic Yard
(f)	Aggregate Shoulders	Ton or Cubic Yard
(g)	Aggregate Base, ____ Inches Thick	Square Yard

Items (b) and (d) will apply when the Contractor has the option of furnishing one or another of two or more designated sizes of Aggregates.

In items (c) and (e), the designated size of Aggregate to be used will be inserted in the blank.

In item (g), the depth of Aggregate Base will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for water used in the mixture, mixed and placed according to 00641.41(a), subject to the limitations of 00641.80(d).

No separate or additional payment will be made for water used in the care of the Work according to 00641.60.

00641.91 Material on Hand - Payment for stockpiled materials on hand may be allowed according to 00195.60, subject to the requirements of 00641.10, 00641.15, 00641.16(a), and subject to QA verification.

Section 00680 - Stockpiled Aggregates

Description

00680.00 Scope - This Work consists of furnishing crushed Rock or other Aggregates in stockpiles at the places and in the manner specified.

Materials

00680.10 Sources of Material - Obtain the material to be furnished in stockpiles from sources according to 00160.60.

00680.11 Aggregates - Furnish Aggregates meeting the following requirements:

(a) Aggregate Base and Shoulder Aggregate - Furnish Aggregates in stockpiles of the sizes specified and conforming to the requirements of 00641.10.

(b) Emulsified AC Aggregate - Furnish Aggregates in stockpiles of the following sizes or as specified:

1" - 1/2"
3/4" - 1/2"
1/2" - 1/4"
3/8" - 1/4"
3/8" - No. 4
3/8" - No. 8

Aggregates in stockpiles shall conform to the following requirements:

(1) Quality - Provide Aggregates meeting the requirements of 00715.10(a), (c), (d), (e) and (f).

(2) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide grading for the designated size Aggregate according to the following:

	Designated Sizes					
	1" - 1/2"	**3/4" - 1/2"**	**1/2" - 1/4"**	**3/8" - 1/4"**	**3/8" - No. 4**	**3/8" - No. 8**
Sieve Size	**Percent Passing (by weight)**					
1"	100	100				
3/4"	95 - 100	90 - 100	100			
1/2"	60 - 90	0 - 10	85 - 100	100	100	
3/8"	–	–	–	85 - 100	80 - 100	100
1/4"	15 - 30	0 - 2	0 - 15	0 - 15	10 - 40	–
No. 4	–	–	–	–	–	45 - 65
No. 8	0 - 7	–	0 - 4	–	0 - 6	0 - 10
No. 30	–	–	–	0 -2	0 - 2	–
No. 200	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2	0 - 2
No. 200 *	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1

* In gravels

00680.15 Aggregate Production Quality Control - Provide quality control during production of Aggregate according to Section 00165. Sampling and testing shall be performed by a CAgT at the minimum frequency schedule in the MFTP for Section 00641, or according to Section 00715, as applicable. Aggregates will be evaluated for compliance according to the following:

(a) Gradation - Analyze gradation statistically according to Section 00165. A stockpile contains specification Aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of Aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.

(b) Other Tests - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.

00680.16 Acceptance of Aggregate - The Contractor's quality control tests will be used for acceptance of Aggregates if verified by the Agency's quality assurance program. The Agency will perform Aggregate production quality assurance according to the following:

(a) ODOT-Administered Projects - Quality assurance testing on projects administered by ODOT will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Program.

(b) Projects Administered by Other Agencies - The quantity of quality assurance testing on projects administered by Agencies other than ODOT will be at the discretion of the Agency or as specified.

Equipment

00680.20 Rock Crusher - Comply with the following:

(a) Permits - Before crushing Rock for the Project, provide the Agency with copies of permits according to 00160.70.

(b) Crusher - Furnish Rock crushers capable of producing Rock meeting the Specifications. Use an impact crusher of sufficient size and capable of producing Aggregate in cubical form, free from sharp points or slivers.

00680.21 Conveyor - Provide conveyors capable of reaching a minimum distance of 70 feet, to stockpile sanding materials in sand sheds without segregation during stockpiling.

00680.22 Hauling Equipment - Provide vehicles for hauling crushed Aggregates capable of discharging the materials without segregation.

Labor

00680.30 Quality Control Personnel - Provide a technician having a CAgT technical certification.

Construction

00680.40 Preparation of Sites:

(a) Source Sites - Prepare and develop the source site according to the terms of the source permit and source development plan in the Special Provisions.

(b) Stockpile Sites - Clear, level, and prepare stockpile sites as directed.

00680.41 Piling of Materials - Place each separate designated size of material to be stockpiled at a given site in a separate stockpile. Locate each stockpile to occupy as small an area as practicable, and separate each pile so that working room will be adequate for removing the materials later. Height of the piles shall not be less than 8 feet, nor side Slopes flatter than 1V:1.5H, unless directed. Except in sand sheds, stockpile sanding materials to a height of 15 feet, or as directed.

Place the material in stockpiles with a minimum of segregation. Unless otherwise allowed, place the material in stockpiles in horizontal layers not more than 4 feet in thickness.

00680.42 Places of Delivery - Places of delivery and the tentative plans of distribution of the materials will be shown or specified.

00680.43 Agency's Right to Materials - If the Engineer finds it necessary, the Agency may take materials from stockpiles before the stockpiles have been completed and measured, or may take a part of the materials intended for placement in stockpiles, in trucks or other vehicles at the plant.

Finishing and Cleaning Up

00680.70 Cleaning Up Source Sites - Clean up the source sites according to the terms of the source permit and source development plan in the Special Provisions.

Measurement

00680.80 Measurement - The quantities of each designated size of Material will be measured according to the following:

- **Weight Basis** - When measurement is by weight, the quantities of each designated size of Material will be measured on the weight basis, in the hauling vehicle.

- **Volume Basis** - When measurement is by volume, the quantities of each designated size of Material will be measured on the volume basis, by cross section measurement or a digital terrain model of the completed neat stockpiles, with no allowance for settlement or shrinkage.

00680.81 Materials Taken from Stockpiles Prior to Completion - Materials taken by the Agency according to 00680.43 will be measured in the Agency's hauling vehicles. If measurement is on the volume basis, the vehicle measurement will be converted to equivalent stockpile measurement at the ratio of 1.00 cubic yard, vehicle measurement to 0.95 cubic yard, stockpile measurement. If measurement is on the weight basis, the weight will be determined in the same manner and by the same means as used in determining the weight of Materials stockpiled and paid for under the Contract.

Payment

00680.90 Payment - The accepted quantities of each size of specified Material will be paid for at the Contract unit price, per ton or cubic yard, for the item "____ Material In Stockpile".

The respective sizes of stockpiled Aggregates will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials in stockpiles and sand sheds, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for source development and clean-up, preparation of stockpile sites, hauling of stockpile materials, or placing materials in sand sheds.

PART 00700 - WEARING SURFACES

Section 00705 - Emulsified Asphalt Prime Coat and Emulsified Asphalt Fog Coat

Description

00705.00 Scope - This Work consists of applying asphalt, with or without Aggregate cover materials, to a prepared surface. The prime coat referred to in these Specifications is a penetration treatment to Aggregate surfaces to coat and bind the material into a hard surface. The fog coat referred to in these Specifications is a treatment applied to existing asphalt concrete Pavement surfaces to renew and seal the Pavement surface.

Materials

00705.10 Aggregate Cover Material - When required by the Special Provisions, furnish Aggregate cover material consisting of crushed or uncrushed Rock free of Clay, loam or other harmful substances and meeting the following gradation. Sieve analysis will be determined according to AASHTO T 27. Sieve analysis may be waived and the Aggregate cover material accepted visually if allowed by the Engineer.

Fine Cover		Coarse Cover	
Sieve Size	**Percent Passing (by Weight)**	**Sieve Size**	**Percent Passing (by Weight)**
3/8"	100	1"	100
1/4"	90 - 100	3/4"	90 - 100
No. 8	30 - 66	3/8"	55 - 75
No. 30	8 - 28	1/4"	40 - 60
No. 100	0 - 5	No. 8	*

* Of the fraction passing the 1/4 inch sieve, 40 to 60 percent shall pass the No. 8 sieve.

00705.11 Emulsified Asphalt - Furnish asphalt meeting the following requirements:

(a) General - Provide Emulsified Asphalt conforming to the requirement of ODOT's publication, *Standard Specifications for Asphalt Materials*. Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Obtain samples of Emulsified Asphalt according to AASHTO T 40, prior to dilution with water, at the frequency in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency, within 30 Calendar Days from the Day the sample was taken.

(b) Prime Coat - Provide CSS-1, CSS-1h, or CMS-2S Emulsified Asphalt for the prime coat.

(c) Fog Coat - Provide CSS-1, CSS-1h, or HFRS-P1 Emulsified Asphalt for the fog coat.

For every part Emulsified Asphalt, add not more than one part water. Add water at point of supply or point of application as directed, and mix with Emulsified Asphalt. The exact proportion of added water will be determined in a manner acceptable to the Engineer.

Equipment

00705.20 Equipment - Provide a pressure distributor, hauling vehicles, and other necessary Equipment to ensure efficient operation and construction to meet specified results. Provide Equipment in such number and capacities as will provide coordinated and uniform progress of the Work.

00705.21 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained, and operated so the Emulsified Asphalt material is applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor Equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

00705.22 Aggregate Spreaders - When Aggregate cover material is required, provide a mechanical spreading device that will spread the Aggregate cover material in a manner acceptable to the Engineer.

00705.23 Power Brooms - When Aggregate cover material is required, provide pickup or non-pickup type power brooms equipped with a positive means to control vertical pressure.

Construction

00705.40 Season and Weather Limitations - Do not place the prime coat or fog coat when the air temperature is below 60 °F, or when the Engineer determines that weather or surface conditions are detrimental to proper construction.

00705.41 Preparation of Underlying Surfaces - Prepare underlying surfaces according to the following:

(a) Prime Coats - Bring Aggregate bases and other bases or foundations, when constructed under the Contract, to the completed and finished condition according to the applicable Specifications.

Bring existing bases and foundations, constructed by others, to the applicable condition according to Section 00610, and within 0.04 foot of established grade and Cross Section.

(b) Fog Coats - Apply the fog coat to a clean and dry surface. Clean and remove all loose material by sweeping or other approved methods.

00705.42 Sequence of Operations - Construct the prime coat or fog coat with a single spread of asphalt followed immediately with a single spread of Aggregate cover material, if required.

00705.43 Application of Asphalt - Apply asphalt according to the following:

(a) Prime Coats - Apply asphalt at a uniform rate, normally within a range of 0.20 to 0.75 gallons per square yard of surface. The exact rate of application will be determined by the Engineer.

(b) Fog Coats - Apply the diluted Emulsified Asphalt within the range of 0.10 to 0.15 gallons per square yard. The exact rate of application will be determined by the Engineer.

Discontinue application of the Emulsified Asphalt fog coat sufficiently early in the Day to permit the termination of traffic control prior to sunset. Apply Emulsified Asphalt to only one designated Traffic Lane at a time.

00705.44 Spreading Aggregate Cover Material - When Aggregate cover material is required, spread the Aggregate cover material within the range of 0.004 to 0.013 cubic yards per square yard as directed.

Maintenance

00705.60 Curing, Maintaining and Opening Prime Coats to Traffic - Cure the prime coat for a minimum of 3 Calendar Days after construction, as directed, before a succeeding Course is placed upon it. If directed, traffic may be allowed to travel over the prime coat at any time after its construction. During the curing period, when in use by traffic and until it is covered by a succeeding Course, maintain the prime coat to the specified shape and condition, as directed.

00705.61 Power Brooming Fog Coats - Following the applications of all Aggregate cover material, carefully broom the entire surface unless brooming damages the fog coat, to remove loose Aggregate that could damage vehicles. Use a minimum of two power brooms.

Subsequent brooming the following 2 days may be directed by the Engineer to ensure that the surface is free of loose Aggregate that could cause vehicle damage.

In curbed areas, use a pickup type power broom. On Bridges, sidewalks and other areas off the roadway, remove all extraneous Aggregates to the satisfaction of the Engineer.

Measurement

00705.80 Measurement - The quantities of Emulsified Asphalt will be measured on the weight basis.

The quantities of Aggregate cover Material will be measured on the weight basis or on the volume basis in the hauling vehicle.

Payment

00705.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Emulsified Asphalt in Prime Coat	Ton
(b)	Emulsified Asphalt in Fog Coat	Ton
(c)	Aggregate Cover Material	Ton or Cubic Yard

Item (b) includes water required to dilute the Emulsified Asphalt, according to 00705.11(c).

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for materials used during the maintenance period.

Section 00706 - Emulsified Asphalt Slurry Seal Surfacing

Description

00706.00 Scope - This Work consists of applying one or more layers of slurry seal consisting of Emulsified Asphalt, water, Aggregate, and additives on a prepared surface as shown or directed.

Materials

00706.10 Emulsified Asphalt - Furnish CQS-1h Emulsified Asphalt meeting the following requirements when tested according to AASHTO T 59:

Saybolt Viscosity, seconds at 77 °F ..... 15 - 50
Residue from Distillation, Weight % ..... 57% minimum
Sieve Test, % Retained on No. 20 Sieve ..... 0.1 maximum
Particle Charge, Electroplate..... (informational)
Settlement (Storage Stability), 24 hour..... 1% maximum
Cement Mixing Test ..... (informational)

The residue shall meet the following Specifications:

Penetration at 77 °F, 3.5 ounces, 5 sec ..... 40 - 90 minimum
Solubility in CS_2 or TCE..... 97.5 minimum
Ductility at 77 °F, inch..... 15.7 minimum

00706.11 Polymer Modified Emulsion - Furnish CQS-1h polymer modified emulsion. The polymer modifier shall be either a solid synthetic rubber or latex material. Combine the polymer modifier with the base asphalt or asphalt emulsion, prior to loading at the manufacturing plant, at the minimum rate of 2.5 to 3 percent polymer solids by weight of asphalt. The polymer modified emulsion shall be compatible with the mix design developed for the conventional slurry seal. Each shipment of Emulsified Asphalt shall be accompanied by a certificate of analysis or certificate of compliance from the manufacturer.

00706.12 Aggregate - The Aggregate used shall be clean, angular, durable, well graded and uniform. The Aggregate shall consist of broken stone, crushed gravel, slag or a combination of them. To assure the material is totally crushed, 100 percent of the parent Aggregate shall be larger than the largest stone in the gradation to be used.

Aggregate gradation shall meet one of the following types:

Sieve Size	TYPE I - Parking Areas, Urban and Residential Streets, Airport Runways Percent Passing	TYPE II - Urban and Residential Streets, Airport Runways Percent Passing	TYPE III - Primary and Interstate Routes Percent Passing	Stockpile Tolerance
3/8"	100	100	100	0
No. 4	100	90 - 100	70 - 90	± 5%
No. 8	90 - 100	65 - 90	45 - 70	± 5%
No. 16	65 - 90	45 - 70	28 - 50	± 5%
No. 30	40 - 65	30 - 50	19 - 34	± 5%
No. 50	25 - 42	18 - 30	12 - 25	± 4%
No. 100	15 - 30	10 - 21	7 - 18	± 3%
No. 200	10.0 - 20.0	5.0 - 15.0	5.0 - 15.0	± 2.0%

The job mix gradation shall be within the gradation band for the desired type. After the target gradation has been submitted then the percent passing each sieve shall not vary by more than the stockpile tolerance and still remain within the gradation band.

00706.13 Additives and Mineral Filler - Liquid retardant and mineral fillers may only be used when their quantity can be metered. The use of additives in the slurry mix, (or individual materials), shall comply initially with the quantities predetermined by the mix design, or with field adjustments if required, after approval by the Engineer.

Portland cement, hydrated lime, limestone dust, fly ash or other approved filler required by the mix design shall meet the requirements of ASTM D242, and shall be considered as part of the dry Aggregate.

00706.14 Water - Water shall be potable, free of harmful salts and contaminants, and compatible with the slurry mix. Water used in mixing or curing shall be reasonably clean and free of oil, sugar, organic matter or other substance injurious to the finished product.

00706.15 Job Mix Formula - Prior to the pre-construction conference, submit a signed slurry seal mix design for the specific materials to be used on the Project. Show the percentages of each individual material required on the mix design report. The complete mix design shall be made with the same Aggregate gradation that will be used on the Project. After the mix design has been approved no substitution will be allowed unless approved. Water, not exceeding 11 percent by weight to asphalt emulsion, shall be used to develop a good mix.

(a) Laboratory Evaluation - Have the mix design prepared and tested by a laboratory which has experience in designing Emulsified Asphalt slurry seal Surfacing. Determine the proportions of component materials and perform the tests described in 00706.15(b). The final mix design shall meet the limits described in 00706.15(b) and 00706.15(c).

(b) Mix Design Tests:

Test	Description	Specification
ISSA TB-106	Slurry Seal Consistency	
ISSA TB-139 (For quick-traffic systems)	Wet Cohesion, 30 minutes set 60 minutes set	0.10 lb.-in. min. 0.17 lb.-in. min.
ISSA TB-109 (For heavy traffic areas only)	Excess Asphalt by LWT and Sand Adhesion	1 lb./sq. yd. max.
ISSA TB-114	Wet Stripping	Pass (90% minimum)
ISSA TB-100	Wet Track Abrasion Loss One hour soak	1.5 lb./sq. yd. max.
ISSA TB-113	Mix Time *	Controllable to 180 sec. minimum

* The mixing test and set time test should be done at the highest temperatures expected during construction.

The wet track abrasion test is used to determine the minimum asphalt content.

The mixing test is used to predict how long the material can be mixed in the machine before it begins to break.

The laboratory shall also report the quantitative effects of moisture content on the unit weight of the Aggregate (bulking effect). The report shall clearly show the proportions of Aggregate, the minimum and maximum proportions of mineral filler and water, additive usage, and asphalt emulsion based on the dry weight of the Aggregate.

All the component materials used in the mix design shall be representative of the materials proposed for use on the Project.

Show the percentages of each individual material required in the laboratory report. Adjustments may be required during the construction, based on the field conditions. The Engineer will give final approval for all such adjustments.

(c) Component Materials - The Engineer will approve the mix design, all slurry seal materials and methods prior to use. The component materials shall be within the following limits:

- **Residual Asphalt:**
  - Type I - 10% - 16%
  - Type II - 7.5% - 13.5%
  - Type III - 6.5% - 12%
  - Based on dry weight of Aggregate
- **Mineral Filler:**
  - 0.5% - 2.0%
  - Based on dry weight of Aggregate
- **Additives** - As needed.
- **Water** - As needed to achieve proper mix consistency. Total mix liquids shall not exceed the loose Aggregate voids. Use ISSA T106 to check optimum liquids.

00706.16 Tolerances and Limits - Tolerances for individual materials as well as the slurry seal mixture during production are as follows:

- After the designed residual asphalt content is determined, a plus or minus one percentage point variation will be allowed.
- The percentage of Aggregate passing each sieve shall be within the stockpile tolerance range as stated in 00706.12.
- The percentage of Aggregate passing shall not go from the high end to the low end of the specified range of any two successive sieves.
- The slurry consistency shall not vary more than plus or minus 0.2 inch from the job mix formula after field adjustments.
- The rate of application, once determined by the Engineer, shall not vary more than plus or minus 2 pound per square yard while remaining within the design application rate.

00706.17 Quality Control - Be responsible for quality control as required by Section 00165. Perform quality control sampling and testing as follows:

(a) QC/QA Slurry Seal Program - Test gradation, mixture, moisture, and asphalt according to the MFTP.

(b) Slurry Seal Production (Gradation):

- **Stockpile** - Every 60,000 square yards.
- **Tanker** - Every 60,000 square yards.
- **Mixture** - To be taken directly out of pug mill every 60,000 square yards.

(c) Verification Testing - If comparisons of test results are outside the allowable differences, the Contractor and Engineer will investigate the reason. The Engineer may stop production while the investigation is in progress if the potential for Pavement failure is present. The investigation may include review of calculation, testing of the remaining samples, review and observation of Contractor testing procedures and Equipment, and a comparison of sample test results.

Equipment

00706.20 Equipment - Provide suitable surface preparation Equipment, traffic control Equipment, hand tools and any other support Equipment required as necessary to perform the Work.

00706.21 Mixing Equipment - The machines shall be specifically designed and manufactured to lay slurry seal. Mix slurry seal in continuous pug mill mixers; a self-propelled machine specifically designed and manufactured to accurately deliver and proportion the Aggregate, Emulsified Asphalt, mineral filler, control setting additive and water to a revolving blade mixer that discharges the thoroughly mixed product on a continuous flow basis. Concrete transit mixer trucks shall not be used. Minimum slurry seal machine size shall be 7 cubic yards. In the case of Equipment failure have a minimum of two machines on-site with another off site for immediate backup. The machine shall be capable of mixing materials at pre-set proportions regardless of the speed of the machine and without changing machine settings.

The mixing machine shall be equipped with an approved fine feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the Aggregate is fed. Use the fine feeder whenever added mineral filler is a part of the Aggregate blend.

The mixing machine shall be equipped with a water pressure system and fog type spray bar adequate for complete fogging of the surface preceding spreading Equipment.

(a) Proportioning Devices - Provide and properly mark individual volume or weight controls, such as revolution counters or similar devices, for proportioning each material to be added to the mix (for example; Aggregate, mineral filler, additive, Emulsified Asphalt and water). Instruct the Engineer how to calculate the application rate per square yard utilizing the Contractor's proportioning devices.

(b) Calibration - Calibrate, in the presence of the Engineer, each slurry mixing unit to be used on the Project prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted by the Engineer provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machines metering devices. No machine will be allowed to Work on the Project until the calibration has been completed and/or accepted.

00706.22 Spreading Equipment - Spreader Box - Attach to the mixer machine a mechanical type squeegee distributor equipped with flexible material that is in contact with the Pavement surface to prevent the loss of slurry from the distributor. Adjust the distributor to prevent the loss of slurry on varying grades and crown and to assure uniform spread. There shall be a steering device and a flexible strike-off. The spreader box shall have an adjustable width. Keep the spreader box reasonably clean, and do not allow buildups of asphalt and Aggregate. Only one tail rubber will be allowed. Any type of drag used shall be subject to approval by the Engineer and kept in a completely flexible condition at all times.

00706.23 Rollers - If required by Special Provision, rollers shall be self-propelled, steel-wheeled or pneumatic-tired type and be equipped with a water spray system. Steel-wheeled rollers shall be capable of providing a weight of not less than 2,400 pounds per foot width of the compression roll or rolls. Pneumatic-tired rollers shall be capable of exerting a ground pressure of not less than 80 pounds per square inch of tire contact area.

Labor

00706.30 Quality Control Personnel - Provide a technician having a CAT-I technical certification.

Construction

00706.40 Weather Limitations - Do not apply the slurry seal if either the Pavement or air temperature is below 50 °F and falling. The slurry seal may be applied when both the Pavement and air temperature are above 45 °F and rising. Do not apply if there is a danger that the finished product will freeze before 24 hours. Do not apply when weather conditions prolong opening to traffic beyond a reasonable time. Do not apply in the rain. Replace slurry damaged by rain after application according to the Specifications, and as determined by Engineer, at no additional cost to the Agency. Clean the street of all remaining slurry mix materials prior to re-application.

Adjust the rate of application of the fog spray during the Day to suit temperatures, surface texture, humidity and dryness of Pavement surface. Do not spray additional water into the spreader box.

00706.41 Preparation of Surface - Submit details of the proposed street cleaning for approval by the Engineer prior to the preconstruction conference.

Remove any organic materials in cracks or joints not removed during crack sealing as part of the Pavement preparation.

Pavement preparation shall consist of removal of all oil spills, flushing and sweeping. Complete flushing, as needed, prior to sweeping. Finish sweeping with a vacuum sweeper no more than 24 hours prior to application of the slurry seal. If there is a delay of more than 48 hours between sweeping and slurry sealing caused by weather conditions or other unforeseen circumstances, re-sweep as determined by the Engineer, at no additional cost to the Agency.

Prepare the Pavement on which the slurry seal is to be placed as follows, as directed.

(a) Base Repairs - Where determined by the Engineer, excavate and replace Surfacing materials according to Section 00748.

(b) Surface Repairs - Where the Pavement is severely cracked, rutted, deformed or otherwise distressed, place a Leveling Course or patch using 3/4" or 1/2" ACP. The class of mix to be used shall conform to Sections 00744 and 00745, as applicable. Place the mixture according to Sections 00744 and 00745, as applicable.

(c) Crack Sealing - Clean and fill cracks 1/8 inch and larger inside the proposed slurry seal area.

(d) Tack Coat - On old, dry bituminous Pavements and on rigid Pavements, the Engineer may direct that tack coats be applied prior to placing the slurry seal. The tack coat shall be a diluted asphalt emulsion of the same type and grade specified for the slurry mix. The ratio of asphalt emulsion to water shall be 1:3. Apply the diluted material uniformly with a pressure distributor at a rate between 0.05 to 0.10 gallon per square yard, as determined by the Engineer. The tack coat shall be cured thoroughly prior to the application of the slurry seal.

(e) Street Equipment and Procedure - Immediately prior to applying the slurry seal, clear the surface of all loose material, silt spots, vegetation, oil spots and other objectionable material. Any standard cleaning method will be acceptable. If water is used, allow cracks to dry thoroughly before slurry sealing. The Engineer will approve the surface preparation prior to sealing.

(f) Utility Covers - Protect manholes, valve boxes, drop inlets and other service entrances from the slurry seal by a suitable method. Clean these covers as quickly as possible after the application of the slurry seal and definitely prior to the final set. If necessary, clean slurry residual from the interior of the utilities.

(g) Pavement Markings - Cover, or remove, all reflector buttons before slurry seal is to be applied to any area, as determined by the Engineer. Cover all thermo-tape markings and do not slurry seal over, or remove and replace as directed. Remove all paint pavement markings to prevent bleeding through the slurry seal and to allow proper adhesion.

00706.42 General - The surface may be wetted by fogging ahead of the slurry box, if required by local conditions. Apply water used in wetting the surface at such a rate that the entire surface is damp with no apparent flowing water in front of the slurry box. The slurry mixture shall be of the desired consistency upon leaving the mixer. Do not add additional elements. Carry a sufficient amount of slurry in all parts of the spreader at all times so that complete coverage is obtained. Do not allow lumping, balling or unmixed Aggregate in the spreader box. Do not allow segregation of the emulsion and Aggregate fines from the coarse Aggregates. If the coarse Aggregate settles to the bottom of the mix, remove the slurry from the Pavement. Do not allow excessive breaking of the emulsion in the spreader box. Do not leave streaks, such as caused by oversized Aggregate, in the finished Pavement. Maximum mixing time in the pug mill shall be 4 minutes.

00706.43 Application Rate - The minimum rate of application of dry Aggregate per square yard will be determined by the Engineer. The depth of the slurry seal shall be sufficient to correct surface conditions, fill surface voids, and provide sealing and a minimum wearing surface. The maximum allowable vehicle speed for the rate of application shall be 180 feet per minute. Failure to demonstrate

the proper rate of application will result in suspension of the Work until the Contractor can demonstrate otherwise, at no additional cost to the Agency.

ISSA TB112 gives a method to determine expected application rates.

The slurry seal mixture shall be of proper consistency at all times to provide the application rate required by the surface condition. The average application rate, as measured by the Engineer, shall be according to the following table:

	Recommended Use	Application Rate
TYPE I	Parking Areas, Urban and Residential Streets, Airport Runways	6.7 - 10.0 lbs./sq. yd.
TYPE II	Urban and Residential Streets, Airport Runways	10.0 - 16.7 lbs./sq. yd.
TYPE III	Primary and Interstate Routes	15.0 - 25.0 lbs./sq. yd.

00706.44 Applying Slurry Seal Sample Strip - The strip shall consist of two Panels approximately 50 feet long, placed side by side to form a typical seam between them. The width of the Panels shall be the same as the Contractor plans to use on the streets. Place the strip at least 24 hours prior to the beginning of the actual Work. Use the strip to calculate and monitor the rate of application in relation to weight of material per area, and to define the speed of the Equipment related to the rate of application. If it is determined by the Engineer on the basis of this test strip that there are deficiencies in the mix design, method of application and rate of application, the Engineer may require the Contractor to revise the mix design, or repair or modify the Equipment or application. After all changes are made, lay a new sample strip.

00706.45 Joints - Construct a uniform line along the edge and a good seal at curb lines. Construct the flow line at curbs to allow storm drainage flow to catch basins without bonding along the curb line. In the case of a concrete gutter, cover the gutter line joint with the slurry seal, but do not overlap onto the gutter. Remove any overlap, as determined by the Engineer, at no additional cost to the Agency. Streets that have been recently slurry sealed that cross this Project shall not be slurry sealed again.

The slurry joints and Panels shall be straight, neat and uniform and follow the contour of the existing curb or concrete gutter. The width of the Panels shall be the same as demonstrated in the sample strip. Floating (adding additional water other than what is required for the approved mix design) of the emulsion or slurry mixture in the pug mill and/or spreader box to cover or overlap missed areas will be prohibited. Keep lines straight at intersections to provide a good appearance.

00706.46 Handwork - Use approved squeegees to spread slurry in areas not accessible to the slurry mixer.

Limit handwork at the beginning and end of the Panels to prevent segregation of the Rock from the emulsion and to minimize cosmetic drag mop marks and/or defects in the finished product.

The same type finish as applied by the spreader box shall be required. Complete handwork prior to setting of the slurry.

00706.47 Curing - The rate of curing of the slurry seal shall be such that a street may be opened to traffic after application without tracking or damage to the surface. Protect the area for the full curing period with suitable barricades or markers.

The Agency will not be responsible for any damage to the slurry seal prior to opening the area. Repair all damage to the slurry, to the satisfaction of the Engineer, at no additional cost to the Agency.

00706.48 Rolling - If required by Special Provision, apply a minimum of two full coverage Passes to the surfaced areas by the roller, or as directed.

00706.49 Cleanup - Remove all debris associated with the performance of the Work on a daily basis.

Temporary

00706.51 Provision for Traffic - Be responsible for notifying all abutting property owners along the streets according to the approved schedule, or an approved revision of the schedule, 48 hours prior to the specific Work.

Remove all traffic control promptly when it is determined that the street may be open to traffic. Do not seal any street that requires closing overnight without the approval of the Engineer.

If the slurry seal does not cure in a timely manner and remains trackable overnight, apply a covering of 1/4 inch minus material to prevent tracking and related property damage prior to permitting traffic on the street at no additional cost to the Agency.

Be responsible for all damage to the uncured slurry or to private or public property due to tracking of the uncured material.

Measurement

00706.80 Measurement - Crack sealing will be measured on the length basis, of material in place.

Slurry seal will be measured on the area basis.

Asphalt concrete Pavement repair will be measured according to 00748.80.

Payment

00706.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Slurry Seal Crack Sealing	Foot
(b)	Slurry Seal	Square Yard

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Asphalt concrete Pavement repair will be paid for according to 00748.90.

When the Contract Schedule of Items does not indicate payment for Work under this Section, no separate or additional payment will be made. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00710 - Single Application Emulsified Asphalt Chip Seal

Description

00710.00 Scope - This Work consists of applying Emulsified Asphalt and graded Aggregates as shown or directed.

The chip seal design will be designated on the Plans or in the Special Provisions.

Materials

00710.10 Aggregates - Furnish Aggregates meeting the following requirements:

(a) Size Designation - Provide the size of Aggregate for the single application Emulsified Asphalt chip seal design designated in the Plans or Special Provisions according to the following:

Chip Seal Design	Size of Screenings
Fine	3/8" - No. 8
Single Size Medium	3/8" - 1/4"
Graded Medium	3/8" - No. 4
Coarse	1/2" - 1/4"

(b) Fractured Faces - Provide Aggregates consisting of broken stone, crushed gravel or a combination of both. Crush Aggregate such that at least 90 percent by weight of the total Aggregate retained on the No. 8 and larger sieves is fractured on two faces, as determined according to AASHTO T 335.

(c) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide grading for the designated single application Emulsified Asphalt chip seal design according to the following:

Sieve Size	Coarse 1/2" - 1/4"	Single Size Medium 3/8" - 1/4"	Graded Medium 3/8" - No. 4	Fine 3/8" - No. 8
	Percent Passing (by Weight)			
3/4"	100			
1/2"	85 - 100	100	100	
3/8"	–	85 - 100	80 - 100	100
1/4"	0 - 15	0 - 15	10 - 40	–
No. 4	–	–	–	45 - 65
No. 8	0 - 4	–	0 - 6	0 - 10
No. 30	–	0 - 2	0 - 2	–
No. 200 (wet)	0.0 - 2.0	0.0 - 2.0	0.0 - 2.0	0.0 - 2.0
No. 200 (wet) *	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0

* in gravels

(d) Unit Weight of Aggregate - Provide Aggregate with a minimum unit weight of 90 pounds per cubic foot according to AASHTO T 19.

(e) Soundness - Provide coarse and fine Aggregate with a weighted loss not exceeding 12 percent when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

(f) Durability - Provide Aggregates meeting the following durability requirements:

Test	Test Method ODOT	Test Method AASHTO	Maximum Values
Abrasion		T 96	30.0%
Degradation (coarse Aggregate)			
Passing No. 20 Sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(g) Harmful Substances - Provide Aggregates meeting the following harmful substances requirements:

Test	Test Method ODOT	Test Method AASHTO	Limits
Lightweight Pieces		T 113	1.0% maximum
Wood Particles	TM 225		0.1% maximum
Elongated Pieces (coarse Aggregate at a ratio of 5:1)	TM 229		10.0% maximum
Cleanness Value	TM 227		75 minimum

(h) Taking Aggregates from Agency Stockpiles - When it is specified that Aggregates are to be taken from Agency-controlled stockpiles, take the material in an orderly manner. Do not contaminate the materials. Salvage all material possible from the area which the material is taken. Shape unused portions of a stockpile to Neat Lines. The Contractor will be charged for materials wasted through negligence or used without authority.

(i) Stockpiling Contractor Furnished Aggregates on Agency Property - Aggregates may be temporarily stockpiled at approved sites on Agency property provided the areas used are as small as practicable. Restore the site to its original condition after the materials have been removed. Any contamination during storage or from reloading operations will be cause for rejection.

00710.11 Emulsified Asphalt - Furnish polymer-modified Emulsified Asphalt or non-polymer-modified Emulsified Asphalt as specified for the single application Emulsified Asphalt chip seal design designated in the Plans or Special Provisions. When non-polymer- modified Emulsified Asphalt is designated, the Contractor may elect to substitute a polymer-modified Emulsified Asphalt, however, selection of the polymer-modified Emulsified Asphalt will not be cause for additional compensation.

(a) Non-Polymer-Modified Emulsified Asphalt - When non-polymer-modified Emulsified Asphalt is specified, use CRS-2 or HFRS-2 Emulsified Asphalt as the Contractor elects.

(b) Polymer-Modified Emulsified Asphalt - When polymer-modified Emulsified Asphalt is specified, use CRS-2P or HFRS-P1 as the Contractor elects.

(c) Acceptance of Emulsified Asphalt - Provide Emulsified Asphalt conforming to the requirements of ODOT's publication, *Standard Specifications for Asphalt Materials*. Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable Specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the Emulsified Asphalt or excessive pumping of the Emulsified Asphalt may significantly reduce the viscosity and may make the material unsuitable for chip seal

use. For this reason limit pumping between the bulk storage tank, hauling transportation, field storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of Emulsified Asphalt will be at the point of application.

Obtain samples of Emulsified Asphalt according to AASHTO T 40 at the frequency in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency. Non-polymer-modified Emulsified Asphalt will be tested within 30 Calendar Days from the date it is sampled. Polymer-modified Emulsified Asphalt will be tested within 14 Calendar Days from the date it is sampled.

00710.15 Aggregate Production Quality Control - Provide quality control during production of Aggregate according to Section 00165. Sampling and Testing shall be performed by a CAgT at the minimum frequency schedule in the MFTP.

(a) Quality Control Compliance - Evaluate Aggregates for compliance according to the following:

(1) Gradation - Analyze gradation statistically according to Section 00165. A stockpile contains specification Aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of Aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.

(2) Other Tests - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.

(3) Preproduced Aggregate - Compliance of Aggregates produced and stockpiled before the Award of this Contract will be determined by either of the following:

- Continuing production records meeting the requirements of 00710.10 and 00710.15.
- Sampling according to AASHTO R 90 and testing the entire stockpile at the minimum frequency schedule in the MFTP. The material shall meet the requirements of 00710.10 and 00710.15.

(b) Materials on Hand - Payment for stockpiled materials on hand may be allowed as described in 00195.60 subject to meeting the requirements of 00710.10 and 00710.15.

00710.16 Acceptance of Aggregate - The Contractors quality control tests will be used for acceptance of Aggregates if verified by the Agency's quality assurance program. The Agency will perform Aggregate production quality assurance according to the following:

(a) ODOT Administered Projects - Quality assurance testing on ODOT administered projects will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Program.

(b) Projects Administered by Other Agencies - The quantity of quality assurance testing on projects administered by other Agencies will be at the discretion of the Agency or as designated in the Special Provisions.

Equipment

00710.20 Equipment - Provide a pressure distributor, hauling vehicles, chip spreader, compactors, power brooms and other necessary Equipment to ensure efficient operation and construction to meet specified results. Provide Equipment in sufficient number and capacities that will provide coordinated and uniform progress of the Work.

Provide two-way radio communication between the asphalt distributor and chip spreader.

00710.21 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained and operated so the Emulsified Asphalt material may be applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 - 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor Equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

00710.22 Chip Spreaders - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the Aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders equipped with an Aggregate segregator assembly. Chip spreaders without an Aggregate segregator assembly may be allowed if approved by the Engineer. Provide chip spreaders of adequate width to provide full coverage of the specified Panel and without placing joints in the travel lanes.

00710.23 Compactors - Provide self-propelled pneumatic-tired or steel-wheeled rollers in good condition and capable of operating at speeds compatible with the chip seal operation. A minimum of two pneumatic-tired rollers and one steel-wheeled roller is required.

(a) Pneumatic-tired Rollers - Provide self-propelled, tandem or multiple axle, multiple wheel type pneumatic-tired rollers with smooth-tread pneumatic tires of equal size. The tires shall be staggered on the axles at such spacings and overlaps that will provide uniform compacting pressure for the full compacting width of the roller. The minimum load per tire shall be 2,800 pounds, with tire inflation pressures of 45 psi to 90 psi.

(b) Steel-wheeled Rollers - Provide steel-wheeled rollers with a gross static weight of at least 8 tons.

00710.24 Power Brooms - Provide pickup or non-pickup type power brooms equipped with a positive means to control vertical pressure.

Labor

00710.30 Quality Control Personnel - Provide a technician having a CAgT technical certification.

Construction

00710.40 Season and Weather Limitations - Do not apply Emulsified Asphalt when the Pavement temperature is below 70 °F, or if the humidity is higher than 75 percent. Complete the application of the Emulsified Asphalt and the Aggregate 3 hours before sunset. Remove by milling, or other methods approved by the Engineer, and replace all chip seals damaged by weather during the first 24 hours after application at no additional cost to the Agency. The placing of single application Emulsified Asphalt chip seal will not be allowed before July 1 or after August 31.

00710.41 Rate of Progress and Scheduling - Do not apply more chip seal in any 1 Day than can be broomed the following morning, unless approved by the Engineer. Provide a traffic control plan for approval by the Engineer if operations exceed 3 centerline miles or 6 lane miles per Day.

00710.42 Preparation of Underlying Surfaces - Immediately before applying the Emulsified Asphalt, clean and dry the surface to be treated in a manner approved by the Engineer.

00710.43 Sequence of Operations - Construct the single application Emulsified Asphalt chip seal with a single spread of Emulsified Asphalt followed immediately with a single spread of Aggregate and initial rolling, unless otherwise directed by the Engineer. Chip seal is not required for guardrail flares, driveways, or other irregular areas as directed.

00710.44 Application Rates - Apply the Emulsified Asphalt and spread the Aggregate within the following ranges of rates for the specified chip seal design. The exact application and spread rate will be determined by the Engineer.

Chip Seal Design	Emulsified Asphalt Application Rate (gal./sq. yd.)	Aggregate Spread Rate (cu. yd./sq. yd.)
Fine	0.25 - 0.40	0.004 - 0.009
Single Size Medium	0.40 - 0.65	0.005 - 0.015
Graded Medium	0.40 - 0.65	0.005 - 0.015
Coarse	0.33 - 0.70	0.009 - 0.018

00710.45 Applying Emulsified Asphalt - Apply Emulsified Asphalt at the rates specified in 00710.44 and according to the following:

- Apply the Emulsified Asphalt working toward the Aggregate stockpile at all times, unless otherwise approved by the Engineer.
- Leave a minimum of 200 gallons of Emulsified Asphalt in the distributor tank at all times.
- Do not apply Emulsified Asphalt to more than one-half the width of the travel way at one time with the remaining width remaining open to traffic. Do not close the open lane until traffic controlled by pilot car is operating on the new chip seal. Apply the chip seal, weather permitting, to both sides of the travel way so that the end of the Work is squared up 3 hours before sunset.
- Do not apply Emulsified Asphalt a greater distance than can be immediately covered by Aggregates before the emulsion breaks.
- Place building paper over the treated surface at the beginning of each spread to ensure that the nozzles are operating properly before the uncovered surface is reached. Remove and dispose of building paper in a manner satisfactory to the Engineer.
- If requested by the Engineer, demonstrate that the distribution of the Emulsified Asphalt does not vary between the individual nozzles by more than 15 percent transversely from the average, and no more than 10 percent longitudinally from the specified rate of application.
- Apply the Emulsified Asphalt at a temperature between 140 °F and 185 °F as recommended by the manufacturer.

00710.46 Hauling and Spreading Aggregates - Spread Aggregates at the rates specified in 00710.44.

Do not operate hauling and spreading Equipment on uncovered Emulsified Asphalt. During the first hour after application of the Emulsified Asphalt and Aggregate, operate at speeds no more than 10 mph and after the first hour, not more than 15 mph until otherwise allowed by the Engineer. Carefully operate hauling Equipment at all times, at moderate speeds that will not damage the new

chip seal or create a hazard to the traveling public. Route hauling Equipment and pilot lines as uniformly as possible over the full width of the new surface in place.

Calibrate the gate opening, gear selection and engine RPM of the chip spreaders for the various sizes of Aggregate to be used. Following calibration, verify the rate of application by a method acceptable to the Engineer.

Immediately cover the Emulsified Asphalt surface with Aggregate unless otherwise authorized by the Engineer. Maintain the rate of spread of this Aggregate within 10 percent of specified rate. Using approved methods, remove or repair Emulsified Asphalt that has set or "broke" before being covered with Aggregate, at no additional cost to the Agency.

Aggregates shall be surface damp at the time of application. Excess free water (water not adhering to the Aggregate surface) on the Aggregate will not be allowed.

Do not operate the chip spreader at speeds which cause the chips to roll over after striking the emulsion covered surface.

Provide coverage without gaps or overlapping adjacent coverages. Do not construct longitudinal joints within the travel lanes.

Construct neat transverse cut off of Aggregates and remove any excess Aggregates from the surface prior to resuming operations.

00710.47 Shaping and Compacting - After the Aggregates have been placed on the Emulsified Asphalt, spread or remove all piles, ridges, or uneven distribution to ensure against rough spots in the final surface.

Compact the surface with a minimum of two coverages with a pneumatic-tired roller and one coverage with a steel-wheeled roller. Continue compacting until the material is interlocked, firm and partially bound with the underlying Emulsified Asphalt. The sequence of roller coverages may be adjusted at the discretion of the Engineer.

Operate rollers at speeds such that the rollers do not pick up Aggregates from the surface. Do not exceed rolling speeds of 5 mph.

In the event Aggregates begin to pick up under traffic or from the rolling operation, immediately cover and roll the area with additional quantities of Aggregate.

Maintenance

00710.60 Power Brooming - Following the application of the chip seal, carefully broom the entire surface to remove loose Aggregate. Discontinue the operation if brooming damages the chip seal. Use a minimum of two power brooms.

Subsequent brooming the following 2 days may be directed by the Engineer to ensure that the surface is free of loose Aggregate that could cause vehicle damage.

In curbed areas, use a pick-up type power broom. On Bridges, sidewalks and other areas off the roadway, remove all loose Aggregates to the satisfaction of the Engineer.

Measurement

00710.80 Measurement - The quantities of Aggregate will be measured on the weight basis or on the volume basis in the hauling vehicle.

The quantities of Emulsified Asphalt will be measured on the weight basis.

The quantities of asphalt chip seal of approaches will be measured on the unit basis for each street connection and road approach.

Payment

00710.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Aggregate in Emulsified Asphalt Chip Seal	Ton or Cubic Yard
(b)	Asphalt in Emulsified Asphalt Chip Seal	Ton
(c)	Extra for Emulsified Asphalt Chip Seal Approaches	Each

Item (c) applies to the extra costs of placing the Aggregates and asphalt in single application Emulsified Asphalt chip seals only on street connections and road approaches. Payment will be in addition to payment made for the Materials used in the Work.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for preparing the road surface, placing Materials in final position, or brooming.

Section 00711 - Pre-Coated Aggregate Asphalt Chip Seal

Description

00711.00 Scope - This Work consists of applying a chip seal using a modified hot asphalt binder and precoated graded Aggregate as shown.

Materials

00711.10 Aggregates - Furnish Aggregate meeting the following requirements:

(a) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide Aggregate meeting the following gradation:

Sieve Size	3/8" - No. 4 Percent Passing (by Weight)
1/2"	100
3/8"	85 - 100
No. 4	0 - 15
No. 8	0 - 5
No. 200 Wet	0 - 1.5

(b) Fractured Faces - Provide Aggregate consisting of broken stone, crushed gravel, or a combination of both. Crush Aggregate such that at least 90 percent by weight of the total Aggregate retained on the No. 8 and larger sieves is fractured on two faces, as determined according to AASHTO T 335.

(c) Unit Weight of Aggregate - Provide Aggregate with a minimum unit weight of 90 pounds per cubic foot according to AASHTO T 19.

(d) Soundness - Provide Aggregate with a weighted loss not exceeding 12 percent when subjected to five cycles of the soundness test using sodium sulfate according to AASHTO T 104.

(e) Durability - Provide Aggregate meeting the following durability requirements:

Test	Test Method ODOT	 AASHTO	Maximum Values
Abrasion		T 96	30.0%
Degrade (Plus No. 4) Passing No. 20 Sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(f) Harmful Substances - Provide Aggregate meeting the following harmful substances requirements:

Test	Test Method ODOT	 AASHTO	Limit
Lightweight Pieces		T 113	1.0% maximum
Wood Particles	TM 225		0.1% maximum
Elongated Pieces (5:1 ratio)	TM 229		10.0% maximum
Cleanness Value	TM 227		75 minimum

00711.11 Asphalt Binder - Furnish AC15-5TR or AC-15P asphalt conforming to the requirements of ODOT's publication *Standard Specifications for Asphalt Materials*. Copies of the publication are available from ODOT's website. The applicable Specifications are those contained in the current publication on the date the Project is advertised.

00711.12 Asphalt and Additives for Pre-Coated Aggregate - Furnish PG64-22 grade asphalt to pre coat the Aggregate meeting the requirement of ODOT's publication, *Standard Specifications for Asphalt Materials*. Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable Specifications are those contained in the current publication on the date the Project is advertised.

Obtain samples of asphalt according to AASHTO T 40 when requested by the Engineer. Samples may be tested at the discretion of the Engineer at the Agency's expense.

00711.15 Aggregate Production Quality Control - Provide quality control during production of Aggregates according to Section 00165. Have a CAgT sample and test according to the MFTP section 4(D), for section 00710 materials. Statistically evaluate the Aggregates according to Section 00165.

00711.16 Acceptance of Aggregate - The Contractors quality control tests will be used for acceptance of Aggregates if verified by the Agency's quality assurance program. The Agency will perform Aggregate production quality assurance according to Section 00165, the MFTP, and section 00710.16 of the ODOT Quality Assurance Program.

Obtain asphalt binder samples according to AASHTO T 40 at a frequency of one sample for each 50 tons of asphalt binder used. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency.

00711.17 Pre-Coated Aggregate Mixture - Pre-coat, cure, store, and maintain the pre-coated Aggregate mixture according to the following:

- Waste all bag house dust during production of the pre-coated Aggregate mixture.
- Use an asphalt hot plant to coat the Aggregate with asphalt.
- Achieve at least a 90 percent coating on all the material retained on the No. 4 sieve by applying between 0.7 and 1.0 percent liquid asphalt of the total weight of the material. Establish the target value and obtain the Engineer's approval before beginning the coating process. The acceptable liquid asphalt tolerance is ± 0.2 percent. Test according to ODOT TM 321 at a frequency of one test for every 500 tons of mixture. Coated Aggregate that is not within the acceptable tolerance will be rejected.
- Maintain the plant dryer temperature between 190 °F and 230 °F. Maintain the liquid asphalt temperature at the liquid asphalt Supplier's recommended temperature.
- The maximum moisture content of the pre-coated Aggregate mixture is limited to 1.3 percent. Test according to AASHTO T 329 at a frequency of one test for every 500 tons of mixture.
- After pre-coating, stockpile, cool, and cure the Aggregate mixture for at least 7 Calendar Days before using it.
- Use multiple stockpiles to store the pre-coated Aggregate mixture. Do not place additional pre-coated Aggregate mixture into an existing stockpile until the temperature of the additional pre-coated Aggregate mixture is no more than 140 °F.
- Turn the pre-coated Aggregate mixture with a loader or other means to accelerate cooling, to increase uniformity of the coating on the Aggregates, to avoid heat buildup, and to prevent burning of the asphalt coating. Excessive clumping may require re screening of the mixture

before acceptance. If excessive dust is encountered when placing the pre-coated Aggregate mixture, re-screen it at the stockpile site.

- Final acceptance of the pre-coated Aggregate mixture will be completed at the stockpile staging site.

Equipment

00711.20 Equipment - Provide pressure distributors, hauling vehicles, chip spreader, compactors, power brooms and other necessary Equipment to insure efficient operation and construction to meet specified results. Provide Equipment in sufficient number and capacities that will provide coordinated and uniform progress of the Work.

Provide two-way radio communication between the asphalt distributor and chip spreader.

00711.21 Asphalt Distributors - Provide asphalt distributors that are:

- Designed, equipped, maintained, and operated so the asphalt material may be applied uniformly at even heat, and in a continuous operation.
- Capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 - 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard.
- Equipped with a tachometer, pressure gages, accurate volume measuring devices, and a thermometer for measuring temperature of tank contents.
- Equipped with a Computer Rate Control device.
- Equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically.

Set the bar height for triple lap coverage.

Demonstrate to the Engineer that the asphalt distributors are properly calibrated before beginning Work.

00711.22 Chip Spreaders - Provide chip spreaders that are:

- Self-propelled, computerized chip spreaders, and with a screenings hopper in the rear and a belt conveyor to carry the screenings to the front of the spreader hopper. Rear screens may be removed at the direction of the Engineer if excess build-up occurs.
- Capable of providing a uniform spread rate over the entire width of the Traffic Lane in one application.
- Equipped with an Aggregate segregator assembly unless otherwise allowed by the Engineer.
- Of adequate width to provide full coverage of the specified Panel without placing joints in the travel lanes.
- Equipped with a surface temperature thermometer which reads the surface temperature in advance of Rock placement, and be visible to the chip spreader operator.

Provide verification to the Engineer that the chip spreaders are properly calibrated before beginning Work.

00711.23 Compactors - Provide at least three rollers for multiple Pass operations and at least five rollers for continuous operations meeting the following requirements:

- Be self-propelled pneumatic-tired in good condition and capable of operating at speeds compatible with the chip seal operation.
- Be tandem or multiple axle, multiple wheel type pneumatic-tired rollers with smooth-tread pneumatic tires of equal size.
- Have staggered tires on the axles at spacing and overlaps that will provide uniform compaction pressure for the full compacting width of the roller.
- Have minimum load per tire of 2,800 pounds, with tire inflation pressures of 45 to 100 psi.
- Maintained air pressure to not vary more than ± 5 psi in each tire per machine.

00711.24 Power Brooms - Provide at least four pickup or non-pickup type power brooms equipped with a positive means to control vertical pressure.

00711.25 Asphalt Storage Tank - Provide a heated asphalt storage tank in close proximity to Project.

Labor

00711.30 Quality Control Personnel - Provide a technician having a CAgT technical certification.

00711.31 Technical Representative - Provide a qualified technical representative from the asphalt binder Supplier, on site, during all chip seal operations. The technical representative duties are to assist the Engineer in establishing the asphalt binder and pre-coated Aggregate mixture application rates and to provide input on the temperatures for the application of the asphalt binder coat.

Construction

00711.40 Season, Weather and Temperature Limitations - Construct the chip seal in warm dry weather. Apply the hot asphalt binder only when the ambient temperature is 70 °F or higher and the Pavement surface temperature, in the sun and shade is 75 °F or higher. Do not apply if the road surface is wet or if rain is predicted. If unexpected rain does occur during application, shut off the asphalt distributor but continue with pre-coated Aggregate mixture placement until all newly sprayed asphalt binder has been covered. Do not resume the chip seal operation for at least 2 days and when allowed by the Engineer.

00711.41 Rate of Progress and Scheduling - Do not apply more chip seal in any one Day than can be broomed the same Day.

00711.42 Preparation of Underlying Surfaces - At the beginning of the shift, clean the surface to be treated of all loose material by brooming.

00711.43 Sequence of Operations - Construct the chip seal as follows:

- Apply the binder.
- Distribute the pre-coated Aggregate mixture.
- Compact it with pneumatic tired rollers.

When applying the asphalt binder at intersections, turn pockets, gore points, and other irregular areas do not apply the asphalt binder in excess of what can be covered with the pre-coated Aggregate mixture within the appropriate temperature range of the asphalt binder.

00711.44 Application Rates - Apply the asphalt binder and spread the pre-coated Aggregate mixture within the following ranges of rates. The exact application and spread rate will be determined by the Engineer.

Asphalt binder application rate.....0.35 to 0.45 gallon per square yard

Pre coated Aggregate mixture spread rate .....10 to 20 pounds per square yard

00711.45 Applying Asphalt Binder Coat - Place asphalt binder to the road surface with a pressure distributor at the rates specified and according to the following:

- Apply to no more than one-half the width of the travel way at one time.
- Apply so the longitudinal joint between adjacent applications of asphalt binder and pre-coated Aggregate mixture coincides with the line between designated Traffic Lanes.
- Apply asphalt binder at a distance that allows the pre-coated Aggregate mixture to be applied at the binder surface temperature listed in 00711.46. Do not operate hauling and spreading Equipment on uncovered asphalt binder.
- Apply at a temperature between 330 °F and 370 °F or as recommended by the asphalt binder Supplier. Do not elevate the asphalt binder above 330 °F for more than a 4 hour period or a temperature or time period recommended by the asphalt binder Supplier.
- Clean all joints of excess loose material before applying the asphalt binder.
- Construct joints without ridges and depressions and have uniform appearance consistent with the adjacent sealed surface. Correct all defects at no cost to the Agency.
- Place building paper over the treated surface at the beginning of each spread for each distributor to insure that the nozzles are operating properly before the uncoated surface is reached. Remove and dispose of building paper according to Section 00290.

00711.46 Hauling and Spreading Aggregates - Haul and spread the pre-coated Aggregate mixture at the rates specified and the following:

- Periodically verify the gate opening to be sure a consistent spread rate is maintained. Maintain the pre-coated Aggregate mixture spread rate within ± 5% of the established rate.
- Operate hauling Equipment at speeds that will not damage the new chip seal. Route hauling Equipment and pilot car traffic as uniformly as possible over the full width of the new surface.
- Cover the asphalt binder surface with pre-coated Aggregate mixture when the asphalt binder surface temperature is between 130 °F and 180 °F.
- Uniformly spread pre-coated Aggregate mixture to provide coverage without gaps or overlapping adjacent coverages. Do not construct longitudinal joints within the travel lanes.

Construct neat transverse cut off of pre-coated Aggregate mixture and remove all excess Aggregate from the surface before resuming operations.

00711.47 Shaping and Compacting - After the pre-coated Aggregate mixture has been spread on the asphalt binder surface, remove all piles, ridges, and uneven surfaces.

Make the initial compaction Pass behind the spreader as soon as the pre-coated Aggregate mixture is spread. Hauling Equipment may be used to assist in compaction immediately behind the spreader. Use sufficient pneumatic rollers to cover the width of the pre-coated Aggregate mixture spread in one Pass. Roll in a staggered pattern. Operate rollers to maintain close proximity to the spreader but do not exceed 5 mph. Complete at least three roller Passes within 30 minutes of spreading pre-coated Aggregate mixture. If rollers are unable to keep up with the spreader, stop application of asphalt binder and pre-coated Aggregate mixture until to rollers catch up or furnish additional rollers. If

pre-coated Aggregate mixture spreading is stopped for more than 2 minutes, move the spreader ahead of or off the surface so that cover material may be immediately rolled.

Maintenance

00711.60 Power Brooming - After rolling the pre-coated Aggregate mixture, remove loose Aggregate by brooming the entire surface. Delay brooming if the brooms damage the surface. Broom one Pass in the opposite direction in which the pre-coated Aggregate mixture was placed. Do not allow uncontrolled traffic on the surface until all brooming of excess Aggregate is completed.

Subsequent brooming may be required for up to 2 days after placement as directed.

Seven Calendar Days after completion of a section of chip seal, remove all loose Aggregate from the Shoulder area by brooming.

On Bridges, barrier areas, minimum width Median areas, and curbed areas, use a pick-up type power broom. On Bridges, sidewalks, and other areas off the roadway, remove all loose Aggregates to the satisfaction of the Engineer. Dispose of loose Aggregate at least 150 feet from the nearest waterway in areas identified for this purpose.

Measurement

00711.80 Measurement - The quantities of Work performed under this Section will be measured on the weight basis.

Payment

00711.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Pre-coated Aggregate in Asphalt Chip Seal	Ton
(b)	Asphalt Binder Coat in Asphalt Chip Seal	Ton
(c)	PG64-22 in Pre-coated Aggregate	Ton

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00715 - Multiple Application Emulsified Asphalt Surface Treatment

Description

00715.00 Scope - This Work consists of applying multiple layers of Emulsified Asphalt and graded Aggregates, applied in successive spreads, to form a firm, finished surface as shown or directed.

The surface treatment design will be designated on the Plans or in the Special Provisions.

Materials

00715.10 Aggregates - Furnish Aggregates meeting the following requirements:

(a) Fractured Faces - Provide Aggregates consisting of broken stone, crushed gravel, or a combination of both. Crush Aggregate such that at least 90 percent by weight of the total Aggregate retained on the No. 8 and larger sieves is fractured on two faces, as determined according to AASHTO T 335.

(b) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide designated gradings for the specified multiple application Emulsified Asphalt surface treatment design according to the following:

	Designated Size			
Sieve Size	**1" - 1/2"**	**3/4" - 1/2"**	**1/2" - 1/4"**	**3/8" - No. 8**
		Percent Passing (by Weight)		
1"	100	100		
3/4"	95 - 100	90 - 100	100	
1/2"	60 - 90	0 - 10	85 - 100	
3/8"	–	–	–	100
1/4"	15 - 30	0 - 2	0 - 15	–
No. 4	–	–	–	45 - 65
No. 8	0 - 7	–	0 - 4	0 - 10
No. 200 (wet)	0.0 - 2.0	0.0 - 2.0	0.0 - 2.0	0.0 - 2.0
No. 200 (wet) *	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0

* in gravels

(c) Unit Weight of Aggregate - Provide Aggregate with a minimum unit weight of 90 pounds per cubic foot according to AASHTO T 19.

(d) Soundness - Provide coarse and fine Aggregate with a weighted loss not exceeding 12 percent when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

(e) Durability - Provide Aggregates meeting the following durability requirements:

	Test Method		Maximum
Test	**ODOT**	**AASHTO**	**Values**
Abrasion		T 96	30.0%
Degradation (coarse Aggregate)			
Passing No. 20 Sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(f) Harmful Substances - Provide Aggregates meeting the following harmful substances requirements:

Test	Test Method ODOT	Test Method AASHTO	Limits
Lightweight Pieces		T 113	1.0% maximum
Wood Particles	TM 225		0.1% maximum
Elongated Pieces (coarse Aggregate at a ratio of 5:1)	TM 229		10.0% maximum
Cleanness Value	TM 227		75 minimum

(g) Taking Aggregates from Agency Stockpiles - When it is specified that Aggregates are to be taken from Agency-controlled stockpiles, take the material in an orderly manner. Do not contaminate the materials. Salvage all material possible from the area which the material is taken. Shape unused portions of a stockpile to Neat Lines. The Contractor will be charged for materials wasted through negligence or used without authority.

(h) Stockpiling Contractor Furnished Aggregates on Agency Property - Aggregates may be temporarily stockpiled at approved sites on Agency property provided the areas used are as small as practicable. Restore the site to its original condition after the materials have been removed. Any contamination during storage or from reloading operations will be cause for rejection.

00715.11 Emulsified Asphalt - Furnish polymer-modified Emulsified Asphalt or non-polymer-modified Emulsified Asphalt as specified for the multiple application Emulsified Asphalt surface treatment design designated in the Plans or Special Provisions. When non-polymer-modified Emulsified Asphalt is designated, the Contractor may elect to substitute a polymer-modified Emulsified Asphalt, however, selection of the polymer-modified Emulsified Asphalt will not be cause for additional compensation.

(a) Non-Polymer-Modified Emulsified Asphalt - When non-polymer-modified Emulsified Asphalt is specified, use CRS-2 or HFRS-2 Emulsified Asphalt as the Contractor elects.

(b) Polymer-Modified Emulsified Asphalt - When polymer-modified Emulsified Asphalt is specified, use CRS-2P or HFRS P1 as the Contractor elects.

(c) Acceptance of Emulsified Asphalt - Provide Emulsified Asphalt conforming to the requirement of ODOT's publication *Standard Specifications for Asphalt Materials*. Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable Specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the Emulsified Asphalt or excessive pumping of the Emulsified Asphalt may significantly reduce the viscosity and may make the material unsuitable for surface treatment use. For this reason limit pumping between the bulk storage tank, hauling transportation, field storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of Emulsified Asphalt will be at the point of application.

Obtain Emulsified Asphalt samples according to AASHTO T 40 at the frequency in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency. Non-polymer-modified Emulsified Asphalt will be tested within 30 Calendar Days from the date it is sampled. Polymer-modified Emulsified Asphalt will be tested within 14 Calendar Days from the date it is sampled.

00715.15 Aggregate Production Quality Control - Provide quality control during production of Aggregate according to Section 00165. Sampling and Testing shall be performed by a CAgT at the minimum frequency schedule in the MFTP.

(a) Quality Control Compliance - Evaluate Aggregates for compliance according to the following:

(1) Gradation - Analyze gradation statistically according to Section 00165. A stockpile contains specification Aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of Aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.

(2) Other Tests - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.

(3) Preproduced Aggregate - Compliance of Aggregates produced and stockpiled before the Award of this Contract will be determined by either one of the following:

- Continuing production records meeting the requirements of 00715.10 and 00715.15.
- Sampling according to AASHTO R 90 and testing the entire stockpile at the minimum frequency schedule in the MFTP. The material shall meet the requirements of 00715.10 and 00715.15.

(b) Materials on Hand - Payment for stockpiled materials on hand may be allowed as described in 00195.60 subject to meeting the requirements of 00715.10 and 00715.15.

00715.16 Acceptance of Aggregate - The Contractors quality control tests will be used for acceptance of Aggregates if verified by the Agency's quality assurance program. The Agency will perform Aggregate production quality assurance according to the following:

(a) ODOT Administered Projects - Quality assurance testing on ODOT administered projects will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Program.

(b) Projects Administered by Other Agencies - The quantity of quality assurance testing on projects administered by other Agencies will be at the discretion of the Agency or as designated in the Special Provisions.

Equipment

00715.20 Equipment - Provide a pressure distributor, hauling vehicles, chip spreader, compactors, power brooms, and other necessary Equipment to ensure efficient operation and construction to meet specified results. Provide Equipment in sufficient number and capacities that will provide coordinated and uniform progress of the Work.

Provide two way radio communication between the asphalt distributor and chip spreader.

00715.21 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained and operated so the Emulsified Asphalt material is applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and

controlled rates from 0.05 - 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor Equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

00715.22 Chip Spreaders - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the Aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders equipped with an Aggregate segregator assembly. Chip spreaders without an Aggregate segregator assembly may be allowed if approved by the Engineer. Provide chip spreaders of adequate width to provide full coverage of the specified Panel and without placing joints in the travel lanes.

00715.23 Compactors - Provide self-propelled, pneumatic-tired or steel-wheeled rollers in good condition and capable of operating at speeds compatible with the multiple application Emulsified Asphalt surface treatment operation. A minimum of two pneumatic-tired rollers and one steel-wheeled roller is required.

(a) Pneumatic-tired Rollers - Provide self-propelled, tandem or multiple axle, multiple wheel type pneumatic-tired rollers with smooth-tread pneumatic tires of equal size. The tires shall be staggered on the axles at such spacings and overlaps that will provide uniform compacting pressure for the full compacting width of the roller. The minimum load per tire shall be 2,800 pounds, with tire inflation pressures of 45 psi to 90 psi.

(b) Steel-wheeled Rollers - Provide steel-wheeled rollers with a gross static weight of at least 8 tons.

00715.24 Power Brooms - Provide pickup or non-pickup type power brooms equipped with a positive means to control vertical pressure.

Labor

00715.30 Quality Control Personnel - Provide a technician having a CAgT technical certification.

Construction

00715.40 Season and Weather Limitations - Do not apply Emulsified Asphalt when the Pavement temperature is below 70 °F, or if the humidity is higher than 75 percent. Complete the application of the Emulsified Asphalt and the Aggregate 3 hours before sunset. Remove by milling, or other methods approved by the Engineer, and replace all surface treatments damaged by weather during the first 24 hours after application at no additional cost to the Agency. The placing of multiple application Emulsified Asphalt surface treatments will not be allowed before July 1 or after August 31.

00715.41 Preparation of Underlying Surfaces - Prepare underlying surfaces according to the following:

(a) Asphalt Surfaces - Immediately before applying the Emulsified Asphalt, clean and dry the surface to be sealed and trim the Shoulders in a manner approved by the Engineer.

(b) Aggregate Surfaces - Bring Aggregate bases and other bases or foundations, when constructed under the Contract, to the completed and finished condition according to the applicable Specifications.

Bring old bases and foundations, constructed by others, to the applicable condition according to Section 00610, and within 0.04 foot of established grade and Cross Section.

00715.42 Sequence of Operations and Application Rates - Construct the number of spreads, the size of Aggregates, and the application rates for both Emulsified Asphalt and Aggregates for the multiple application Emulsified Asphalt surface treatment design specified according to Table 00715-1. Vary the rates of spread as directed during the progress of the Work to produce the best results. Surface treatment is not required for guardrail flares, driveways, or other irregular areas as directed.

Table 00715-1
Multiple Surface Treatment Design

Spreading Order and Rates of Spread*	Fine Double Chip Seal	Medium Double Chip Seal	Type E-9 Oil Mat	Type E-11 Oil Mat
First Course				
Emulsified Asphalt	0.20	0.25	0.30	0.30
1" - 1/2" Aggregate	–	–	–	0.015
3/4" - 1/2" Aggregate	–	–	0.014	–
1/2" - 1/4" Aggregate	–	0.010	–	–
3/8" - No. 8 Aggregate	0.008	–	–	–
Second Course				
Emulsified Asphalt	0.30	0.30	0.35	0.35
1" - 1/2" Aggregate	–	–	–	0.015
1/2" - 1/4" Aggregate	–	–	0.010	–
3/8" - No.8 Aggregate	0.006	0.007	0.002	0.002
Third Course				
Emulsified Asphalt	–	–	0.30	0.35
1/2" - 1/4" Aggregate	–	–	–	0.010
3/8" - No. 8 Aggregate	–	–	0.007	0.003
Fourth Course				
Emulsified Asphalt	–	–	–	0.30
3/8" - No. 8 Aggregate	–	–	–	0.007
Total Quantities				
Emulsified Asphalt	0.50	0.55	0.95	1.30
Aggregates	0.014	0.017	0.033	0.052

* The rates of spread are in the following units:
Emulsified Asphalt - gallons per square yard
Aggregates - cubic yards per square yard

(a) Type E-9 and E-11 Oil Mats - Use one of the following procedures as mutually agreed to by the Engineer and Contractor for Type E-9 and E-11 oil mats:

- Complete first and second Course (and third Course for Type E-11) of the oil mat throughout the entire section (including the dry key) to which the oil mat is to be applied. Square up these Courses 3 hours prior to sunset each Day.

Prior to applying third Course (fourth Course for Type E-11), lightly broom any loose Aggregates from surface. Apply third or fourth Course (seal coat) throughout entire section. Square up the Courses 3 hours prior to sunset each Day.

- Square up first and second Course (and third Course for Type E-11) of the oil mat 3 hours prior to sunset.
- The following Day, prior to applying third Course (fourth Course for Type E-11), lightly broom any loose Aggregates from surface. Place the third or fourth Course (seal coat) of the oil mat and square up 3 hours prior to sunset.
- Complete all Courses the same Day. Square up all Courses 3 hours prior to sunset.

(b) Taper at Project Ends - Stop succeeding Courses of each surface treatment 16 feet beyond the preceding Course, or as directed by the Engineer, at Project ends to provide a smooth transition to the existing Pavement.

00715.43 Applying Emulsified Asphalt - Apply Emulsified Asphalt at the rates specified in 00715.42 and according to the following:

- Apply Emulsified Asphalt, working toward the Aggregate stockpile at all times, unless otherwise approved by the Engineer.
- Leave a minimum of 200 gallons of Emulsified Asphalt in the distributor tank at all times.
- Do not apply Emulsified Asphalt to more than one-half the width of the travel way at one time with the remaining width remaining open to traffic. Do not close the open lane until traffic controlled by pilot car is operating on the new surface treatment. Apply the surface treatment, weather permitting, to both sides of the travel way so that the end of the Work is squared up 3 hours before sunset.
- Do not apply Emulsified Asphalt a greater distance than can be immediately covered by Aggregates before the emulsion breaks.
- Place building paper over the treated surface at the beginning of each spread to ensure that the nozzles are operating properly before the uncovered surface is reached. Remove and dispose of building paper in a manner satisfactory to the Engineer.
- If requested by the Engineer, demonstrate that the distribution of the Emulsified Asphalt does not vary between the individual nozzles by more than 15 percent transversely from the average, and no more than 10 percent longitudinally from the specified rate of application.
- Apply the Emulsified Asphalt at a temperature between 140 °F and 185 °F as recommended by the manufacturer.

00715.44 Hauling and Spreading Aggregates - Spread Aggregates at the rates specified in 00715.42.

Do not operate hauling and spreading Equipment on uncovered Emulsified Asphalt. During the first hour after application of the Emulsified Asphalt and Aggregate, operate at speeds no more than 10 mph and after the first hour, not more than 15 mph until otherwise allowed by the Engineer. Carefully operate hauling Equipment at all times, at moderate speeds that will not damage the new surface treatment or create a hazard to the traveling public. Route hauling Equipment and pilot lines as uniformly as possible over the full width of the new surface in place.

Calibrate the gate opening, gear selection and engine RPM of the chip spreaders for the various sizes of Aggregate to be used. Following calibration, verify the rate of application by a method acceptable to the Engineer.

Immediately cover the Emulsified Asphalt surface with Aggregate unless otherwise authorized by the Engineer. Maintain the rate of spread of this Aggregate within 10 percent of specified rate. Using

approved methods, remove or repair Emulsified Asphalt that has set or "broke" before being covered with Aggregate, at no additional cost to the Agency.

Aggregates shall be surface damp at the time of application. Excess free water (water not adhering to the Aggregate surface) on the Aggregate will not be allowed.

Do not operate the chip spreader at speeds which cause the chips to roll over after striking the emulsion covered surface.

Provide coverage without gaps or overlapping adjacent coverages. Do not construct longitudinal joints within the travel lanes.

Construct neat transverse cut off of Aggregates and remove any excess Aggregates from the surface prior to resuming operations. Stagger cut-offs of successive Courses a minimum of 16 feet prior to the end of a proceeding Course.

00715.45 Shaping and Compacting - After the Aggregates have been placed on the Emulsified Asphalt and spread, remove all piles, ridges or uneven distribution to ensure against rough spots in the final surface.

Compact the surface with a minimum of four complete coverages immediately behind the chip spreader. Perform additional coverages as directed by the Engineer until the material is interlocked, firm, and partially bound with the underlying Emulsified Asphalt. The sequence of rollers will be as directed by the Engineer.

Operate rollers at speeds that do not damage the surface. Do not exceed rolling speeds of 5 mph. In the event Aggregates begin to pick up under traffic or from the rolling operation, immediately cover and roll the area with additional quantities of Aggregate.

Begin rolling at the low side of the Cross Section and progress with Passes parallel to the roadway centerline. Overlap each preceding Pass by at least one half the width of the roller.

Along curbs, walls and at all other places not accessible to specified rollers, thoroughly compact the Aggregate with mechanical tampers or hand tampers. Provide hand tampers with a weight of not less than 50 pounds and a tamping face of not more than 0.7 square foot.

Correct irregularities in Emulsified Asphalt distribution, surface smoothness, non-uniformity of texture, segregation of materials, dirt pockets, spots of excess asphalt and other deficiencies and defects. Accomplish this by the removal, replacement, addition of material, repetition of construction operations or other suitable means, as directed or approved by the Engineer.

Maintenance

00715.60 Establishment - During periods when partial construction is open to traffic and for 7 Calendar Days following original completion of the final Course throughout the entire length of the Project, perform the following operations:

- Maintain the surface to correct bleeding of asphalt, keep the surface free of ravel, traffic grooves, holes and other deformations, and eliminate other defects that may appear.
- Roll and compact the surface to maintain or restore firmness and stability to the materials.
- Broom the surface to ensure that the surface is free of loose Aggregate. Discontinue brooming if the operation damages the surface. In curbed areas, use a pick up type power broom. On Bridges, sidewalks and other areas off the roadway, remove all loose Aggregates to the satisfaction of the Engineer.

Perform the above operations under traffic and at frequencies which the Engineer determines as being necessary to develop and establish the Course to uniform firmness and stability throughout.

Finishing and Cleaning Up

00715.70 Surface Tolerance - Provide a finished surface, after brooming, that does not vary by more than 1/2 inch either transverse or perpendicular to centerline when tested with a 12-foot straightedge. Furnish and operate the straightedge under the observation of the Engineer.

00715.71 Correction of Surface Deficiencies - Correct all deficiencies in surface tolerance in a manner acceptable to the Engineer. Perform all corrective Work within 14 Calendar Days following notification at no additional cost to the Agency.

Measurement

00715.80 Measurement - The quantities of Aggregate will be measured on the weight basis or on the volume basis in the hauling vehicle.

The quantities of Emulsified Asphalt will be measured on the weight basis.

The quantities of asphalt surface treatment of approaches will be measured on the unit basis for each street connection and road approach.

Payment

00715.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Aggregate in Multiple Application Emulsified Asphalt Surface Treatment	Cubic Yard or Ton
(b)	Asphalt in Multiple Application Emulsified Asphalt Surface Treatment	Ton
(c)	Extra for Multiple Application Emulsified Asphalt Surface Treatment Approaches	Each

Item (c) applies to the extra costs of placing the Aggregates and asphalt in Emulsified Asphalt surface treatment only on street connections and road approaches. Payment will be in addition to payment made for the Materials used in the Work.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for preparing the road surface, placing Material in final position, or blading and brooming.

Section 00730 - Emulsified Asphalt Tack Coat

Description

00730.00 Scope - This Work consists of furnishing and placing Emulsified Asphalt on a prepared asphalt concrete, portland cement concrete, or other paved surface to ensure bond between Lifts as specified.

Materials

00730.11 Emulsified Asphalt - Furnish CSS-1, CSS-1h, CMS-2, CMS-2S, CMS-2h, CRS-1, CRS-2, HFRS-2, or HFMS-2 as selected by the Contractor.

Furnish Emulsified Asphalt meeting the requirements of ODOT's publication *Standard Specifications for Asphalt Materials*. Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable Specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project.

Excessive delay in the use of the Emulsified Asphalt or excessive pumping of the Emulsified Asphalt may significantly reduce the viscosity and may make the material unsuitable for tack coat use. For this reason limit pumping between the bulk storage tank, hauling transportation, field storage tanks and distributor to an absolute minimum to maintain proper viscosity. Final acceptance of Emulsified Asphalt will be at the point of application.

Dilution of the tack coat material may be allowed to a maximum 1:1 ratio. Determine the proportion of water to be added to the Emulsified Asphalt. Do not dilute the Emulsified Asphalt until the Engineer approves the dilution ratio. Add the water to the Emulsified Asphalt and mix according to the asphalt Supplier.

Obtain samples according to AASHTO T 40 prior to dilution with water, if allowed, at the frequency in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency. Emulsified Asphalt will be tested within 30 Calendar Days from the date it is sampled.

Equipment

00730.22 Asphalt Distributor - Provide an asphalt distributor designed, equipped, maintained and operated so the Emulsified Asphalt material may be applied uniformly at even heat. The distributor shall be capable of applying the asphalt on variable surface widths up to 16 feet, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, and with uniform pressure. The variation allowed from any specified rate shall not exceed 0.02 gallons per square yard. Provide distributor Equipment that includes a tachometer, pressure gauges, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Provide distributors equipped with a positive power unit for the asphalt pump, and full circulation spray bars adjustable both laterally and vertically. Set the bar height for triple lap coverage.

Construction

00730.40 Temperature Limitations - Apply tack coat only when the surface temperature in the shade is not less than the appropriate minimum surface temperature according to 00735.40, 00744.40, and 00745.40, as applicable.

00730.41 Traffic Control - Do not apply the tack to more than one-half the width of the travel way at one time. The remaining width shall remain open to traffic. Do not close the open lane until traffic controlled by pilot car is operating on the new surface.

00730.42 Preparation of Underlying Surfaces - Immediately before applying the tack coat, the surface to be tacked shall be clean and dry. Clean all loose material by brooming, flushing with water or other approved methods.

00730.44 Applying Tack Coat - Apply the Emulsified Asphalt with a pressure distributor conforming to 00730.22, unless otherwise allowed. Apply the Emulsified Asphalt to the prepared surface at a rate between 0.05 and 0.20 gallons per square yard as directed and with the Emulsified Asphalt temperature between 140 °F and 185 °F as recommended by the manufacturer. Application rates for tack coat diluted according to 00730.11 will be increased as necessary to provide the same amount of residual asphalt as the application rates specified above.

Do not place hot mixed asphalt concrete Pavement or Emulsified Asphalt Concrete Pavement on the tack coat until the Emulsified Asphalt separates from the water (breaks), but before it loses its tackiness.

Measurement

00730.80 Measurement - The quantities of Emulsified Asphalt cement used as tack will be measured on the weight basis.

Payment

00730.90 Payment - The accepted quantities of Emulsified Asphalt cement used as tack coat will be paid for at the Contract unit price, per ton, for the item "Emulsified Asphalt for Tack Coat".

Payment will be payment in full for furnishing, mixing with water, and placing the Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for water added to dilute the Emulsified Asphalt used for tack coat after delivery from the asphalt supplier.

Section 00735 - Emulsified Asphalt Concrete Pavement

Description

00735.00 Scope - This Work consists of constructing an Emulsified Asphalt Concrete (EAC) Pavement composed of Aggregate and Emulsified Asphalt, plant mixed into a uniformly coated mixture, spread on a prepared Base, covered with choke Aggregate, and compacted to the lines, grades, thicknesses, and Cross Sections shown or established.

00735.05 Precrushing and Prepaving Conferences:

(a) Precrushing Conference - Supervisory personnel of the Contractor and any Subcontractors who are to be involved in Aggregate crushing of EAC Aggregates shall meet with the Engineer at a mutually agreed time, to discuss methods of accomplishing all phases of the crushing Work. The Crusher Supervisor and the Contractor's CAgT shall attend the meeting.

(b) Prepaving Conference - Supervisory personnel of the Contractor, including the CAT-I and any Subcontractors who are to be involved in the paving Work, shall meet with the Engineer at a mutually agreed time to discuss methods of accomplishing all phases of the paving Work.

Materials

00735.10 Aggregates - Furnish Aggregates for EAC meeting the following requirements:

(a) General - Scalp the Rock material used to produce Aggregates on a 3/4 inch sieve covering the entire screen deck (after it has passed through the primary crusher if quarry Rock is used). The material remaining may be accepted for use by visual inspection. The Engineer may perform verification testing of the gradation. The Material shall meet the following:

Sieve Size	Percent Passing (by Weight)
4"	95 - 100
3/4"	5 Max.

(b) Soundness - Provide coarse and fine Aggregate with a weighted loss not exceeding 12 percent when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

(c) Durability - Provide EAC Aggregates meeting the following durability requirements:

Test	Test Method ODOT	Test Method AASHTO	Maximum Values
Abrasion		T 96	30.0%
Degradation (coarse Aggregate)			
Passing No. 20 Sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(d) Fractured Faces - Determine fracture of Aggregates according to AASHTO T 335. Crush Aggregate to provide at least two fractured faces on 90 percent of the material retained on a 1/4 inch sieve, and one fractured face on 75 percent of the material retained on a No. 8 sieve.

(e) Harmful Substances - Provide EAC Aggregates meeting the following harmful substances requirements:

Test	Test Method ODOT	Test Method AASHTO	Limits
Lightweight Pieces		T 113	1.0% maximum
Wood Particles	TM 225		0.1% maximum
Elongated Pieces (coarse Aggregate at a ratio of 5:1)	TM 229		10.0% maximum
Cleanness Value	TM 227		75 minimum

(f) Grading - Perform sieve analysis according to AASHTO T 27 and AASHTO T 11. Provide grading of EAC Aggregate conforming to the following:

Sieve Size	Percent Passing (by Weight)	Leveling or Patching Percent Passing (by Weight)
1"	100	
3/4"	95 - 100	100
1/2"	60 - 90	95 - 100
1/4"	15 - 30	15 - 40
No. 8	0 - 7	0 - 10
No. 200	0.0 - 2.0	0.0 - 2.0
No. 200 *	0.0 - 1.0	0.0 - 1.0

* in gravels

If the Aggregates are produced in two or more separate sizes, the gradation of the blended sizes shall conform to the above grading requirements.

(g) Stockpiling - Prepare the ground for the stockpile site to prevent contamination. Prevent segregation, as much as possible, when stockpiling and removing the Aggregate.

00735.11 Emulsified Asphalt - Furnish CMS-2, CMS-2S, or HFMS-2 Emulsified Asphalt meeting the requirements of ODOT's publication *Standard Specifications for Asphalt Materials*. Copies of the publication are available from the ODOT Pavement Services Engineer. The applicable Specifications are those contained in the current publication on the date the Project is advertised. The materials may be conditionally accepted at the source or point of loading for transport to the Project. Acceptance of the selected Emulsified Asphalt is subject to the production of a suitable JMF.

Excessive delay in the use of the Emulsified Asphalt or excessive pumping of the Emulsified Asphalt may significantly reduce the viscosity and may make the material unsuitable for EAC use. Limit pumping between the bulk storage tank, hauling transportation, field storage tanks, and plant to an absolute minimum to maintain viscosity.

Obtain Emulsified Asphalt samples according to AASHTO T 40 at the frequency in the MFTP. Samples will be tested at the ODOT Materials Laboratory, or other laboratory as designated by the Agency, within 30 Calendar Days from the Day the sample was taken.

00735.13 Job Mix Formula - Provide a mixture comprised of Aggregate and Emulsified Asphalt in the proportions established in the job mix formula (JMF). The Emulsified Asphalt content shall be between 5.0 and 8.0 percent, by weight, of the total Aggregate. Vary the proportions of materials as directed.

The CMDT shall prepare, sign and submit a JMF and samples to the Engineer for each mixture required at least 10 Calendar Days prior to anticipated use in EAC, and according to the latest copy of the ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*.

Furnish representative samples of material to be used in the mixture as follows:

Material	Amount
New Coarse Aggregate	55 pounds
Emulsified Asphalt Cement	4 quarts in 1 quart plastic containers

Provide a JMF meeting the following mixture requirements:

EAC Mixture

Air Voids, %	15 - 30 according to AASHTO T 269*
IRS	Report according to ODOT TM 313*
Percent Coating	90% minimum

* AASHTO T 269 and ODOT TM 313 procedures available from ODOT Materials Laboratory.

00735.14 Choke Aggregate - Furnish choke Aggregate meeting the gradation below. Perform sieve analysis according to AASHTO T 27. Use crushed or uncrushed Rock free of Clay, loam or other harmful substances.

Sieve Size	Percent Passing (by Weight)
3/8"	100
1/4"	90 - 100
No. 8	30 - 66
No. 30	8 - 28
No. 100	0 - 5

00735.15 Aggregate Production Quality Control - Provide quality control during production of EAC Aggregate according to Section 00165. Sampling and testing shall be performed by a CAgT at the minimum frequency in the MFTP.

Evaluate EAC Aggregates for conformance according to the following:

(a) Gradation - Analyze gradation statistically according to Section 00165. A stockpile contains specification Aggregate when the Pay Factor (PF) for each sieve size calculated according to 00165.40 is equal to or greater than 1.00. Each required sample represents a sublot.

When the results from Table 00165-2 yield a Pay Factor of less than 1.00 for any sieve size, the material is non-specification. The Engineer will reject any stockpile of Aggregate containing non-specification material unless the non-specification material is removed from the stockpile. Do not add additional material to such a stockpile until enough non-specification material is removed so that the PF for each sieve size is equal to or greater than 1.00.

(b) Other Tests - Stop production, make appropriate operational adjustments, and remove all failing material from the stockpile whenever a quality control test result, other than sieve analysis, does not meet Specifications. Document operational adjustments made and notify the Engineer prior to resuming production.

(c) Preproduced Aggregate - Compliance of Aggregates produced and stockpiled before the Award of this Contract will be determined by either of the following methods:

- Continuing production records meeting the requirements of 00735.10, 00735.14, and 00735.15.
- Sampling according to AASHTO R 90 and testing the entire stockpile at the minimum frequency schedule in the MFTP. The material shall meet the requirements of 00735.10, 00735.14, and 00735.15.

00735.16 Acceptance of Aggregate - The Contractor's quality control tests will be used for acceptance of EAC Aggregates if verified by the Agency's quality assurance program. The Agency will perform Aggregate production quality assurance according to the following.

(a) ODOT Administered Projects - Quality assurance testing on ODOT administered projects will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Program.

(b) Projects Administered by Other Agencies - The quantity of quality assurance testing on projects administered by other Agencies will be at the discretion of the Agency or as designated in the Special Provisions.

00735.17 EAC Mixture Production Quality Control - Provide quality control during production of EAC mixture according to Section 00165 and the following:

(a) Personnel Requirements - Maintain quality control by:

- Providing at least one CAT-I full-time at each plant site used to furnish mixture to the Project.
- Obtaining samples under the direct supervision of a CAT-I.
- Having all testing, data analysis and reporting of test results performed by a CAT-I.

(b) Laboratory Requirements - Furnish and maintain an ODOT certified laboratory at the plant site furnished with the necessary Equipment and supplies for performing Contractor quality control testing.

The laboratory shall be on-site and operational prior to the beginning of EAC production. Provide laboratory Equipment meeting the requirements of the test methods identified in the Specifications.

Calibrate all testing Equipment according to the required test methods. The Engineer may inspect measuring and testing devices to confirm both calibration and condition.

(c) Plant Calibration - Calibrate the plant according to ODOT TM 322. The plant calibration shall be witnessed and documented by a CAT-I. Do not begin production until calibration tests indicate that the specified proportions can be obtained.

(d) Required Tests - Randomly sample and test the Aggregate and Emulsified Asphalt during EAC mixture production according to Section 00165 and the MFTP.

(e) Quality Control Compliance - Evaluate EAC mixture for compliance according to Section 00165 and the MFTP.

00735.18 Acceptance of EAC Mixture - The Contractor's quality control tests will be used for acceptance of EAC mixture if verified by the Agency's quality assurance program. The Agency will perform EAC mixture production quality assurance according to the following:

(a) ODOT Administered Projects - Quality assurance testing on ODOT administered projects will be performed according to Section 00165, the MFTP and the ODOT Quality Assurance Program.

(b) Projects Administered by Other Agencies - The amount of quality assurance testing on projects administered by other Agencies will be at the discretion of the Agency or as designated in the Special Provisions.

Equipment

00735.20 EAC Mixing Plant - Mix the EAC at a plant capable of providing a mix of Aggregate and Emulsified Asphalt of uniform proportions and consistency as designated.

Provide mixing plants with the following operating Equipment:

- A positive control linking the Aggregate and Emulsified Asphalt feed so that a constant ratio of Emulsified Asphalt to Aggregate is maintained.
- Totalizers for the Emulsified Asphalt metering device and the Aggregate scales.
- A metering device that can determine percent of Emulsified Asphalt in mixture at any time the plant is in operation.
- An adjustable Emulsified Asphalt spray bar.

Provide and operate a mechanical sampling device that produces a representative sample of the quantity of material required for the appropriate tests, when sampling at or around crushing, screening, mixing plants, conveyors, or other similar mechanical Equipment.

Proportion the Aggregate by weight. Proportion the Emulsified Asphalt by either weight or metering. Provide Equipment capable of feeding and maintaining a constant rate of Aggregate within a tolerance of plus or minus 5 percent, by weight, of the designated amount, and feeding a constant rate of Emulsified Asphalt within ± 0.5 percent, by weight, of the designated amount.

00735.21 Hauling Equipment - Provide hauling vehicles in good operating condition with tight, clean, metal beds and a cover. Equip beds of hauling vehicles with a positive system to prevent materials from leaking onto the surfaces over which the hauling vehicle travels. If leakage occurs, remove any spilled material and repair any damage according to 00170.85.

Coat the beds with a minimum amount of an approved material to keep the EAC from sticking to the beds. Do not use diesel oil. Drain excess coating material before loading by raising the truck bed, opening belly dump gates, or operating the conveyor belt, as appropriate.

Do not use vehicles that cause segregation or delay operations.

00735.22 EAC Pavers - Provide EAC pavers meeting the following requirements:

(a) Power and Support - Self-contained, self-propelled, supported on tracks or wheels, none of which contact the mixture being placed.

(b) Augers and Screed - Equipped with augers and a screed or strike-off assembly, heated if necessary, which:

- Can spread and finish EAC to a uniform texture, in the specified widths, thicknesses, lines, grades, and Cross Sections.
- Will not segregate, tear, shove, or gouge EAC.
- Produce a finished surface to specified evenness and texture.

(c) Control System - Equipped with a paver control system which:

- Controls EAC placement to specified Slope and grade.
- Maintains the paver screed in proper position.
- Provides specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references.

00735.23 Compactors - Provide self-propelled, steel-wheeled and pneumatic-tired rollers capable of reversing without backlash according to the following:

(a) Steel-Wheeled Rollers - Provide steel-wheeled rollers with:

- A gross static weight of at least 8 tons.
- A gross static weight of at least 6 tons for finish rolling.

(b) Pneumatic-tired Rollers - Provide pneumatic-tired rollers meeting the following:

- Be tandem, or multiple axle, multiple wheel type.
- Have smooth-tread, pneumatic tires of equal size.
- Have tires staggered on the axles, spaced and overlapped to provide uniform compacting pressure for the full compacting width.
- Have a minimum load of 2,800 pounds per tire with tire inflation pressures of 45 psi to 90 psi.

00735.24 Chip Spreaders - Provide self-propelled chip spreaders equipped with a mechanical device that will spread the Aggregate at a uniform rate across the full width of the chip spreaders. Provide chip spreaders of adequate width to provide full coverage of the specified Panel.

00735.25 Power Brooms - Provide pickup and/or non-pickup power brooms that have a positive means to control vertical pressure.

00735.26 Release Agents - Do not use diesel oil as a release agent to coat or clean Equipment at the mixing plant, or on hauling Equipment beds or compactors.

Labor

00735.30 Quality Control Personnel - Provide technicians having CAgT, CAT-I, and CMDT technical certifications.

Construction

00735.40 Season and Weather Limitations - Place EAC from May 1 to August 31, inclusive, when the Pavement temperature is 60 °F or above. Seasonal limitations for EAC will not supersede seasonal limitations for Emulsified Asphalt chip seals on the Project.

Do not place EAC:

- When the underlying layer is frozen.
- During rain or other adverse weather conditions.

Correct mixtures damaged by weather by milling and replacement or other approved methods at no additional cost to the Agency.

00735.41 Rate of Progress and Scheduling - Do not begin Work until there is enough mixing, hauling, spreading and compacting Equipment on the Project to assure that the paving machine can place the EAC without stopping, as nearly as possible.

00735.42 Preparation of Underlying Surfaces - Clean all deleterious material, dirt and dust from existing and new Bases, Surfacings, and Pavements in a manner acceptable to the Engineer.

Bring the existing surface to uniformity by Patching irregular or depressed surfaces and potholes with EAC thoroughly compacted until it conforms with the surrounding surface. Prepare individual potholes for Patching by cutting the edges vertically to the depth of the deepest portion of the hole.

When designated in the Plans or Special Provisions, place Leveling Courses of EAC on existing Pavements before constructing the final paving Course. Perform the Leveling Work to the lines and grades established. Place Leveling material with either a paving machine or motor grader as directed.

Apply a tack coat to the existing surface according to Section 00730 prior to placing EAC.

00735.43 Mixing:

(a) General - Mix the Aggregate and Emulsified Asphalt until a uniform consistency is obtained. Use the temperature of the Emulsified Asphalt cement recommended by the Supplier.

(b) Moisture - At the time it is mixed with the Emulsified Asphalt, provide Aggregate with a moisture content adequate to allow distribution of the emulsion, but not so great that moisture or emulsion runs from the mixture. Provide special processing necessary to attain an acceptable moisture content at no additional cost to the Agency.

(1) No Moisture Problem - A visual moisture content determination by the Engineer will suffice when there are no apparent moisture problems.

(2) Moisture Problems - If there are unresolved moisture problems, the maximum allowable moisture shall be the saturated surface dry (SSD) moisture content for the Aggregate submitted for the JMF, as determined by AASHTO T 84 and AASHTO T 85.

00735.44 Control of Grade - Use a floating beam device of adequate length and sensitivity on either or both sides of the paver to provide adequate reference to control the grade of the paver.

Where this method is impractical, manual control of grade for the paver will be allowed when approved.

00735.45 Hauling, Depositing, and Placing:

(a) Hauling - Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the Contractor matches the delivery rate of mixture with the capacity of the paving machine.

If rain or cold weather conditions are encountered any time between loading and placement:

- Suspend mixing operations.
- Cover the mixture in transit.

- Do not place mixture that is in transit until conditions improve, unless placed at Contractor's risk according to 00735.40.
- Take action to prevent emulsion run-off from entering drainage channels or facilities.

The EAC will be rejected before placing if it is found to be:

- Segregating or separating.
- Solidifying or crusting.

Work with the Engineer to make appropriate adjustments if an excessive amount of Emulsified Asphalt is leaking from trucks.

No more EAC will be accepted until corrective action has been taken.

Dispose of rejected loads at no additional cost to the Agency.

(b) Depositing - Deposit the EAC material in windrows from the hauling vehicles so segregation is prevented. Alternate methods of depositing may be used if specified in the Special Provisions or allowed by the Engineer.

Provide pick-up Equipment that can:

- Pick up substantially all of the material deposited on the Roadway.
- Be self-supporting, not exert any vertical load on the paving machine, or cause vibrations or other motions which could have a detrimental effect on the riding quality of the completed Pavement.

(c) Placing - Place the EAC on dry, prepared surfaces with pavers meeting the requirements of 00735.22. Spread and finish to established widths, thickness, line, grade and Cross Section.

When approved, the EAC may be spread with other Equipment and means where irregularities or obstacles make the use of specified equipment impracticable.

00735.46 Compaction - Compact the EAC as follows:

(a) General - After the EAC has been spread, struck off, and surface irregularities or other defects remedied roll it uniformly until compacted as specified.

(b) Rolling - Compact the EAC with rollers conforming to 00735.23. Provide sufficient rollers of type and weight to compact the mixture while it is in a workable condition. Operate rollers at a uniform speed not more than 3 mph, with the drive roll or wheels nearest the paver.

Begin rolling at the sides and proceed longitudinally, parallel to the road centerline, and gradually progressing towards the center, unless otherwise directed. On superelevated curves, begin rolling at the low side and progress to the high side. When paving in echelon, or when abutting a previously paved lane, roll the longitudinal joint first, followed by the regular rolling pattern.

Do not make sharp turns or park rollers on the EAC. Stop each Pass at least 5 feet longitudinally from preceding stops. Do not displace the line and grade of edges. Prevent the EAC from sticking to the wheels and spotting or defacing the EAC by wetting them with a minimum of water or other approved material.

(1) Breakdown Rolling - Use non-vibratory, three-wheel steel, or tandem-wheeled-steel rollers. Make at least three complete roller coverages.

(2) Intermediate Rolling - Use a self-propelled, pneumatic-tired roller following the placement of choke Aggregate according to 00735.47. Make at least two complete roller coverages with the pneumatic-tired roller immediately following application of choke Aggregate.

(3) Finish Rolling - Use non-vibratory, tandem-wheeled steel rollers, and continue until roller marks are eliminated.

Compact areas inaccessible to rollers with mechanical tampers as directed.

00735.47 Choke Aggregate - Provide at least two choke Aggregate trucks. After breakdown compaction and before intermediate compaction, place choke Aggregate with a chip spreader capable of obtaining a rate between 0.003 to 0.006 cubic yard per square yard.

If Aggregate ravels or picks from the fresh EAC Pavement during rolling operations or after opening to traffic, cover immediately with additional choke Aggregate and roll with a tandem-wheeled steel roller, unless otherwise directed.

Be prepared to place additional choke Aggregate for a period of 48 hours after the fresh EAC Pavement is open to traffic. Spread excess Aggregate uniformly across the fresh EAC Pavement by brooming or other suitable means.

00735.48 Longitudinal Joints - Bond, compact and finish the new EAC at longitudinal joints equal to the EAC against which it is placed.

(a) Location - Place EAC in Panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one Panel by at least 6 inches from the longitudinal joints in the Panel immediately below.

(1) Base Course - Place Base Course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

(2) Wearing Course - Do not construct longitudinal joints in the wearing Course within the area or width of a Traffic Lane. On Median lanes and on Shoulder areas, construct joints only at lane lines or at points of change in the transverse slopes, as shown or as directed.

(b) Drop-Offs:

- Provide warning signs and markings according to Sections 00222 and 00225 where abrupt or sloped edge drop-offs 1 inch or more in height occur.
- Protect edges from being broken down.
- If unable to complete the Pavement without drop-offs according to 00735.48(c):
  - Construct and maintain a wedge of EAC at a Slope of 1V:10H or flatter along the exposed longitudinal joint.
  - Remove and dispose of the wedge before continuing paving operations.
  - Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Agency. EAC for the temporary wedge will be paid for at the Contract unit price.

(c) Placing EAC Under Traffic - When placing EAC Pavement under traffic, schedule Work for the nominal thickness being laid as follows or as required by the Special Provisions:

(1) More Than 2 inches - Schedule Work so at the end of each working shift the full width of the area being paved, including Shoulders, is completed to the same elevation with no longitudinal drop-offs.

(2) More Than 1 inch But Not More Than 2 inches - Schedule Work so at the end of each working shift one Panel of new travel lane Pavement does not extend beyond the adjoining Panel of new travel lane Pavement more than the distance normally covered by each shift. At the end of each workweek complete the full width of the area to be paved, including Shoulders, to the same elevation with no longitudinal drop-offs.

00735.49 Transverse Joints - Construct transverse joints according to the following:

(a) Travel Lanes - Construct transverse joints on the travel lane portion of all specified Pavement Courses, except Leveling Courses, as follows:

(1) Project Ends - Construct transverse joints at Project ends as shown or as directed.

(2) Temporary End Panel - Maintain Pavement depth, line and grade at least 5 feet beyond the selected transverse joint location, and from that point wedge down on the appropriate Slope until it meets the surface beneath the EAC, assuming a Pavement Course thickness of 2 inches, as follows:

- For wedges that will be under traffic for less than 24 hours, the wedge length shall be 8 feet (1V:50H taper rate).
- For wedges that will be under traffic for 24 hours or longer, the wedge length shall be 25 feet (1V:160H taper rate).

When the Pavement Course thickness is different than the above 2 inch example, use the appropriate taper rate to compute the length of the wedge. The wedge length plus the 5 feet or longer Panel form the "temporary end Panel".

(3) Vertical Face - After the mixture has reached the required density:

- Provide a smooth, vertical face the full depth of the Course being laid at the location selected for the joint by sawing, cutting or other approved methods.
- Remove EAC material from the joint to the end of the Panel. If removed before resuming paving beyond the joint, reconstruct the temporary end Panel immediately by placing a bond-breaker of paper, dust or other suitable material against the vertical face and on the surface to be occupied by the temporary end Panel. Construct a full-depth Panel at least 5 feet long, beginning at the sawed or cut joint, and taper it according to 00735.49(a)(2) to zero thickness.

(4) Excess EAC - After completing a temporary end Panel as specified, dispose of the unused remainder of EAC as directed. Payment will be made for the entire load of EAC, but will be limited to one load only per joint per Panel.

(5) Resume Paving - When permanent paving resumes, remove the temporary end Panel and any bond-breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

(6) Joint Requirements - Compact both sides of the joint to specified density. When tested with a straightedge placed across the joint, provide a joint surface meeting specified surface tolerances.

(b) Abutting Bridge Ends - Compact the EAC abutting bridge ends, and other rigid type Structures, in the transverse and/or diagonal direction, as well as longitudinally, as directed.

Maintenance

00735.60 Correction of Defects - Correct all defects in material and Work, as directed, at no additional cost to the Agency. Defects include segregation of materials, non-uniform texture and fouled surfaces preventing full bond between successive spreads of mixture. No adjustment in Contract Time will be made for corrective Work.

(a) Slicks - Remove and replace slicks immediately with suitable materials.

(b) Roller Damage Surface Repair - Correct all displacements of any Course at once, with rakes and addition of fresh mixture when required, regardless of thickness.

(c) Other Defects - Remove, replace with fresh EAC, and compact to conform to the surrounding area all EAC that:

- Is loose, broken or mixed with dirt.
- Shows visually too much or too little asphalt.
- Is defective in any way.

If a seal coat is required by the Special Provisions, or if directed, remove and replace the EAC that contains defects, excesses, or deficiencies prior to placing the seal coat at no additional cost to the Agency.

00735.61 Brooming - Remove loose choke Aggregate by carefully brooming the entire surface. Do this as directed by the Engineer, unless brooming damages the new EAC Pavement.

Subsequent brooming the following 2 days may be directed by the Engineer to ensure that the surface is free of loose Aggregate that could cause vehicle damage.

In curbed areas, use a pick up type power broom. On Bridges, sidewalks and other areas off the roadway, remove all loose Aggregates to the satisfaction of the Engineer.

00735.62 Curing - After each Lift of EAC has been placed, allow the EAC to cure a minimum of 72 hours after laydown or as directed, before placing the next Lift of EAC.

Finishing and Cleaning Up

00735.70 Pavement Smoothness - Furnish a 12-foot straightedge and/or a 12-foot rolling straightedge and test as specified. Additional testing may be required. Mark areas not meeting the surface tolerance.

Perform Pavement smoothness testing immediately after initial brooming of choke Aggregate.

(a) Single Course Construction - Test with the 12-foot straightedge parallel to and perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

(b) Multiple Course Construction - Test the surface of the Course on which the wearing Course is placed according to 00735.70(a).

Test the wearing Course of EAC with the rolling straightedge in the designated wheel path of a 0.1 mile strip of each travel lane per mile, where directed, and on each transverse joint throughout

the Project. Operate the rolling straightedge parallel to the centerline. The surface shall not vary more than 0.015 foot.

Also test the wearing Course of EAC with a 12-foot straightedge placed perpendicular to the centerline at least once within the above-mentioned 0.1 mile strip. It shall not vary by more than 1/4 inch.

If the 0.1 mile testing strip meets the Specifications, no further testing of the mile represented by the testing strip will be required, except at the transverse joints. If any part of the testing strip does not meet the Specifications, both wheel paths of the entire mile shall be tested.

00735.71 Correction of Pavement Roughness - Correct Equipment or paving operation immediately when tests show the Pavement smoothness is not meeting the tolerance in 00735.70.

Correct the surface roughness to the required tolerances by a means acceptable to the Engineer.

Complete correction of all surface roughness within 14 Calendar Days following notification unless otherwise directed at no additional cost to the Agency.

00735.72 Fog Coat - After the EAC has cured at least 14 Calendar Days, apply a fog coat to the EAC surface according to Section 00705. Place the fog coat at least 1 Day prior to placing a single or multiple application chip seal if a chip seal is required by the Special Provisions.

00735.73 Emulsified Asphalt Chip Seal - After the EAC has been placed and has cured at least 14 Calendar Days, apply a single or multiple application Emulsified Asphalt chip seal according to Section 00710 or Section 00715 if required by the Special Provisions.

Measurement

00735.80 Measurement - The quantities of EAC will be measured on the weight basis. No deduction will be made for the weight of the Emulsified Asphalt used in the EAC.

The quantities of Emulsified Asphalt in the EAC will be measured on the weight basis.

The quantities of choke Aggregate will be measured on the weight basis, or on the volume basis in the hauling vehicle.

Payment

00735.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Emulsified Asphalt Concrete Mixture	Ton
(b)	Emulsified Asphalt in Mixture	Ton
(c)	Choke Aggregate	Ton or Cubic Yard
(d)	Emulsified Asphalt Concrete in Leveling and/or Patching	Ton
(e)	Haul and Place Emulsified Asphalt Concrete Mixture	Ton
(f)	Haul and Place Choke Aggregate	Ton

Item (d) applies when EAC is used in Leveling, Patching, or Leveling and Patching.

Item (e) applies to EAC that is furnished by the Agency and hauled and placed by the Contractor.

Item (f) applies to choke Aggregate that is furnished by the Agency and hauled and placed by the Contractor.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for water used in brooming operations.

Section 00738 - Safety Edge

Description

00738.00 Scope - This Work consists of furnishing and placing a consolidated sloped Pavement edge treatment, known as a safety edge, constructed monolithically with the Pavement as shown.

Materials

00738.10 Materials - Construct the safety edge using the same material used to construct the adjoining Pavement.

Equipment

00738.20 Safety Edge Device - Attach a device to the asphalt concrete paver screed that confines the asphalt concrete at the end gate and extrudes the asphalt concrete in a wedge shape onto the roadway Shoulder. The safety edge device shall compact a wedge between the ratios 1:1 1/2 and 1:2, providing a uniform texture and shape; shall adjust to varying paving thicknesses; and shall allow for transitions for cross roads, driveways, and obstructions. Brief stops of the paving machine to adjust the safety edge device at transitions are allowed. A single plate strike off is not allowed.

Use a safety edge device manufactured by Transtech Systems, Inc; Advant-Edge Paving Equipment, LLC; Carlson Paving Products; Troxler Electronic Laboratories, Inc; or a similar device that produces the same wedge consolidation results. If a similar device is used, provide proof the device has been used on previous projects with acceptable results or construct a test section meeting the requirements of 00738.47.

Construction

00738.40 Asphalt Concrete Density Adjacent to Safety Edge - Compact asphalt concrete Pavement adjacent to the safety edge according to Section 00743, 00744, or 00745, as applicable. No additional compaction of the safety edge is required.

00738.43 Handwork - Short sections of handwork are allowed where the safety edge transitions at locations such as driveways, intersections, interchanges, and Bridges.

00738.47 Test Section - At the beginning of the paving operation, construct one initial test strip of asphalt Pavement at least 0.1 mile but not more than 0.2 mile in length, at the specified paving width. Safety edge will be evaluated for wedge ratio, compaction, texture, and shape, to the satisfaction of the Engineer.

The initial test strip will be waived if the safety edge device is manufactured by a company listed in the Special Provisions, or the device has been proven to the satisfaction of the Engineer.

Measurement

00738.80 Measurement - No measurement of quantities will be made for safety edge.

Payment

00738.90 Payment - No separate or additional payment will be made for safety edge. Payment will be included in payment for the appropriate items under which this Work is required.

Section 00740 - Commercial Asphalt Concrete Pavement (CACP)

Description

00740.00 Scope - This Work consists of furnishing and placing commercial asphalt concrete Pavement (CACP) to the lines, grades, thicknesses, and Cross Sections shown or established.

Materials

00740.10 Materials - Furnish CACP that is a well-graded, uniform, durable commercial mix. All new materials, or a combination of new materials and reclaimed materials, may be used. If requested, provide a copy of the JMF to the Engineer before paving.

00740.12 Asphalt Cement - Use PG 64-22 or PG 64-28 unless otherwise specified in the Contract Documents or approved. Provide asphalt cement conforming to the requirement of ODOT's publication *Standard Specifications for Asphalt Materials*. Copies of the publication are available from ODOT's website. The applicable Specifications are those contained in the current publication on the date the Project is advertised.

00740.13 Tack Coat - Furnish tack meeting the requirements of Section 00730.

00740.14 Acceptance - All material will be accepted by visual inspection by the Engineer.

Construction

00740.44 Placing Asphalt Concrete - Place asphalt concrete Structures of uniform width by either mechanical extrusion methods or between suitable forms, as the Contractor elects. Other Structures may be constructed without the use of forms unless otherwise directed. The Engineer may allow small or special pavers, spreader boxes, or blade graders for placing asphalt concrete. The Engineer may allow mixture to be placed by hand methods.

00740.45 Compacting Asphalt Concrete - Compaction of the asphalt concrete to a specified density will not be required, regardless of thickness. Perform breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the rollers. Perform additional coverages, as directed, to obtain finish rolling of the CACP.

Along curbs and walls, on walks, irregular areas, and other areas not practically accessible to rollers, compact the mixture with small, self-propelled rollers, mechanical tampers, hot hand tampers, or hand rollers. On depressed areas a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Measurement

00740.80 Measurement - The quantities of commercial asphalt concrete Pavement will be measured on the weight basis.

Payment

00740.90 Payment - The accepted quantities of commercial asphalt concrete Pavement will be paid for at the Contract unit price, per ton, for the item "Commercial Asphalt Concrete Pavement".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for reclaimed asphalt Pavement, reclaimed asphalt shingles, or asphalt cement.

Section 00743 - Porous Asphalt Concrete (PAC)

Description

00743.00 Scope - This Work consists of constructing one or more Courses of porous asphalt concrete (PAC) Pavement for drainage or stormwater infiltration, plant mixed into a uniformly coated mixture, placed on a prepared foundation, compacted and finished to a specified smoothness to the lines, grades, thickness, and Cross Sections shown or established.

00743.01 Abbreviations:

PAC - Porous Asphalt Concrete

TSR - Tensile Strength Ratio

VFA - Voids Filled with Asphalt

VMA - Voids in Mineral Aggregate

00743.02 Definitions:

Porous Asphalt Concrete - A plant mixed, uniformly coated mixture of asphalt cement, open graded Aggregate and additives as required.

Asphalt Treated Permeable Base - A plant mixed, uniformly coated mixture of asphalt cement, open graded Aggregate and additives as required. All references to PAC will also apply to ATPB unless otherwise specified.

Wearing Course - The top Lift of PAC, regardless of thickness.

Materials

00743.10 Aggregate - Furnish new Aggregates meeting the following requirements:

(a) New Coarse and Fine Aggregates - Produce and stockpile coarse and fine Aggregate from crushed Rock or other inert material of similar characteristics.

No natural or uncrushed blend sand will be allowed in PAC.

(1) Soundness - Provide coarse and fine Aggregate with a weighted loss not exceeding 12 percent when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

(2) Durability - Provide Aggregate not exceeding the following maximum values:

	Test Method		Aggregates
Test	**ODOT**	**AASHTO**	**Coarse**
Abrasion		T 96	30.0%
Degradation			
Passing No. 20 sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(3) Fractured Faces - Provide crushed Aggregate with not less than the minimum number of fractured faces as determined by AASHTO T 355 as follows:

Percent of Fracture (by Weight)

Type of Mix	Material Retained on 1", 3/4", 1/2", and No. 4 Sieve (two fractured faces)	Material Retained on No. 8 sieve (one fractured face)
ATPB	75	75
PAC	90	75

(4) Harmful substances - Do not exceed the following values:

Test	Test Method ODOT	Test Method AASHTO	Aggregates Coarse	Aggregates Fine
Lightweight pieces		T 113	1.0%	
Wood Particles	TM 225		0.10%	
Elongated Pieces (at a ratio of 5:1)	TM 229		10.0%	
Plasticity Index		T 90		0 or NP
Sand Equivalent		T 176		45 min.

(b) Reclaimed Asphalt Pavement - Reclaimed asphalt Pavement (RAP) material used in the production of new PAC is optional. No more than 30 percent RAP material will be allowed in the new PAC Pavement. Use RAP Aggregates in the PAC that are no larger than the specified maximum allowable Aggregate size before entering the cold feed. Blend the RAP material with new Aggregate to provide a mixture conforming to the JMF within the tolerances specified.

00743.11 Asphalt Cement, Additives, and Aggregate Treatment - Furnish the following asphalt cement and additives:

(a) Asphalt Cement - Use the grade of asphalt that is specified in the Contract Documents. A polymer modified asphalt cement is required in the wearing Course. Provide asphalt cement conforming to the requirement of ODOT's publication *Standard Specifications for Asphalt Materials*. Copies of the publication are available on ODOT's website. The applicable Specifications are those contained in the current publication on the date the Project is advertised.

(b) Asphalt Cement Additives - Use standard recognized asphalt cement additive products that are of known value for the intended purpose and approved for use on the basis of laboratory tests and capable of being thoroughly mixed. Do not use asphalt cement additives that have deleterious effects on the asphalt material. Do not use silicones as an additive. Add the following asphalt cement additives when required by the JMF:

- Anti-stripping asphalt cement additives to prevent stripping or separation of asphalt coatings from Aggregates to satisfy the TSR specified in 00743.13.
- Asphalt cement admixtures used to aid in the mixing.

00743.12 Mix Type and Broadband Limits - Furnish the mix type specified in the Contract Documents within the broadband limits according to the following:

(a) Mix Type - Furnish the types of PAC shown or as directed.

(b) Broadband Limits - Provide a JMF for the specified mix type within the control points listed below:

Sieve Size	3/8" PAC Control Points (% passing by Weight)		1/2" PAC Control Points (% passing by Weight)		3/4" ATPB Control Points (% passing by Weight)	
	Min.	Max.	Min.	Max.	Min.	Max.
1"					99	100
3/4"			99	100	85	95
1/2"	99	100	90	98	35	68
3/8"	90	100	–	–	–	–
No. 4	22	40	18	32	2	10
No. 8	5	15	3	15	0	5
No. 200	1.0	5.0	1.0	5.0	0.0	2.0
Asphalt Cement	*	*	*	*	2.5	3.5

* Per JMF

00743.13 Job Mix Formula Requirements - Do not begin production of PAC for use on the Project until the JMF is reviewed by the Engineer and written consent is provided to proceed. The JMF proposed for use on the Project will be evaluated based on the criteria identified in 00743.13(b) and the latest ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*. For all mixes, complete TSR testing at least once per calendar year. A new JMF is required if the asphalt cement grade or source, any additives, or the source of the Aggregate change during production.

(a) Contractor Provided Job Mix Formula - Have a CMDT prepare, sign, and submit a JMF to the Engineer for each mixture required at least 10 Calendar Days before the anticipated use in PAC, and according to the latest copy of the ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*. If requested, submit material samples at least 10 Calendar Days before use.

(b) Job Mix Formula Requirements - Provide a JMF meeting the following mixture requirements:

	3/8" and 1/2" PAC	3/4" ATPB
Design Method	ODOT	ODOT
Air Voids, %	16.0 - 20.0	–
Draindown, %	70 - 80	–
TSR *, % minimum	80	–
Coating, % minimum	–	90
VFA, %	30 - 50	–

* Run the TSR for open graded mixtures on a surrogate dense graded mixture. If a dense graded JMF has been prepared for the same material sources in the last year, the results for the most recent TSR may be applied to the porous asphalt mixture. If not, prepare the TSR test samples for a dense graded mix using the equivalent top size stone and materials from the same sources, which will represent the porous asphalt mixture.

00743.14 Tolerances and Limits - Produce and place PAC within the following JMF tolerances and limits:

Gradation Constituent	PAC Type 1/2"	3/8"	ATPB
1"			99 - 100%
3/4"	99 - 100%		85 - 95%
1/2"	90 - 98%	99-100%	35 - 68%
3/8"	–	90-100%	–
No. 4	JMF ± 5%	JMF ± 5%	JMF ± 5%
No. 8	JMF ± 4%	JMF ± 4%	JMF ± 4%
No. 30	JMF ± 4%	JMF ± 4%	–
No. 200	JMF ± 2.0%	JMF ± 2.0%	JMF ± 2.0%

Constituent of Mixture	PAC All Types
Asphalt Cement - ODOT TM 321 (Cold Feed/Meter)	JMF ± 0.20%
Asphalt Cement - AASHTO T 308 (Ignition) and ODOT TM 323	JMF ± 0.50%
RAP Content - ODOT TM 321	JMF ± 2.0%
Moisture content at time of discharge from the mixing plant - AASHTO T 329*	1.10% max.

* Does not apply to 3/4" ATPB

When a JMF tolerance applies to a constituent, full tolerance will be given even if it exceeds the control points established in 00743.12(b).

00743.16 Sampling and Testing - For each 1,000 tons of placement, have a CAT-1 perform a minimum of one of each of the following test methods as modified in the MFTP:

- Asphalt Content:
  - Mixes with RAP - AASHTO T 308 with ODOT TM 323 determined Calibration Factor
  - Mixes without RAP - AASHTO T 308 with ODOT TM 323 determined Calibration Factor or ODOT TM 321
- Gradation:
  - Mixes with RAP - AASHTO T 30
  - Mixes without RAP - AASHTO T 30 or AASHTO T 27/11
- Mix Moisture - AASHTO T 329

When less than 1,000 tons of mix is placed in a Day, perform a minimum of one series of tests per Day. Provide test results to the Engineer by the middle of the following work shift.

If less than three samples are obtained on a Project, the Contractor may supplement test results with the Engineer's approval by:

- Accelerating testing.
- Provide test results from other projects with the same JMF within the past 120 days of first date of JMF production.

- Test back up samples.

Provide a minimum of three test results. Provide samples or split samples to the Engineer when requested.

00743.17 Acceptance - If the average for each mix gradation constituent and asphalt content is within the Specification limits, the Material will be accepted. If the average asphalt content or one or more gradation constituents is not within the Specification limits, the Material that is not within the Specification limits will be accepted according to 00150.25.

Equipment

00743.20 Pavers - Provide pavers specifically designed to spread and finish asphalt concrete Pavement to a uniform texture in the widths, thicknesses, lines, grades, and Cross Sections specified. When approved, alternate equipment may be used for areas where the use of a paver is impracticable.

00743.21 Compactors - Provide self-propelled steel-wheeled rollers specifically designed to compact asphalt concrete Pavement and capable of reversing without backlash. Provide a sufficient number of appropriately weighted rollers to compact the mixture.

Labor

00743.30 Quality Control Personnel - Provide technicians having CAT-I, CMDT, and CAgT technical certifications.

Construction

00743.40 Season and Temperature Limitations - Place PAC when the temperature of the surface that is to be paved is not less than 50 °F.

00743.41 Prepaving Conference - Have a prepaving conference with all Contractor Supervisory personnel, all Subcontractors who are to be involved in the paving Work, and the Engineer. Meet at a mutually agreed time to discuss all methods of accomplishing all phases of the paving Work.

00743.42 Preparation of Underlying Surfaces - All bases and foundations on which the Pavement is to be constructed shall meet the applicable Specifications and be approved before beginning paving operations. Recondition existing bases and foundations according to Section 00610. Trim broken or ragged edges to firm material when directed.

The Pavement surface shall be dry before the preparation Work and paving.

00743.43 Mixing and Placement Temperatures - Establish the allowable mixing and placement temperature ranges by the JMF. Measure the mixture temperature at the discharge of the mixer. Measure the placement temperature behind the paver. The maximum mixture temperature of the PAC at the mixer is 350 °F. The minimum placement temperature of the PAC behind the paver is 205 °F

00743.44 Hauling, Depositing, and Placing - Haul, deposit, and place PAC according to the following:

(a) Hauling - Cover PAC if rain or cold air temperatures are encountered any time between loading and placement.

If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the mixture delivery rate matches the paving machine operation.

(b) Depositing - Deposit PAC from the hauling vehicles so segregation is prevented.

(c) Placing - Place the mixture in the number of Lifts and Courses, and to the compacted thickness for each Lift and Course, as shown. Place each Course in one Lift unless otherwise specified. Do not exceed a compacted thickness of 4 inches for any Lift unless approved. Limit the minimum Lift thickness to twice the maximum Aggregate size in the mix.

Uncompacted mixture behind the paver with temperatures below the minimum specified in 00743.43 will be rejected unless otherwise allowed by the Engineer.

Do not place PAC during rain or other adverse weather conditions, unless allowed by the Engineer. PAC in transit at the time adverse conditions occur may be placed if:

- It has been covered during transit.
- The PAC temperature is satisfactory.
- It is placed on a foundation free from pools or flow of water.

00743.45 Longitudinal Joints - At longitudinal joints, bond, compact and finish the PAC equal to the Pavement against which it is placed.

(a) Location - Place the PAC in Panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one Panel by at least 6 inches from the longitudinal joints in the Panel immediately below.

(1) Base Course - Place Base Course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

(2) Wearing Course - Do not construct longitudinal joints within the width of a Traffic Lane. Construct longitudinal joints at either skip lines or fog lines unless approved. On Median lanes and on Shoulder areas construct longitudinal joints only at lane lines or at points of change in the transverse slopes, as shown or as directed.

(b) Drop-Offs:

- Provide warning signs and markings according to Sections 00222 and 00225 where abrupt or sloped edge drop-offs 1 inch or more in height occur.
- Protect edges from being broken down.

00743.49 Compaction - After the PAC has been spread, struck off, and surface irregularities and other defects remedied, roll it uniformly until compacted. Compaction of PAC to a specified density will not be required. Continue the breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the rollers. Perform additional coverages to complete finish rolling of the PAC.

Maintenance

00743.60 Correction of Defects - Correct all defects in material and Work, as directed, at no additional cost to the Agency, according to the following:

(a) Fouled Surfaces - Repair and clean fouled surfaces that would prevent full bond between successive Lifts of mixture.

(b) Boils, Slicks, and Oversized Material - Replace boils, slicks, and oversized material with fresh mixture. If problems with boils and slicks continue to occur, stop production until a plan for eliminating the boils and slicks is approved by the Engineer.

(c) Roller Damage to Surface - Correct surface damage from rollers with additional fresh mixture or by other means approved by the Engineer.

Finishing and Cleaning Up

00743.70 Pavement Smoothness - Furnish a 12-foot straightedge and test as specified. Additional testing may be required. Mark areas not meeting the surface tolerance.

(a) Travel Lanes - Test wearing Course with the 12-foot straightedge in travel lanes parallel to and perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

(b) Utility Appurtenances - If the Contractor constructs or adjusts Utility appurtenances the tolerances of 00743.70(a) apply. If the Utility appurtenances are adjusted by others, these tolerances do not apply.

(c) Shoulders, Paved Medians, Parking Lanes, and Parking Lots - Straightedge testing in Shoulders, paved Medians, parking lanes, and parking lots is not required.

00743.71 Correction of Pavement Roughness - Correct Equipment or paving operation procedures when tests show the Pavement smoothness does not comply with 00743.70. In addition, do the following:

(a) Methods - Correct wearing Course surface roughness to the required tolerances, using one of the following methods as approved by the Engineer:

- Remove and replace the wearing surface Lift.
- Profile to a maximum depth of 0.3 inch with abrasive grinders equipped with a cutting head comprised of multiple diamond blades.

(b) Time Limit - Complete correction of all surface roughness within 14 Calendar Days of completion of paving.

00743.72 Opening to Traffic - Allow PAC to cure at least 72 hours before opening to traffic, unless otherwise directed.

Measurement

00743.80 Measurement - The quantities of PAC will be measured on the weight basis.

No deductions will be made for asphalt cement, mineral filler, lime, anti-strip, or any other additive used in the mixture.

Payment

00743.90 Payment - The accepted quantities of PAC incorporated into the Project, whether or not recycled Materials are used, will be paid for at the Contract unit price, per ton, for the item "____ Mixture".

The types of PAC (1/2 inch PAC, 3/8 inch PAC, 3/4 inch ATPB) will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for Leveling Work, QC testing, asphalt cement, mineral filler, lime, anti-stripping or other additives.

Section 00744 - Asphalt Concrete Pavement

Description

00744.00 Scope - This Work consists of constructing asphalt concrete Pavement (ACP) to the lines, grades, thicknesses, and Cross Sections shown or established.

00744.01 Abbreviations:

HMAC - Hot Mix Asphalt Concrete
MAMD - Moving Average Maximum Density
RAM - Recycled Asphalt Material
TSR - Tensile Strength Ratio
VFA - Voids Filled with Asphalt
VMA - Voids in Mineral Aggregate
WMAC - Warm Mix Asphalt Concrete

00744.02 Definitions:

Asphalt Concrete Pavement - Uniformly coated mixture of asphalt cement, graded Aggregate, and additives as required. The use of ACP in this section refers to either hot mix or warm mix asphalt concrete.

Hot Mix Asphalt Concrete - A hot plant mixed ACP.

Level 1 ACP - ACP for use in applications with very low traffic and only limited exposure to trucks.

Level 2 ACP - ACP for use in applications with low traffic volumes and low volume truck traffic.

Level 3 ACP - ACP for use in applications exposed to moderate truck traffic.

Recycled Asphalt Material - The combination of reclaimed asphalt Pavement (RAP) and recycled asphalt shingles (RAS).

Warm Mix Asphalt Concrete - An asphalt concrete mix following all requirements of HMAC, except that through use of approved additives or processes, it is mixed, placed, and compacted at lower temperatures.

Materials

00744.10 Aggregate - Furnish new Aggregate, RAP Aggregate, and RAS Aggregate meeting the following requirements:

(a) New Coarse and Fine Aggregates - Produce coarse and fine Aggregate from crushed Rock or other inert material of similar characteristics.

Blend sand is allowed for Levels 1, 2, and 3 mixes. Do not use more than 6 percent natural or uncrushed blend sand, by weight, in the total Aggregate. Provide a means of verifying and documenting the amount of blend sand added to the Aggregate.

Testing of Aggregates for soundness, durability, and harmful substances will be at the discretion and expense of the Agency.

(1) Soundness - Provide coarse and fine Aggregate with a weighted loss not exceeding 12 percent when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

(2) Durability - Provide Aggregate not exceeding the following maximum values:

Test	Test Method		Aggregates
	ODOT	AASHTO	Coarse
Abrasion		T 96	30.0%
Degradation			
Passing No. 20 sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

(3) Fractured Faces - Provide crushed Aggregate with not less than the minimum number of fractured faces as determined by AASHTO T 335 as follows:

	Percent of Fracture (by Weight)	
Type of Mix	Material Retained on 1", 3/4", 1/2" and No. 4 Sieve (two fractured faces)	Material Retained on No. 8 sieve (one fractured face)
All ACP	75	75

(4) Harmful Substances - Do not exceed the following maximum values:

Test	Test Method		Aggregates	
	ODOT	AASHTO	Coarse	Fine
Lightweight pieces		T 113	1.0%	
Wood Particles	TM 225		0.10%	
Elongated Pieces (at a ratio of 5:1)	TM 229		10.0%	
Plasticity Index		T 90		0 or NP
Sand Equivalent		T 176		45 min.

(b) Reclaimed Asphalt Pavement - RAP material used in the production of new ACP is optional. No more than 30 percent RAP material will be allowed in the new ACP Pavement. Use RAP Aggregates in the ACP that are no larger than the specified maximum allowable Aggregate size before entering the cold feed. Blend the RAP material with new Aggregate to provide a mixture conforming to the JMF within the tolerances specified.

(c) Recycled Asphalt Shingles - RAS used in the production of new ACP is optional. Either manufacturer waste (post-manufacturer) RAS or tear-off (post-consumer) RAS may be used. Manufacturer waste RAS is processed asphalt shingle material derived from manufacturer's shingle scrap. Tear-off RAS is processed asphalt shingle material derived from shingle scrap removed from Structures. All percentages are based upon dry weights for calculations.

(1) Processing Shingles - Process the RAS by grinding at ambient temperature so that 100 percent of the shredded pieces are less than 1/2 inch in any dimension and that 90 percent are less than 3/8 inch in any dimension when sampled according to AASHTO R 90 and tested according to AASHTO T 27. Sample and test the processed RAS for gradation at a frequency of one test for every 50 tons of RAS processed.

(2) Harmful Substances - Certify that the RAS does not contain asbestos fibers according to the policies and procedures established by the Department of Environmental Quality. Test deleterious materials according to ODOT TM 335 at a frequency of one test for every 50 tons of RAS material. Limit the percentage of deleterious materials to 1.0 percent. If fine Aggregate is added as an anti-clumping agent, sample and test processed RAS for harmful substances before adding the fine Aggregates.

(3) Anti-Clumping Additive - Fine Aggregate meeting the requirements of 00744.10(a) may be added to the RAS in a quantity not to exceed 4 percent by weight of RAS to keep the material workable and to prevent conglomeration of the shingle particles in the stockpile. Include these added fine Aggregates in the mix design. RAS may also be blended with RAP in controlled percentages to preclude clumping. Do not contaminate stockpiled RAS with dirt or other foreign materials.

(4) Allowable Percentages - No more than 5.0 percent RAS by total weight of Aggregate is allowed in ACP mixtures. Restrict the maximum allowable percentage of asphalt binder replacement to 20.0 percent for Base Courses and 15.0 percent for wearing Courses in ACP containing only RAS.

When RAS is used in conjunction with RAP, restrict the maximum allowable percentage of binder replacement to 30.0 percent for Base Courses and 25.0 percent for wearing Courses.

(5) Establishing Mix Design Inputs - For ACP mixtures containing RAS or RAM, following any addition of fine Aggregate as an anti-clumping agent, test the material according to ODOT TM 319 to establish the asphalt content, material specific gravities, and gradation. Develop mixture designs according to the ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*.

Blend the RAS or RAM with new Aggregate to provide a mixture conforming to the JMF within the tolerances specified.

00744.11 Asphalt Cement and Additives - Furnish the following asphalt cement and additives:

(a) Asphalt Cement - Provide asphalt cement conforming to the requirement of ODOT's publication *Standard Specifications for Asphalt Materials*. Copies of the publication are available from ODOT's website. The applicable Specifications are those contained in the current publication on the date the Project is advertised. Use the grade of asphalt that is specified in the Special Provisions.

(b) Asphalt Cement Additives - Use standard recognized asphalt cement additive products that are of known value for the intended purpose and approved for use on the basis of laboratory tests and capable of being thoroughly mixed. Do not use asphalt cement additives that have detrimental effects on the asphalt material. Do not use silicones as an additive. Add the following asphalt cement additives when required by the JMF:

- Anti-stripping asphalt cement additives to prevent stripping or separation of asphalt coatings from Aggregates to satisfy the TSR specified in 00744.13.
- Asphalt cement admixtures used to aid in the mixing or use of asphalt mixes or for experimental purposes.

When WMAC is used, select one of the WMAC technologies and process and additive types identified on ODOT's publication *Approved WMAC Technologies*.

Submit the proposed WMAC technology to be used and a plan for its implementation at the pre-construction conference.

Comply with the manufacturer's recommendations for incorporating additives and WMAC technologies into the mix. Comply with manufacturer's recommendations regarding receiving, storing, and delivering the additives.

00744.12 Mix Type and Broadband Limits - Furnish the mix type specified in the Contract Documents within the broadband limits according to following:

(a) Mix Type - Furnish the types of ACP shown or as directed. When the Plans allow an option of two types for a Course of Pavement, use only one type throughout the Course.

(b) Broadband Limits - Provide a JMF for the specified mix type within the control points listed below:

Sieve Size	3/4" ACP Control Points (% passing by Weight)		1/2" ACP Control Points (% passing by Weight)		3/8" ACP Control Points (% passing by Weight)	
	Min.	Max.	Min.	Max.	Min.	Max.
1"	100					
3/4"	90	100	100			
1/2"	–	90	90	100	100	
3/8"	–	–	–	90	90	100
No. 4	–	–	–	–	–	90
No. 8	23	49	28	58	32	67
No. 200	2.0	8.0	2.0	10.0	2.0	10.0

00744.13 Job Mix Formula Requirements - Provide a JMF for the Project meeting the following criteria and that was either developed or verified within 3 years of the date the Contract was advertised:

	Level 1	Level 2	Level 3
Design Method	Superpave	Superpave	Superpave
Compaction Level	65 Gyrations	65 Gyrations	80 Gyrations
Air Voids, %	3.5	4.0	4.0
VMA, % minimum	1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0
VMA, % maximum	min + 2.0%	min + 2.0%	min + 2.0%
P No. 200 / Eff. AC ratio	0.8 to 1.6	0.8 to 1.6	0.8 to 1.6
TSR, % minimum	80	80	80
VFA, %	70 - 80 3/8 inch: 70 - 80	65 - 78 3/8 inch: 70 - 80	65 - 75 3/8 inch: 70 - 80

Develop the JMF according to the ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*; or verify according to the ODOT Mix Design Verification process. Submit the proposed JMF and supporting data to the Engineer for review at least 10 Calendar Days before anticipated use. If acceptable, written acceptance will be provided. Perform a new TSR if the source of the asphalt cement changes.

For Level 3 wearing Course mixes, include the results of the performance testing as outlined in the latest ODOT *Contractor Mix Design Guidelines for Asphalt Concrete* in the mix design submittal.

Issue a separate JMF for WMAC. Do not use RAS in WMAC mixes with minimum compaction temperatures less than 260 °F.

When WMAC is used, provide the following information in addition to the requirements listed for ACP:

- WMAC technology and WMAC additives information.
- WMAC technology manufacturer's established recommendations of usage.
- WMAC technology manufacturer's established target rate for water and additives, the acceptable variation for production, and documentation showing the impact of excessive production variation.
- WMAC technology material safety data sheets if applicable.
- Temperature range for mixing.
- Temperature range for compacting.
- Except for foaming technology, asphalt binder performance grade test data of the asphalt binder and chemical additive at the manufacturer's recommended dosage rate.
- Except for foaming technology, WMAC mixture performance test results. Perform testing for foaming technology on the production mix on specimens compacted at WMAC compaction temperatures.

00744.14 Tolerances and Limits - Produce and place ACP within the following JMF tolerances and limits:

Gradation Constituent	ACP Type 3/4"	1/2"	3/8"
1"	JMF ± 5% *		
3/4"	90 - 100%	JMF ± 5% *	
1/2"	JMF ± 5%	90 - 100%	JMF ± 5% *
3/8"	–	–	90 - 100%
No. 4	JMF ± 5%	JMF ± 5%	JMF ± 5%
No. 8	JMF ± 4%	JMF ± 4%	JMF ± 4%
No. 30	JMF ± 4%	JMF ± 4%	JMF ± 4%
No. 200	JMF ± 2.0%	JMF ± 2.0%	JMF ± 2.0%

* Maximum not to exceed 100%

Constituent of Mixture	ACP All Types
Asphalt Cement - AASHTO T 308 (Ignition) and ODOT TM 323	JMF ± 0.50%
RAP Content - ODOT TM 321	JMF ± 2.0%
RAS Content - ODOT TM 321	JMF ± 1.0%
RAM Content - ODOT TM 321	JMF ± 2.0%
Moisture content at time of discharge from the mixing plant - AASHTO T 329	0.80% max.

When a JMF tolerance applies to a constituent, full tolerance will be given even if it exceeds the control points established in 00744.12(b). Full tolerance will be given for RAP, RAS, or RAM content even if it exceeds the limits established in 00744.10.

00744.16 Sampling and Testing - For each 1,000 tons of placement, have a CAT-I perform a minimum of one of each of the following test methods as modified in the MFTP:

- Asphalt Content - AASHTO T 308 with ODOT TM 323 determined Calibration Factor
- Gradation - AASHTO T 30
- Mix Moisture - AASHTO T 329
- Maximum Specific Gravity - AASHTO T 209

When less than 1,000 tons of mix is placed in a Day, perform a minimum of one series of tests per Day. Provide test results to the Engineer by the middle of the following work shift.

If less than three samples are obtained on a Project, the Contractor may supplement test results with the Engineer's approval by:

- Accelerating testing.
- Providing test results from other projects with the same JMF within the past 120 days of first date of JMF production.
- Testing back up samples.

Provide a minimum of three test results. Provide samples or split samples to the Engineer when requested.

00744.17 Acceptance - If the average for each mix gradation constituent and asphalt content is within the Specification limits, the Material will be accepted. If the average asphalt content or one or more gradation constituents is not within the Specification limits, the material that is not within the Specification limits will be accepted according to 00150.25.

Equipment

00744.23 Pavers - Provide pavers that are:

- Self-contained, self-propelled, supported on tracks or wheels, none of which contact the mixture being placed.
- Equipped with augers and a screed or strike-off assembly, heated if necessary, which:
  - Can spread and finish the ACP to a uniform texture, in the specified widths, thicknesses, lines, grades and Cross Sections.
  - Will not segregate, tear, shove or gouge the ACP.
- Equipped with a paver control system which:
  - Controls the ACP placement to specified Slope and grade.
  - Maintains the paver screed in proper position.
  - Provides the specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references.

00744.24 Compactors - Provide self-propelled steel-wheeled or vibratory rollers specifically designed to compact ACP and capable of reversing without backlash. Provide a sufficient number of appropriately weighted rollers to compact the mixture. Equip vibratory rollers with amplitude and frequency controls. Do not operate in vibratory mode for Lifts thinner than two times the maximum Aggregate size for the type of ACP being compacted.

Labor

00744.30 Quality Control Personnel - Provide technicians having CAgT, CAT-I, CDT, and CMDT technical certifications.

Construction

00744.40 Season and Temperature Limitations - Place ACP when the temperature of the surface that is to be paved is not less than the temperature specified:

Nominal Compacted Thickness of Individual Lifts and Courses as shown on the Typical Section of the Plans	All Levels	Level 1 and Level 2		Level 3			
		All Courses		Travel Lane Wearing Course		All Other Courses	
	Surface Temperature*	From	To Inclusive	From	To Inclusive	From	To Inclusive
Less than 2 inches	60 °F	All Year**		3/15	9/30	All Year**	
2 inches - 2 1/2 inches	50 °F	All Year**		3/15	9/30	All Year**	
Greater than 2 1/2 inches	40 °F	All Year**		3/15	9/30	All Year**	
Temporary	40 °F	All Year**		All Year**		All Year**	

* Do not use field burners or other devices to heat the Pavement surface to the specified minimum temperature.

** If placing ACP between March 15 and September 30, temperature requirement may be lowered 5 °F.

00744.41 Mixing Temperatures - Produce ACP within the temperature ranges recommended by the asphalt cement Supplier for the grade of asphalt being used on the Project.

Establish the allowable mixing and placement temperature ranges by the JMF. Measure the mixture temperature at the discharge of the mixer. Measure the placement temperature behind the paver. The allowable production temperatures may be adjusted based on the asphalt cement Supplier's recommendation if approved by the Engineer. The maximum mixture temperature and the minimum placement temperature shall be as follows:

	Temperature, °F	
Type	Maximum at Mixer	Minimum Behind Paver
HMAC	350	240
WMAC	275	215

Within the above limits, the Contractor with approval of the Engineer, or the Engineer may adjust this temperature in 10 °F increments from the JMF as follows:

- **Up** - If the Aggregate coating, moisture content, workability or compaction requirements are not attained.
- **Down** - If the Aggregate coating, moisture content, workability and compaction requirements are attained.

00744.42 Tack Coat - Construct a tack coat before placing each Lift of ACP according to Section 00730. A tack coat is not required before placing ACP on Aggregate Base.

Remove all loose material that will reduce adhesion of the tack by brooming, flushing with water, or other approved methods.

Treat all paved surfaces on and against which ACP is to be placed with an asphalt tack coat according to Section 00730. Before applying the tack coat, clean and dry the surface to be tacked.

Treat all waterproofing membranes on and against which ACP is to be placed with an asphalt tack coat meeting the requirements of 00744.11(a) or as recommended by the membrane manufacturer.

00744.43 Hauling, Depositing, and Placing - Haul, deposit, and place ACP according to the following:

(a) Hauling - Cover ACP if rain is encountered any time between loading and placement.

ACP will be rejected before placing if one or more of the following occurs:

- Below temperature limit specified in 00744.41.
- Slumping or separating.
- Solidifying.

Dispose of rejected loads at no additional cost to the Agency.

Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the mixture delivery rate matches the paving machine operation.

(b) Depositing - Deposit ACP from the hauling vehicles so segregation is prevented.

(c) Placing - Alternative equipment and means may be allowed by the Engineer if the use of a paver is impractical.

Do not place ACP during rain or other adverse weather conditions, unless allowed by the Engineer. ACP in transit at the time adverse conditions occur may be placed if:

- It has been covered during transit.
- The ACP temperature is satisfactory.
- It is placed on a foundation free from pools or flow of water.

Place the mixture in the number of Lifts and Courses, and to the compacted thickness for each Lift and Course, as shown. Place each Course in one Lift unless otherwise specified. Do not exceed a compacted thickness of 4 inches for any Lift. Limit the minimum Lift thickness to twice the maximum Aggregate size in the mix.

00744.44 Longitudinal Joints - At longitudinal joints, bond, compact and finish the new ACP equal to the ACP against which it is placed.

(a) Location - Place the ACP in Panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one Panel by at least 6 inches from the longitudinal joints in the Panel immediately below.

(1) Base Course - Place Base Course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

(2) Wearing Course - Construct longitudinal joints at either lane lines or fog lines, or as shown or directed.

(b) Drop-Offs:

- Provide warning signs and markings according to Sections 00222 and 00225 where abrupt or sloped edge drop-offs 1 inch or more in height occur.
- Protect edges from being broken down.

If unable to complete the Pavement without drop-offs according to 00744.44(c) do the following:

- Construct and maintain a wedge of ACP at a Slope of 1V:10H or flatter along the exposed longitudinal joint.
- Remove and dispose of the wedge before continuing paving operations.
- Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Agency. ACP for the temporary wedge will be paid for at the Contract unit price.

(c) Placing Under Traffic - When placing ACP Pavement under traffic, schedule Work for the nominal thickness being laid as follows:

(1) More Than 2 Inches - Schedule Work so at the end of each working shift the full width of the area being paved, including Shoulders, is completed to the same elevation with no longitudinal drop-offs, unless approved.

(2) Less Than or Equal to 2 Inches - Schedule Work so that at the end of each working shift one Panel of new travel lane Pavement does not extend beyond the adjoining Panel of new travel lane Pavement more than the distance normally covered by each shift. At the end of each week complete the full width of the area to be paved, including Shoulders, to the same elevation with no longitudinal drop-offs.

00744.45 Transverse Joints:

(a) Travel Lanes - Construct transverse joints on the travel lane portion of all specified Pavement Courses, except Leveling Courses, as follows:

(1) Temporary End Panel - Maintain Pavement depth, line and grade at least 4 feet beyond the selected transverse joint location, and from that point, wedge down on the appropriate Slope until the top of the Course being laid meets the underlying surface (assuming a Pavement Course thickness of 2 inches) as follows:

- For wedges that will be under traffic for less than 24 hours, construct an 8 foot long wedge (1V:50H taper rate).
- For wedges that will be under traffic for 24 hours or longer, construct a 25 foot long wedge (1V:160H taper rate).
- Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Agency. ACP for the temporary wedge will be paid for at the Contract unit price.

When the Pavement Course thickness is different than the above 2 inch example, use the appropriate taper rate to compute the length of the wedge. The wedge length plus the 4 feet or longer Panel form the temporary end Panel.

(2) Vertical Face - After the mixture has reached the required density:

- Provide a smooth, vertical face the full depth of the Course being laid at the location selected for the joint by sawing, cutting or other approved method.
- Remove the ACP material from the joint to the end of the Panel. If removed before resuming paving beyond the joint, reconstruct the temporary end Panel immediately by placing a bond-breaker of paper, dust, or other suitable material against the vertical face and on the surface to be occupied by the temporary end Panel. Construct a full-depth Panel at least 4 feet long, beginning at the sawed or cut joint, and taper it on a 1V:50H Slope to zero thickness.

(3) Excess Asphalt Concrete Pavement - After completing a temporary end Panel as specified, dispose of unused, remaining ACP as directed. Payment will be made for the entire load of ACP, but will be limited to only one load for each joint of each Panel.

(4) Resume Paving - When permanent paving resumes, remove the temporary end Panel and any bond-breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

(5) Joint Requirements - Compact both sides of the joint to the specified density. When tested with a straightedge placed across the joint, the joint surface shall conform to 00744.70.

(b) Abutting Bridge Ends - Compact the ACP abutting bridge ends and other rigid type Structures in the longitudinal direction and either transverse or diagonal direction, as directed.

(c) Bridge Deck Overlays - Saw cut the wearing Course of Pavement directly over the joints in bridge decks, bridge end joints and end Panel end joints as soon as practical but within 48 hours of paving each stage of the wearing Course, unless otherwise directed. Saw cut a 3/8 inch wide, ± 1/8 inch, by 1/2 inch less than the thickness of the Panel of Pavement depth or 1 1/2 inches deep, whichever is less.

Flush the saw cut thoroughly with a high-pressure water stream after the cut has been made. Before the cut dries out, blow it free of water and debris with compressed air. Fill the saw cut joint with a hot applied joint sealant from the QPL.

00744.49 Compaction - After the ACP has been spread, struck off, and surface irregularities and other defects remedied, roll it uniformly until compacted to a minimum of 91 percent of MAMD. Perform finish rolling and continue until all roller marks are eliminated.

Determine compliance with density Specifications by random testing of the compacted surface with calibrated nuclear gauges. Determine the density by averaging QC tests performed by a CDT with the nuclear gauge operated in the backscatter mode according to AASHTO T 335 at one random location for each 100 tons of asphalt concrete placed, but take no less than 10 tests each shift. Do not locate the center of a density test less than 1 foot from the Panel edge. Calculate MAMD according to ODOT TM 305. The Engineer may waive compaction testing upon written notice.

Compaction to a specified density will not be required for the following:

- **Thin Pavements** - Leveling, patches, or where the nominal compacted thickness of a Course of ACP will be less than 2 inches.

- **Other Areas** - Temporary Surfacing, guardrail flares, mailbox turnouts, road approaches, and areas of restricted width of less than 8 feet wide or limited length, regardless of thickness.

Compact thin Pavements and other areas according to 00749.45.

Maintenance

00744.60 Correction of Defects - Correct all defects in materials and Work, as directed, at no additional cost to the Agency, according to the following:

(a) Fouled Surfaces - Repair, clean, and retack fouled surfaces that would prevent full bond between successive Lifts of mixture.

(b) Boils, Slicks, and Oversized Material - Replace boils, slicks, and oversized materials with fresh mixture.

(c) Segregation - Take corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved.

(d) Roller Damage to Surface - Correct surface damage from rollers with additional fresh mixture or by other approved means.

(e) Longitudinal Joints - Take corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved.

(f) Other Defects - Remove and replace any ACP that:

- Is loose, broken, or mixed with dirt.
- Shows visually too much or too little asphalt.

Finishing and Cleaning Up

00744.70 Pavement Smoothness - Furnish a 12-foot straightedge. Test with a 12-foot straightedge parallel to and perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch. Mark areas not meeting the surface tolerance.

00744.75 Correction of Pavement Roughness - Correct Equipment or paving operation procedures when tests show the Pavement smoothness does not comply with 00744.70. In addition, do the following:

(a) Methods - Correct surface roughness to the required tolerances, using one of the following methods as approved by the Engineer:

- Remove and replace the wearing surface Lift.
- Profile to a maximum depth of 0.3 inch with abrasive grinders equipped with a cutting head comprised of multiple diamond blades, and apply an emulsion fog seal as directed.

(b) Time Limit - Complete correction of all surface roughness within 14 Calendar Days following notification, unless otherwise directed.

Measurement

00744.80 Measurement - The quantities of ACP will be measured on the weight basis.

No deductions will be made for asphalt cement, mineral filler, lime, anti-strip, or any other additive used in the mixture.

Payment

00744.90 Payment - The accepted quantities of ACP incorporated into the Project, whether or not recycled Materials are used, will be paid for at the Contract unit price, per ton, for the item "Level ____, ____ ACP Mixture ____".

The following will be inserted in the blanks:

- The level of ACP (1, 2, 3) will be inserted in the first blank.
- The type of ACP (3/4 inch, 1/2 inch, 3/8 inch), will be inserted in the second blank.
- The words "in Leveling", "in Temporary", or "in Leveling and Temporary" will be inserted in the third blank when applicable.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- asphalt cement, mineral filler, lime, and anti-stripping or other additives
- sawing, cleaning, and filling joints on bridge deck overlays

Section 00745 - Asphalt Concrete Pavement - Statistical Acceptance

Description

00745.00 Scope - This Work consists of constructing one or more Courses of hot mix or warm mix asphalt concrete Pavement, plant mixed into a uniformly coated mixture, laid on a prepared foundation, compacted to specified density, and finished to a specified smoothness to the lines, grades, thickness, and Cross Sections shown or established.

00745.01 Abbreviations:

Gmm - Maximum Specific Gravity of Mixture
HMAC - Hot Mix Asphalt Concrete
MAMD - Moving Average Maximum Density
MDT - Maximum Density Test
MDV - Mix Design Verification
Pbe - Effective Asphalt Content
RAM - Recycled Asphalt Material
RAS - Recycled Asphalt Shingles
SDC - Surface Damp Condition
TSR - Tensile Strength Ratio
Va - Air Voids in Compacted Mixture
VFA - Voids Filled with Asphalt
VMA - Voids in Mineral Aggregate
WMAC - Warm Mix Asphalt Concrete

00745.02 Definitions:

Asphalt Concrete Pavement - Uniformly coated mixture of asphalt cement, graded Aggregate, and additives as required. The use of ACP in this section refers to either hot mix or warm mix asphalt concrete

Hot Mix Asphalt Concrete - A hot plant mixed, uniformly coated mixture of asphalt cement, graded Aggregate and additives as required.

Level 1 ACP - ACP for use in applications with very low traffic and only limited exposure to trucks.

Level 2 ACP - ACP for use in applications with low traffic volumes and low volume truck traffic.

Level 3 ACP - ACP for use in applications exposed to moderate truck traffic.

Level 4 ACP - ACP for use in applications exposed to very heavy traffic volumes or heavy truck traffic.

Lot Size - A lot is the total quantity of material or Work produced per JMF per Project. The following circumstances will require a different lot:

- A new JMF is used. A JMF adjusted according to 00745.16 is not considered a new JMF.
- The method for measuring compaction is changed.
- A new compaction specification limit is required according to 00745.49(b)(3).

- A change from one test procedure for measuring asphalt content to another test procedure for measuring asphalt content occurs.
- WMAC technology is used.

The Engineer may allow material for irregular areas not completed during the main paving operations, such as driveways or guardrail flares to be evaluated as a separate lot.

Recycled Asphalt Material - The combination of reclaimed asphalt Pavement (RAP) and recycled asphalt shingles (RAS).

Sublot Size - A sublot is 1,000 tons of ACP.

Surface Damp Condition - When the outside of the Aggregates are damp with moisture, but little or no free water is present.

Warm Mix Asphalt Concrete - An asphalt concrete mix following all requirements of HMAC, except that through use of approved additives or processes, it is mixed, placed, and compacted at lower temperatures.

Wearing Course - The top Lift of ACP, regardless of thickness.

Materials

00745.10 Aggregate - When requested by the Engineer, supervisory personnel of the Contractor and any Subcontractors who are to be involved in ACP Aggregate crushing shall meet with the Engineer at a mutually agreed upon time to discuss accomplishing all phases of the crushing Work.

(a) New Coarse and Fine Aggregates - Provide and stockpile new Aggregates according to the following requirements:

(1) General - Produce and stockpile Aggregate as follows:

a. Separated Sizes - Advise the Engineer of the separated sizes of coarse and fine Aggregate that will be used and the proposed targets for each individual sieve size for each stockpile. A minimum of one coarse Aggregate and one fine Aggregate stockpile is required. If the Contractor proposes to produce coarse and fine Aggregates in separated sizes other than those specified, request the proposed size changes in writing, and state the proposed target value and specified tolerance for each of the individual sieve sizes of the proposed materials.

The number of fine Aggregate separated sizes selected by the Contractor does not relieve the Contractor of providing a JMF and producing ACP meeting the air voids, VMA, and VFA requirements of 00745.13(a) and 00745.16(b)(1)(a). Perform recrushing, rescreening, or other special processing of the fine Aggregates necessary to achieve the air voids, VMA, or VFA requirements at no additional cost to the Agency.

b. Scalping - Scalp the Rock on a 3/4 inch sieve screen deck. For quarry Rock, scalp the Rock after it has passed through the primary crusher. The material remaining may be accepted for use by visual inspection. The Engineer may perform verification testing of the gradation. The material shall meet the following:

Sieve Size	Percent Passing (by Weight)
8"	95 - 100
3/4"	5 max.

c. Soundness - Provide coarse and fine Aggregate with a weighted loss not exceeding 12 percent when subjected to five cycles of the soundness test using sodium sulfate solution according to AASHTO T 104.

d. Durability - Provide Aggregate not exceeding the following maximum values:

Test	Test Method ODOT	Test Method AASHTO	Aggregates Coarse
Abrasion		T 96	30.0%
Degradation			
Passing No. 20 sieve	TM 208		30.0%
Sediment Height	TM 208		3.0"

e. Fractured Faces - Provide crushed Aggregate with not less than the minimum number of fractured faces as determined by AASHTO T 335 as follows:

Type of Mix	Percent of Fracture (by Weight): Material Retained on 1 1/2", 1", 3/4", 1/2" and No. 4 Sieve (two fractured faces)	Percent of Fracture (by Weight): Material Retained on No. 8 Sieve (one fractured face)
All ACP	75	75

f. Harmful substances - Do not exceed the following values:

Test	Test Method ODOT	Test Method AASHTO	Aggregates Coarse	Aggregates Fine
Lightweight pieces		T 113	1.0%	
Wood Particles	TM 225		0.10%	
Elongated Pieces (at a ratio of 5:1)	TM 229		10.0%	
Plasticity Index		T 90		0 or NP
Sand Equivalent		T 176		45 min.[1]

[1] 50 min. for Level 4 ACP

(2) Coarse Aggregate - Provide coarse Aggregate meeting the following:

a. General Requirements - Produce coarse Aggregate from crushed Rock or other inert material of similar characteristics.

b. Separated Sizes - Allowable separated sizes of coarse Aggregate are as follows:

Type of Asphalt Concrete Mixture	Allowable Separated Sizes 1 1/4" - 3/4"	3/4" - No. 4	3/4" - 1/2"	1/2" - No. 4
1" ACP	Yes	Yes	Yes	Yes
3/4" ACP	–	Yes	Yes	Yes
1/2" ACP	–	–	–	Yes

c. Grading - Determine sieve analysis according to AASHTO T 27 and AASHTO T 11. Establish the target values for each allowable separated size after a maximum of 10 percent

of planned stockpile quantity has been produced. Produce the Aggregate within the following listed tolerances (T):

	Separated Sizes			
	1 1/4" - 3/4"	3/4" - No. 4	3/4" - 1/2"	1/2" - No. 4
	Percent Passing (by Weight)			
Sieve Size	T	T	T	T
1 1/2"	– 1	–	–	–
1 1/4"	± 5	–	–	–
1"	± 10	– 1	– 1	–
3/4"	± 5	± 5	± 7	– 1
1/2"	–	± 8	± 8	± 5
3/8" *	–	–	–	–
No. 4	± 3	± 8	± 8	± 8
No. 8	–	± 5	± 5	± 5
No. 16 *	–	–	-	–
No. 30	± 1	± 3	± 3	± 3
No. 50 *	–	–	–	–
No. 100 *	–	–	–	–
No. 200	–	± 1.0	± 1.0	± 1.0

* Report percent passing sieve when no tolerance is listed

(3) Fine Aggregate - Provide fine Aggregate meeting the following:

a. General - Produce fine Aggregate from crushed Rock or other inert material of similar characteristics and if allowed, blend sand.

b. Separated Sizes - Allowable separated sizes for fine Aggregates are:

No. 4 - 0
No. 4 - No. 8
No. 8 - 0

c. Grading - Determine sieve analysis according to AASHTO T 27 and AASHTO T 11. Establish the target values for each allowable separate size after a maximum of 10 percent of planned stockpile quantity has produced. Produce the Aggregate within the following listed tolerances (T):

	Separated Sizes		
	No. 4 - 0	No. 4 - No. 8	No. 8 - 0
	Percent Passing (by Weight)		
Sieve Size	T	T	T
3/8"	– 1	– 1	–
No. 4	± 7	± 10	– 1
No. 8	± 7	± 7	± 10
No. 16 *	–	–	–
No. 30	± 7	± 5	± 8
No. 50 *	–	–	–
No. 100 *	–	–	–
No. 200	± 3.0	± 2.0	± 4.0

* Report percent passing sieve when no tolerance is listed

d. Combination of Fine Aggregate for Testing - Blend together fine Aggregate produced in two separate sizes at a 1:1 ratio when testing for sand equivalent.

e. Blend Sand - No natural or uncrushed blend sand will be allowed in Level 4 ACP. Blend sand is allowed for Levels 1, 2, and 3 mixes. For these mixes, establish the target gradation and produce all material within the following tolerances (T):

	Percent Passing (by Weight)
Sieve Size	**T**
3/8"	– 1
No. 4	± 5
No. 8	± 15
No. 30	± 20
No. 200	± 5.0

Determine sieve analysis according to AASHTO T 27 and AASHTO T 11. Do not use more than 6 percent natural or uncrushed blend sand, by weight, in the total Aggregate. Provide a means of verifying and documenting the amount of blend sand added to the Aggregate.

(b) Reclaimed Asphalt Pavement - RAP material used in the production of new ACP is optional. No more than 30 percent RAP will be allowed in Level 1, Level 2, and Level 3 ACP. No more than 30 percent RAP will be allowed in Level 4 Base Courses. No more than 20 percent RAP will be allowed in Level 4 wearing Courses.

Establish the amount of asphalt cement in the RAP in the mixture design phase according to ODOT TM 319 and the ODOT *Contractor Mix Design Guidelines for Asphalt Concrete* or other method if approved by the Engineer. Additional testing may be requested at any time by the Agency or the Contractor during the production of the RAP mixture to verify the amount of asphalt cement in the RAP. Conduct new tests by a laboratory mutually agreed upon by the Agency and the Contractor. The party requesting the additional testing pays the cost of the additional testing.

(c) Recycled Asphalt Shingles - RAS used in the production of new ACP is optional. Either manufacturer waste (post-manufacturer) RAS or tear-off (post-consumer) RAS may be used. Manufacturer waste RAS is processed asphalt shingle material derived from manufacturer's shingle scrap. Tear-off RAS is processed asphalt shingle material derived from shingle scrap removed from Structures. All percentages are based upon dry weights for calculations.

(1) Processing Shingles - Process the RAS by grinding without adding moisture so that 100 percent of the shredded pieces are less than 1/2 inch in any dimension and that 90 percent are less than 3/8 inch in any dimension when sampled according to AASHTO R 90 and tested according to AASHTO T 27. Sample and test the processed RAS according to the MFTP.

(2) Harmful Substances - Certify that the RAS does not contain asbestos fibers according to the policies and procedures established by the Department of Environmental Quality. Test deleterious materials according to ODOT TM 335 according to the MFTP. Limit the percentage of deleterious materials to 1.0 percent. If fine Aggregate is added as an anti-clumping agent, sample and test processed RAS for harmful substances before adding the fine Aggregates.

(3) Anti-Clumping Additive - Fine Aggregate meeting the requirements of 00745.10(a)(3)(c) may be added to the RAS in a quantity not to exceed 4 percent by weight of RAS to keep the material workable and to prevent conglomeration of the shingle particles in the stockpile. RAS may also be blended with RAP in controlled percentages to preclude clumping. Do not contaminate stockpiled RAS with dirt or other foreign materials.

(4) Allowable Percentages - No more than 5.0 percent RAS by total weight of Aggregate is allowed in ACP mixtures. Restrict the maximum allowable percentage of asphalt binder replacement to 20.0 percent for Base Courses and 15.0 percent for wearing Courses in ACP containing only RAS.

When RAS is used in conjunction with RAP, restrict the maximum allowable percentage of binder replacement to 30.0 percent for Base Courses and 25.0 percent for wearing Courses.

(5) Establishing Mix Design Inputs - For ACP mixtures containing RAS or RAM, following any addition of fine Aggregate as an anti-clumping agent, test the material according to ODOT TM 319 to establish the asphalt content, material specific gravities, and gradation. Develop mixture designs according to the ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*. Additional testing may be requested by the Agency or the Contractor at any time during the production of the RAS or RAM mixture to verify the amount of asphalt cement in the RAS or RAM. Conduct new tests by a laboratory mutually agreed upon by the Agency and the Contractor. The party requesting the additional testing pays the cost of the additional testing.

(d) Reclaimed Asphalt Pavement and Recycled Asphalt Shingle Aggregate - Blend the RAP, RAS, or RAM material with new Aggregate to provide a mixture conforming to the JMF within the tolerances specified. Have a CAT-I perform sampling and testing of RAP and RAS Aggregates according to Section 00165 and the MFTP.

(e) Stockpiling - Prepare the ground for the stockpile site to prevent contamination. Prevent segregation and contamination, as much as possible, when stockpiling and removing the Aggregate.

(f) Aggregate Production Quality Control - Have a CAgT perform sampling and testing of Aggregates according to Section 00165 and the MFTP. Statistically evaluate the Aggregates according to Section 00165 and the MFTP. Sample before treating with hydrated lime, when lime is required.

(g) Preproduced Aggregate - Compliance of Aggregates produced and stockpiled before the Award date or Notice to Proceed of this Contract will be determined by (1) or (2) below. The material shall meet the requirements of 00745.10.

(1) Continuing production records meeting the requirements of Section 00165 and the MFTP.

(2) Sampling and testing of the entire stockpile according to Section 00165 and the MFTP.

00745.11 Asphalt Cement, Additives, and Aggregate Treatment - Furnish the following asphalt cement, additives and Aggregate treatments:

(a) Asphalt Cement - Use the grade of asphalt specified in the Contract Documents. Provide asphalt cement conforming to the requirement of ODOT's publication *Standard Specifications for Asphalt Materials*. Copies of the publication are available from ODOT's Pavement Services Engineer. The applicable Specifications are those contained in the current publication on the date the Project is advertised.

PG 64-22 or PG 64-28 asphalt cement may be substituted for the grade of asphalt cement specified in the Contract for guardrail flares, mailbox turnouts, road approaches, driveways, and non-travel lane areas of restricted widths that are less than 8 feet wide, excluding Shoulders. Use of substitute asphalt cement for these areas will not require a new JMF.

(b) Asphalt Cement Additives - Use standard recognized asphalt cement additive products that are of known value for the intended purpose and approved for use on the basis of laboratory tests

and capable of being thoroughly mixed. Do not use asphalt cement additives that have deleterious effects on the asphalt material. Do not use silicones as an additive. Add the following asphalt cement additives when required by the JMF:

- Anti-stripping asphalt cement additives to prevent stripping or separation of asphalt coatings from Aggregates to satisfy the TSR specified in 00745.13.
- Asphalt cement admixtures used to aid in the mixing.

When WMAC is used, select one of the WMAC technologies and process and additive types identified on ODOT's publication *Approved WMAC Technologies*.

Submit the proposed WMAC technology to be used and a plan for its implementation at the pre-construction conference.

Comply with the manufacturer's recommendations for incorporating additives and WMAC technologies into the mix. Comply with manufacturer's recommendations regarding receiving, storing, and delivering the additives.

(c) Aggregate Treatment - When lime treated Aggregate is specified in the Contract Documents or required to satisfy the TSR specified in 00745.13, treat new crushed Aggregates, except those in RAP, RAS, or RAM materials, with dry hydrated lime meeting the requirements of Section 02090. Treat Aggregate as follows:

(1) General:

a. Mix the hydrated lime, water, and Aggregate thoroughly in a pug mill.

b. Determine the quantity of lime in Aggregate for each sublot according to ODOT TM 321. If the rates of application specified in 00745.11(c)(2)(b) are not met, take corrective action. Document the corrective action and notify the Engineer.

(2) Treatment During Production:

a. Mix dry lime, water (if necessary to achieve SDC), and Aggregates thoroughly in a pug mill before they enter the paving plant dryer.

b. Proportions of hydrated lime (percent by dry weight of dry Aggregates) and Aggregate moisture:

Hydrated Lime (%)	1.0
Lime Tolerance (%)	- 0.2/+ 0.5
Moisture Content of Aggregate	SDC

00745.12 Mix Type and Broadband Limits - Furnish the mix type specified in the Contract Documents within the broadband limits according to the following:

(a) Mix Type - Furnish the types of ACP shown or as directed. When the Plans allow an option of two types for a Course of Pavement, use only one type throughout the Course.

(b) Broadband Limits - Provide a JMF for the specified mix type within the control points listed below:

Sieve Size	3/4" ACP Control Points (% passing by Weight)		1/2" ACP Control Points (% passing by Weight)		3/8" ACP Control Points (% passing by Weight)	
	Min.	Max.	Min.	Max.	Min.	Max.
1"	100					
3/4"	90	100	100			
1/2"	–	90	90	100	100	
3/8"	–	–	–	90	90	100
No. 4	–	–	–	–	–	90
No. 8	23	49	28	58	32	67
No. 200	2.0	8.0	2.0	10.0	2.0	10.0

00745.13 Job Mix Formula Requirements - Do not begin production of ACP for use on the Project until the JMF is reviewed by the Engineer and written consent is provided to proceed. The JMF proposed for use on the Project will be evaluated based on the criteria identified in 00745.13(a) and 00745.13(b) and the latest ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*. A new JMF is required if the asphalt cement grade, any additives, or the source of the Aggregate change during production. A change in the source of asphalt cement requires a new passing TSR.

Provide a range of proposed JMF targets to the CMDT. The CMDT will select targets from within the proposed range if all of the JMF requirements of 00745.13(a) are met.

A separate JMF will be issued for WMAC. Do not use RAS in WMAC mixes with minimum compaction temperatures less than 260 °F.

When WMAC is used, provide the following information in addition to the requirements listed for HMAC:

- WMAC technology and WMAC additives information.
- WMAC technology manufacturer's established recommendations of usage.
- WMAC technology manufacturer's established target rate for water and additives, and the acceptable variation for production.
- WMAC technology material safety data sheets if applicable.
- Temperature range for mixing.
- Temperature range for compacting.
- Except for foaming technology, asphalt binder performance grade test data of the asphalt binder and chemical additive at the manufacturer's recommended dosage rate.
- Except for foaming technology, WMAC mixture performance test results. Perform testing for foaming technology on the production mix on specimens compacted at WMAC compaction temperatures.

Have a CMDT prepare, sign and submit a JMF to the Engineer for each mixture required at least 10 Calendar Days before the anticipated use in ACP, and according to the latest copy of the ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*. If requested, submit material samples at least 10 Calendar Days before use.

(a) Job Mix Formula Requirements - Provide a JMF meeting the following mixture requirements:

	Level 1	Level 2	Level 3	Level 4
Design Method	Superpave	Superpave	Superpave	Superpave
Compaction Level	65 Gyrations	65 Gyrations	80 Gyrations	100 Gyrations
Air Voids, %	3.5	4.0	4.0	4.0
VMA, % minimum	1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0	3/4 inch - 13.0 1/2 inch - 14.0 3/8 inch - 15.0
VMA, % maximum	min + 2.0%	min + 2.0%	min + 2.0%	min + 2.0%
P No. 200 / Eff. AC ratio	0.8 to 1.6	0.8 to 1.6	0.8 to 1.6	0.8 to 1.6
TSR, % minimum	80	80	80	80
VFA, %	70 - 80 3/8 inch: 70 - 80	65 - 78 3/8 inch: 70 - 80	65 - 75 3/8 inch: 70 - 80	65 - 75 3/8 inch: 70 - 80

(b) Performance Test - For Level 3 wearing Course mixes and all Level 4 mixes, the mix design submittal shall include the results of performance testing as outlined in the latest ODOT *Contractor Mix Design Guidelines for Asphalt Concrete*.

00745.14 Tolerances and Limits - For gradation, measure the sieves with a weighting factor of one or more according to 00745.95. Produce and place ACP within the following JMF tolerances and limits:

Gradation Constituent	3/4"	1/2"	3/8"
1"	JMF ± 5% *		
3/4"	90 - 100%	JMF ± 5% *	
1/2"	JMF ± 5%	90 - 100%	JMF ± 5% *
3/8" **	–	–	90 - 100%
No. 4	JMF ± 5%	JMF ± 5%	JMF ± 5%
No. 8	JMF ± 4%	JMF ± 4%	JMF ± 4%
No. 16 **	–	–	–
No. 30	JMF ± 4%	JMF ± 4%	JMF ± 4%
No. 50 **	–	–	–
No. 100 **	–	–	–
No 200	JMF ± 2.0%	JMF ± 2.0%	JMF ± 2.0%

* Maximum not to exceed 100 %

** Report percent passing sieve when no tolerance is listed

Constituent of Mixture	ACP
Asphalt Cement - AASHTO T 308 (Ignition) and ODOT TM 323	JMF ± 0.50%
RAP Content - ODOT TM 321	JMF ± 2.0%
RAS Content - ODOT TM 321	JMF ± 1.0%
RAM Content - ODOT TM 321	JMF ± 2.0%
Moisture content at time of discharge from the mixing plant - AASHTO T 329	0.80% max.

When a JMF tolerance applies to a constituent, full tolerance will be given even if it exceeds the control points established in 00745.12(b). Full tolerance will be given for RAP content even if it exceeds the limits established in 00745.10(b). Full tolerance will be given for RAS or RAM content even if it exceeds the limits established in 00745.10(c).

Take corrective action when the RAP, RAS, or RAM content, or the moisture content at time of discharge from the mixing plant, exceeds the above tolerance. If the RAP, RAS, or RAM content, or the moisture content at time of discharge from the mixing plant, continues to be outside tolerance, stop production until a plan for corrective action is approved by the Engineer.

00745.16 Asphalt Concrete Pavement Production QC/QA - Provide ACP according to the following:

(a) Quality Control - Provide and maintain a quality control program as defined in Section 00165, the MFTP, and according to the following:

(1) Personnel Requirements - Maintain quality control by:

- Obtaining samples according to the MFTP with certified technicians.
- Having all testing, data analysis and reporting of test results performed by a CAT-I.
- Having a CAT-II available to evaluate and reconcile laboratory and field test results, submit required forms within required timeframes, and make necessary process adjustments.
- Providing at least one CAT-I full-time at each plant site when producing mixture for the Project.
- Providing access to laboratory facilities, technicians, and test results to the Engineer at all times during the production and testing process.

(2) Laboratory Requirements - Furnish and maintain an ODOT certified quality control laboratory. Furnish the laboratory with the necessary Equipment and supplies for performing Contractor quality control testing. Calibrate all testing Equipment according to the required test methods. The Engineer may inspect measuring and testing devices to confirm both calibration and condition.

The laboratory shall be operational before beginning the ACP production and be equipped with a telephone or cellular telephone, if either service is available. Provide laboratory Equipment meeting the requirements of the applicable test methods identified in the Specifications and selected for use on the Project.

(3) Production Sampling and Testing - Perform sampling and testing according to Section 00165 and the MFTP.

(4) Testing Frequency - Conduct the above testing program, once for each sublot, on randomly selected samples for each design mixture. Do not obtain the first sample of the Day in the first 25 tons of production. If the random number indicates that the sample is to be obtained in the first 25 tons, sample at 25 tons. In addition, test the asphalt content at least once during each Day of production. This requirement may be waived by the Engineer.

Provide "QC Program" sampling and testing frequencies (random numbers) to the Engineer before starting production. Provide QC test results to the Engineer by the middle of the following work shift.

Stop production when the pay factor for any constituent with a weighting factor greater than one falls below 0.75. Resume production when a plan for correction is accepted by the Engineer.

(5) Plant Calibration - Calibrate all meters and belt scales at the ACP mixing plant according to ODOT TM 322 before beginning production.

(b) Mix Design Verification:

(1) Mix Design Verification Quality Control:

a. General - Before beginning production and placement of WMAC, perform mix design verification (MDV) tests on the HMAC as required at start-up according to 00745.16(b)(1)(d). Two consecutive MDV test results from testing of HMAC shall be within the limits of 00745.16(b)(1)(a). The Engineer may waive ODOT TM 306 for HMAC production required before WMAC production for one shift.

Perform MDV tests on every sublot and as required at start up according to 00745.16(b)(1)(d) and the MFTP. Perform gradation and asphalt content testing with each MDV test. Calculate the following values for each MDV test:

- Air Voids
- Voids in Mineral Aggregate (VMA)
- Voids Filled with Asphalt (VFA)
- Passing No. 200/Effective Asphalt Content (Pbe) Ratio

The running averages of four MDV results shall be within the limits given below:

	Average of	Limit
Air Voids	4 samples	JMF Target ± 1.0%
VMA	4 samples	12.5 - 17.0 (3/4" Mix)
		13.5 - 17.0 (1/2" Mix)
		14.5 - 17.0 (3/8" Mix)
VFA	4 samples	65 - 75 (3/4" and 1/2" Mix in Level 3 and 4)
		65 - 78 (3/4" and 1/2" Mix in Level 2)
		70 - 80 (1/2" Mix in Level 1 and 3/8" Mix in Levels 1 - 4)
Passing No. 200/Pbe	4 samples	0.8 - 1.6

b. Laboratory Compactor Selection - Use the equivalent laboratory compactor for MDV as used to develop the JMF.

c. Reconciliation of Laboratory and In-place Properties - Have a CDT provide the results from the initial control strip to the CAT-II for evaluation and comparison with the MDV results at the completion of the control strip. If the MDV and density test results are contradictory, inform the Engineer and initiate an investigation. The CAT-II shall recommend a plan to the Engineer for resolving the discrepancy based on the results of the investigation. Submit results of investigation and plan no later than the end of two shifts after investigation has been initiated.

d. Mix Design Verification Requirements at Start-Up - Perform MDV testing at the start-up of the JMF production according to the following process:

1. Obtain a sample in the first 100 tons of production and immediately perform MDV testing.

2. If the Va and VMA mix properties of 00745.16(b)(1)(a) are within tolerance, then continue subsequent MDV testing at the established random QC sublot interval. If not, then go to step "3".

3. If the Va and VMA mix properties are out of tolerance in 00745.16(b)(1)(a), then make mix adjustments within the requirements of 00745.16(b)(1)(e) and immediately obtain another sample and perform MDV testing. Two adjustments will be given. If any of the test results for Va and VMA are not within the limits of 00745.16(b)(1)(a) after second adjustment, then stop production and go to step "4".

4. Have the CAT-II submit the revised JMF targets and production and plant adjustments to the Engineer. Obtain the approval of the Engineer before restarting production. Production will be restarted with MDV testing according to this Subsection.

Use the initial MDV sample as the first random QC sublot test. Subsequent MDV samples required due to failure of start-up criteria will be used for a sublot QC test if the sample is taken within 100 tons of the scheduled random QC sample location. If not, perform the MDV testing separate from, and not included in, the random QC testing program. Complete all required MDV testing at no additional cost to the Agency.

e. Corrective Action - Take corrective action when required by the MDV start-up process of 00745.16(b)(1)(d). After the requirements of 00745.16(b)(1)(d) have been met, take corrective action if the MDV test results show that two consecutive running averages of four samples are outside the limits for air voids, VMA, VFA, or P No. 200/Pbe ratio according to 00745.16(b)(1)(a). Document the corrective action and submit to the Engineer. If the subsequent MDV test results following the corrective action are outside the limits of 00745.16(b)(1)(a), immediately stop production and make adjustments. Restart production according to 00745.16(b)(1)(d) only after the Engineer has approved the proposed adjustments. If the MDV test results are outside the limits of 00745.16(b)(1)(a), but the mixture meets the current requirements for gradation and asphalt content, an adjustment to the JMF targets is required. A new lot is not required as a result of the adjustment.

f. Field Tensile Strength Ratio Testing - Perform a Tensile Strength Ratio (TSR) test according to AASHTO T 283 on a sample obtained during the first 2 days of production after QC test results verify that ACP constituents with a weighting factor greater than one according to 00745.95 are in tolerance. Provide test results to the Engineer within 6 Calendar Days of obtaining the sample. Stop production and make adjustments if the TSR is less than 70. Restart production only after the Engineer has approved the proposed adjustments.

The Engineer may waive Field TSR testing if the Contractor provides Field TSR data dated within the prior 3 months of the first MDV sample.

g. Request for Job Mix Formula Target Adjustment - A request for an adjustment to the JMF targets may be made to the Engineer by the Contractor's CAT-II. The requested change will be reviewed and documented by the Engineer. If acceptable, a revised JMF will be allowed. Document the sublot test for which the adjusted targets are in effect. When making adjustments for gradation do not exceed the tolerances specified for the original JMF limits. Keep AC content adjustments for HMAC within 0.5 percent of the original JMF. Keep AC content adjustments for WMAC within 0.3 percent of the original JMF. The JMF asphalt content may only be adjusted if the production VMA meets the requirements of 00745.16(b)(1)(a). Keep adjustments for RAP or RAM within 5 percent of the original JMF blend percentage, but do not exceed the requirements of 00745.10(b) or 00745.10(c). Adjusting proportions of the combined RAP and RAS will not be allowed during production of the mixture. Keep adjustments for RAS content within 1 percent of the original JMF, but do not exceed the requirements of 00745.10(c). A gradation adjustment is required if the VMA

is outside of the 00745.16(b)(1)(a) limits. Regardless of these tolerances, keep the adjusted JMF within the mixture specification control points of 00745.12. If a redesign of the mixture becomes necessary, submit a new JMF according to the requirements of the Specifications.

(2) Mix Design Verification Quality Assurance - The Engineer will observe and document the Contractor's performing of MDV test procedures and calculations. Immediately correct any deviations from the specified test procedures. The Engineer may conduct MDV assurance testing at any time.

(3) Mix Design Verification for Warm Mix Asphalt Concrete - Perform MDV testing on WMAC according to 00745.16(b)(1)(a). Continued production and placement of WMAC will be allowed at the discretion of the Engineer.

(c) Quality Assurance and Acceptance - The Agency will provide quality assurance according to Section 00165. When QA testing is performed, the Contractor's quality control results will be used for acceptance if they are within acceptable limits of the QA test results as defined by ODOT's Quality Assurance Program.

00745.17 Small Quantity Acceptance - When the quantity of ACP in a lot is less than 2,500 tons, the Engineer may accept the ACP according to Section 4(B) of the MFTP or by test results according to the following:

(a) Within Specification Limits - If all sublot sample test results are within Specification limits for all constituents, including compaction, the material will be accepted and the Contract unit price will be paid for the material represented by that test.

(b) Outside Specification Limits - If a sublot sample test result for any constituent is outside the specification limit the Engineer will have the backup sample tested.

(1) Backup Within Specifications - If the backup sample test results for all constituents are within specification, the material will be accepted and the full Contract unit price will be paid for the material represented by that test.

(2) Backup Out of Specifications - If the backup sample test results are out of specification, the Contractor may choose to accept the price adjustment calculated according to 00745.95 or may choose to sample the in-place material for further testing according to 00745.17(b)(3). The price adjustments will be computed using all original test results as well as all backup test results. If there are less than three tests, average the two tests and use the average as a third test result. The maximum composite pay factor (CPF) will be 1.0.

(3) In-Place Samples - If the Contractor chooses to sample the in-place material, sample from a minimum of three random locations from the area represented by the lot in question under the observation of the Engineer. If the in-place sample test results are within specification, the material will be accepted and paid for at the full Contract unit price. If the in-place sample test results are not within specification, the material will be accepted and paid for at an adjusted price according to 00745.95. The maximum CPF will be 1.0. Perform sampling and testing of in-place material at no additional cost to the Agency.

Equipment

00745.20 Lime Treated Aggregate Plant - When lime treated Aggregate is specified, provide a mixing plant that includes:

- A pug mill that mixes the Aggregate and lime until the Aggregate is uniformly coated and the lime is distributed throughout the Aggregate.

- Provide a system for adding water to the pug mill if necessary to achieve Aggregate that is in SDC. This requirement may be waived by the Engineer if the stockpiled Aggregates are watered to the satisfaction of the Engineer.
- A lime metering or weighing device that determines the amount of lime incorporated within any selected time period. Provide a device that is of sufficient accuracy to supply lime within the tolerances specified in 00745.11(c).

00745.21 Mixing Plant - Provide ACP plants that comply with the following:

(a) DEQ Permits - Before producing ACP for this Contract at a new or revised plant location, provide the Engineer with copies of all permits according to 00160.70.

(b) Scales - Provide required scales to assure a uniform mixture. Check and adjust scales according to 00190.30.

(c) Vibratory Scalping Devices - Provide vibratory scalping devices ahead of the mixer to reject Aggregate, RAP, RAS, or RAM and lumps of cemented material that are detrimental to the mix.

(d) Asphalt Antistrip Additive Metering Device - When asphalt antistrip additive is added into the asphalt at the ACP mixing plant, provide a means to weigh or meter the additive at a specified rate that has an accuracy of plus or minus 0.5 percent.

(e) Thermometers - Provide the following:

- A direct reading, full operating range thermometer in the asphalt feed line near the mixer unit.
- A thermometric instrument that automatically registers the temperature of the materials at the discharge of the mixer.

(f) Sampling Devices - Provide and operate a device that produces a representative sample of the quantity of material required for the appropriate tests when sampling at or around crushing, screening or mixing plants.

(g) Warm Mix Asphalt Concrete Mixing Production - Modify the asphalt mixing plant as required by the manufacturer to introduce the WMAC technology. Plant modifications may include additional plant instrumentation, the installation of asphalt binder foaming systems and WMAC additive delivery systems, tuning the plant burner, and adjusting the flights in order to operate at lower production temperatures and reduced tonnage. Document the integration of plant controls and interlocks.

00745.22 Hauling Equipment - Provide hauling vehicles in good operating condition with tight, clean, smooth beds. Coat the beds with a minimum amount of an approved material to keep the ACP from sticking to the beds. Do not use diesel oil. Drain excess coating material before loading by raising the truck bed, opening belly dump gates, or operating the conveyor belt, as appropriate.

00745.23 Pavers - Provide pavers that are:

- Self-contained, self-propelled, supported on tracks or wheels, none of which contact the mixture being placed.
- Equipped with augers and a screed, heated when necessary, which:
  - Can spread and finish the ACP to a uniform texture, in the specified widths, thicknesses, lines, grades and Cross Sections.
  - Will not segregate, tear, shove or gouge the ACP.
- Equipped with a paver control system which:

- Controls the ACP placement to specified Slope and grade.
- Maintains the paver screed in proper position.
- Provides the specified results through mechanical sensors and sensor-directed devices actuated from independent line and grade control references.

- Equipped with adequate lighting to illuminate the paver and the roadway in front of and behind the paver during the period from 30 minutes after sunset to 30 minutes before sunrise, or as directed. Shield lighting from adjacent traffic as necessary. Provide a minimum light level of 10 footcandles as measured by the Engineer on the roadway surface at a distance of 16 feet from the front and back edges of the paver.

00745.24 Compactors - Provide the specified self-propelled rollers capable of reversing without backlash, as follows:

(a) Steel-Wheeled Rollers - Steel-wheeled rollers with a minimum gross static weight as follows:

	Level 1 and Level 2	Level 3	Level 4
Breakdown and Intermediate	8 ton	10 ton	12 ton
Finish	6 ton	8 ton	10 ton

(b) Vibratory Rollers - Vibratory rollers that:

- Are equipped with amplitude and frequency controls.
- Are specifically designed to compact ACP.
- Are Capable of at least 2000 vibrations per minute.
- Have a minimum gross static weight meeting the requirements of 00745.24(a).

Do not operate in vibratory mode for Lifts thinner than two times the maximum Aggregate size for the type of ACP being compacted.

If vibratory rollers are used for finish rolling, they shall:

- Have a minimum gross static weight meeting the requirements of 00745.24(a).
- Not be operated in the vibratory mode.

(c) Pneumatic-tired Rollers - Pneumatic-tired rollers shall:

- Be tandem, or multiple axle, multiple wheel type.
- Have smooth-tread, pneumatic tires of equal size.
- Have tires staggered on the axles, spaced and overlapped to provide uniform compacting pressure for the full compacting width.
- Have a minimum total load of 2,800 pounds per tire with tire inflation pressures of 45 psi to 90 psi
- Be fully skirted to reduce tire heat loss and mixture pick up.

(d) Illumination - Provide adequate lighting to illuminate each compactor and the roadway in front of and behind each compactor during the period 30 minutes after sunset to 30 minutes before sunrise, or as directed. Shield lighting from adjacent traffic as necessary. Provide a minimum light level of 10 footcandles as measured by the Engineer on the roadway surface at a distance of 60 feet from the front and back edges of each compactor.

Labor

00745.30 Quality Control Personnel - Provide technicians having CAgT, CAT-I, CAT-II, CDT, and CMDT technical certifications.

Construction

00745.40 Season and Temperature Limitations - Place ACP during the dates specified, and when the temperature of the surface that is to be paved is not less than the temperature specified:

Nominal Compacted Thickness of Individual Lifts and Courses as shown on the typical section of the Plans	All Levels	Level 1 and Level 2	Level 3 and Level 4	
		All Courses	Travel Lane Wearing Course	All Other Courses
	Surface Temperature*	From To Inclusive	From To Inclusive	From To Inclusive
Less than 2 inches	60 °F	All Year**	3/15 9/30	All Year**
2 inches - 2 1/2 inches	40 °F	All Year**	3/15 9/30	All Year**
Greater than 2 1/2 inches	40 °F	All Year**	3/15 9/30	All Year**
Temporary	40 °F	All Year**	All Year**	All Year**

* Do not use field burners or other devices to heat the Pavement surface to the specified minimum temperature unless approved.

** If placing ACP between March 15 and September 30, temperature requirement may be lowered 5 °F.

00745.41 Prepaving Conference - Have a prepaving conference with all Contractor supervisory personnel, all Subcontractors who are to be involved in the paving Work, and the Engineer. Meet at a mutually agreed time and discuss all methods of accomplishing all phases of the paving Work. When Level 3 and Level 4 mixes quantities are greater than 5,000 tons include in the prepaving conference a Contractor representative who is responsible for Project quality control.

00745.42 Preparation of Underlying Surfaces - All bases and foundations on which the Pavement is to be constructed shall meet the applicable Specifications and be approved before the start of paving. Recondition existing bases and foundations according to Section 00610. Trim broken or ragged edges to firm material when directed.

Remove existing pavement markers, recessed markers, and pavement legends before paving. Remove pavement lines, bars, and pavement legends as shown or directed and according to 00225.45.

Level and compact depressed areas with ACP as specified or directed. Perform the Leveling Work as a separate operation and at the locations and to the extent as shown or directed. Spread the Leveling material with a paving machine, unless otherwise directed.

Treat all paved surfaces on and against which ACP is to be placed with an asphalt tack coat, according to Section 00730.

Treat all waterproofing membranes on and against which ACP is to be placed with an asphalt tack coat meeting the requirements of 00745.11(a) or as recommended by the membrane manufacturer.

Protect all existing Structures from the overlay operation and check and clean as necessary after the overlay.

00745.43 Drying and Heating Aggregates:

(a) Burner Operation - Operate the burner used to heat the Aggregates to completely burn the fuel so the Aggregate and asphalt are not contaminated and the asphalt is suitably aged.

(b) Heating Temperatures - Establish the allowable mixing and placement temperature ranges by the JMF. Measure the mixture temperature at the discharge of the mixer. Measure the placement temperature behind the paver. The allowable production temperatures may be adjusted based on the asphalt cement Supplier's recommendation if approved by the Engineer. The maximum mixture temperature of the ACP and the minimum placement temperature shall be as follows:

	AC Temperature °F	
Grading Type	**Maximum At Mixer**	**Minimum Behind Paver**
HMAC	350	240
WMAC	–	215

Within the above limits, the Contractor with approval of the Engineer, or the Engineer may adjust this temperature in 10 °F increments from the JMF as follows:

- **Up** - If the Aggregate coating, moisture content, workability or compaction requirements are not attained.
- **Down** - If the Aggregate coating, moisture content, workability and compaction requirements are attained.

00745.44 Asphalt Concrete Pavement Storage - Temporary storing or holding of ACP in storage silos will be allowed if the Contractor complies with the following:

(a) Flow Diverter - Provide a device to divert the flow of ACP away from the silo when starting or stopping plant production, or at any other time necessary, so improperly proportioned mixture or incompletely mixed portions of the mixture do not enter the silo.

(b) Batcher - Equip storage silos with a batcher, rotating chute, or similar device to prevent segregation of ACP as it enters the silo.

(c) Unheated Silos - Store ACP in unheated silos only when the total elapsed time from the mixing to placing is less than 6 hours.

(d) Heated Silos - Store ACP in heated, insulated silos no more than 72 hours only if an atmosphere is maintained in the silo at all times which prevents damage to the mixture or asphalt properties.

(e) Discharging AC and Loading Trucks - Discharge the ACP and load trucks so segregation is prevented. If the ACP is segregated, dispose of segregated ACP and stop temporary storage of the ACP at no additional cost to the Agency.

00745.45 Control of Line and Grade - Use a floating beam device of adequate length and sensitivity to control the grade of the paver. Where this method is impracticable, manual control of grade will be allowed when approved.

00745.46 Hauling, Depositing, and Placing - Haul, deposit, and place ACP as follows:

(a) Hauling - Cover ACP if rain or cold air temperatures are encountered any time between loading and placement.

ACP will be rejected before placing if one or more of the following occurs:

- Below temperature limit specified in 00745.43
- Slumping or separating
- Solidifying

Dispose of rejected loads at no additional cost to the Agency.

Deliver the mixture to the paving machine at a rate that provides continuous operation of the paving machine, except for unavoidable delay or breakdown. If excessive stopping of the paving machine occurs during paving operations, the Engineer may suspend paving operations until the mixture delivery rate matches the paving machine operation.

(b) Depositing - Deposit ACP from the hauling vehicles so segregation is prevented.

When ACP is windrowed, the pick-up Equipment shall:

- Pick up substantially all of the ACP deposited on the Roadway.
- Be self-supporting, not exerting any vertical load on the paving machine, or causing vibrations or other motions which could have a harmful effect on the riding quality of the completed Pavement.

(c) Placing - Alternative equipment and means may be allowed by the Engineer if the use of a paver is impractical.

Do not place ACP during rain or other adverse weather conditions, unless allowed by the Engineer. ACP in transit at the time adverse conditions occur may be placed if:

- It has been covered during transit.
- The ACP temperature is satisfactory.
- It is placed on a foundation free from pools or flow of water.
- All other requirements are met.

When Leveling irregular surfaces and raising low areas, do not exceed 2 inches actual compacted thickness of any one Lift, except the actual compacted thickness of intermittent areas of 1,000 square feet or less may exceed 2 inches, but not more than 4 inches. This may require portions of the mixture to be laid in two or more Lifts.

Place the mixture in the number of Lifts and Courses, and to the compacted thickness for each Lift and Course, as shown. Place each Course in one Lift unless otherwise specified. Do not exceed a compacted thickness of 4 inches for any Lift. Limit the minimum Lift thickness to four times the nominal maximum Aggregate size in the mix.

Do not intermingle ACP produced from more than one JMF. Each Base Course Panel placed during a working shift shall conform to a single JMF. The wearing Course shall conform to a single JMF, except for adjustments in the JMF according to 00745.16(b)(1).

00745.47 Longitudinal Joints - At longitudinal joints, bond, compact and finish the new ACP equal to the ACP against which it is placed.

(a) Location - Place the ACP in Panel widths which hold the number of longitudinal joints to a minimum. Offset the longitudinal joints in one Panel by at least 6 inches from the longitudinal joints in the Panel immediately below.

(1) Base Course - Place Base Course longitudinal joints within 12 inches of the edge of a lane, or within 12 inches of the center of a lane, except in irregular areas, unless otherwise shown.

(2) Wearing Course - Construct longitudinal joints at either lane lines or fog lines, or as shown or directed.

(b) Drop-Offs:

- Provide warning signs and markings according to Sections 00222 and 00225 where abrupt or sloped edge drop-offs 1 inch or more in height occur.
- Protect edges from being broken down.

If unable to complete the Pavement without drop-offs according to 00745.47(c) do the following:

- Construct and maintain a wedge of ACP at a Slope of 1V:10H or flatter along the exposed longitudinal joint.
- Remove and dispose of the wedge before continuing paving operations.
- Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Agency. ACP for the temporary wedge will be paid for at the Contract unit price.

(c) Placing Under Traffic - When placing ACP Pavement under traffic, schedule Work for the nominal thickness being laid as follows:

(1) More Than 2 inches - Schedule Work so at the end of each working shift the full width of the area being paved, including Shoulders, is completed to the same elevation with no longitudinal drop-offs.

(2) Less Than or Equal to 2 Inches - Schedule Work so that at the end of each working shift one Panel of new travel lane Pavement does not extend beyond the adjoining Panel of new travel lane Pavement more than the distance normally covered by each shift. At the end of each week complete the full width of the area to be paved, including Shoulders, to the same elevation with no longitudinal drop-offs.

00745.48 Transverse Joints:

(a) Travel Lanes - Construct transverse joints on the travel lane portion of all specified Pavement Courses, except Leveling Courses, as follows:

(1) Temporary End Panel - Maintain Pavement depth, line and grade at least 4 feet beyond the selected transverse joint location, and from that point, wedge down on the appropriate Slope until the top of the Course being laid meets the underlying surface (assuming a Pavement Course thickness of 2 inches) as follows:

- For wedges that will be under traffic for less than 24 hours, construct an 8 foot long wedge (1V:50H taper rate).
- For wedges that will be under traffic for 24 hours or longer, construct a 25 foot long wedge (1V:160H taper rate).

- Construct, maintain, remove, and dispose of the temporary wedge at no additional cost to the Agency. ACP for the temporary wedge will be paid for at the Contract unit price.

When the Pavement Course thickness is different than the above 2 inch example, use the appropriate taper rate to compute the length of the wedge. The wedge length plus the 4 feet or longer Panel form the temporary end Panel.

(2) Vertical Face - After the mixture has reached the required density:

- Provide a smooth, vertical face the full depth of the Course being laid at the location selected for the joint by sawing, cutting or other approved method.
- Remove the ACP material from the joint to the end of the Panel. If removed before resuming paving beyond the joint, reconstruct the temporary end Panel immediately by placing a bond-breaker of paper, dust, or other suitable material against the vertical face and on the surface to be occupied by the temporary end Panel. Construct a full-depth Panel at least 4 feet long, beginning at the sawed or cut joint, and taper it on a 1V:50H Slope to zero thickness.

(3) Excess Asphalt Concrete Pavement - After completing a temporary end Panel as specified, dispose of unused, remaining ACP as directed. Payment will be made for the entire load of ACP, but will be limited to only one load for each joint of each Panel.

(4) Resume Paving - When permanent paving resumes, remove the temporary end Panel and any bond-breakers. Clean the surface of all debris and apply a tack coat to the vertical edge and the surface to be paved.

(5) Joint Requirements - Compact both sides of the joint to the specified density. When tested with a straightedge placed across the joint, the joint surface shall conform to 00745.70.

(b) Abutting Bridge Ends - Compact the ACP abutting bridge ends and other rigid type Structures in the longitudinal direction and either transverse or diagonal direction, as directed.

(c) Bridge Deck Overlays - Saw cut the wearing Course of Pavement directly over the joints in bridge decks, bridge end joints and end Panel end joints as soon as practical but within 48 hours of paving each stage of the wearing Course, unless otherwise directed. Saw the cut 3/8 inch wide, ± 1/8 inch, by 1/2 inch less than the thickness of the Panel of Pavement depth or 1 1/2 inches deep, whichever is less.

Flush the saw cut thoroughly with a high-pressure water stream after the cut has been made. Before the cut dries out, blow it free of water and debris with compressed air. Fill the saw cut joint with a hot applied joint sealant from the QPL.

00745.49 Compaction:

(a) General - After the ACP has been spread, struck off, and surface irregularities and other defects remedied, roll it uniformly until compacted as specified.

(1) Temperature - Complete breakdown and intermediate compaction before the ACP temperature drops below 180 °F, unless otherwise directed or required based on the control strip. For WMAC, complete breakdown and intermediate compaction before the WMAC temperature drops below 160 °F. When the rolling causes tearing, displacement, cracking or shoving, make necessary changes in compaction temperature, type of compaction Equipment, and rolling procedures.

(2) Rolling - Provide sufficient rollers of the types appropriate to compact the mixture while it is still within the specified temperature. Do not use equipment which crushes the Aggregate. Do not displace the line and grade of edges. Moisten steel roller wheels with a minimum amount of water, or other approved material, necessary to prevent the ACP from sticking to them and spotting or defacing the ACP.

Operate rollers at a slow, uniform speed recommended by the manufacturer. Drive rolls or wheels shall be nearest the paver unless otherwise approved. Operate pneumatic rollers no faster than 3 mph. Operate vibratory rollers at frequencies of at least 2,000 vibrations per minute.

Begin rolling at the sides and proceed longitudinally, parallel to the road centerline, gradually progressing to the center, unless otherwise directed. On superelevated curves, begin rolling at the low side and progress to the high side. When paving in echelon, or when abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling pattern. Do not make sharp turns or park rollers on hot ACP. Stop each Pass at least 5 feet longitudinally from preceding stops.

Perform finish rolling with rollers meeting the requirements of 00745.24(a) or 00745.24(b), and continue until all roller marks are eliminated.

(b) Normal Pavement (Nominal Thickness 2 Inches or Greater):

(1) General - Compliance with the density Specifications for ACP shall be determined by random testing of the compacted road surface with calibrated nuclear gauges. Use the MAMD method of compaction measurement.

Construct a control strip at the beginning of Work on each JMF on the Project according to ODOT TM 306. The purpose of the control strip is to determine the maximum density that can be achieved for the JMF, paving conditions, and Equipment on the Project. Additional control strips are necessary when there is a change in compaction Equipment or when JMF targets are adjusted according to 00745.16(b)(1)(a). The Engineer may waive the control strip for irregular areas or areas too small to establish a reasonable roller pattern.

Stop paving if three consecutive control strips fail to achieve the specified density. Take all actions necessary to resolve compaction problems. Do not resume paving until allowed by the Engineer.

A pneumatic tired roller is not required for Level 1 and Level 2 ACP. Have at least one available pneumatic tired roller conforming to 00745.24(c) on the Project and in good operating condition for Level 3 and Level 4 ACP.

Have the CDT notify the Engineer and CAT-II when the average density for a sublot exceeds 95 percent of MAMD. Initiate an investigation to determine if the results indicate that a problem with the mix is developing. An adjustment to the JMF will not be allowed unless MDV testing supports a required change.

(2) Random Testing - Determine the density of each sublot by averaging five QC tests performed at random locations with the nuclear gauge operated in the backscatter mode. Lots and sublots shall correspond with those defined in 00745.02. In addition, perform at least one density test each Day of production. The additional testing may be waived by the Engineer.

a. Testing - After completion of the finish rolling, test according to AASHTO T 355. Do not locate the center of a density test less than 1 foot from the Panel edge. Complete density testing before traffic is allowed on the new mat.

b. Core Correlation of Nuclear Gauge Readings - Correlate each nuclear gauge on the Project for each Lift when requested or required. Perform core correlations and determine core correlation factors according to AASHTO T 355 and ODOT TM 327. Provide bulk specific gravity values to the Engineer within 24 hours of coring. If an Aggregate source or the asphalt cement source changes, new core correlations are required.

Apply correlation factors to all nuclear gauge readings for the Lift on which the core correlation was performed.

Both the Engineer and the Contractor may request additional core correlation of nuclear gauge readings. Core correlations requested by the Contractor or that are required due to a change in Aggregate or asphalt cement source will be at no additional cost to the Agency. The party requesting the core correlation pays the costs of coring and lab testing of the cores. The party performing nuclear gauge testing pays the costs of the nuclear gauge testing.

(3) Moving Average Maximum Density Method - The MAMD is the average of the current MDT and, if available, the four previous MDT's for the JMF used. Determine each MDT using the Gmm determined according to AASHTO T 209 and calculate the MAMD according to ODOT TM 305.

When this method is used, compact the ACP to at least the percent of the MAMD applicable for the mix type and Lift as follows:

Course of Construction	ACP
First ACP Lift less than 3 inches placed on Aggregate Base	91.0 *
All other	92.0

* If any part of the width of a Lift at a station requires 91.0 percent, then the entire width of that Lift at that station shall be 91.0 percent

(4) Test Results - Provide density results for the completed sublots to the Engineer by the middle of the following working shift.

(c) Thin Pavement - Compaction to a specified density will not be required for Leveling, patches, or where the nominal compacted thickness of a Course of ACP will be less than 2 inches.

Perform breakdown and intermediate rolling until the entire surface has been compacted by at least four coverages of the rollers. Perform additional coverages, as directed, to obtain finish rolling of the ACP.

(d) Other Areas - Compaction to a specified density will not be required on temporary Surfacing, guardrail flares, mailbox turnouts, road approaches, Pavement repair, and areas less than 8 feet wide or limited length, regardless of thickness. Compact these surfaces according to 00749.45.

(e) Bridge Decks and End Panels - Compaction to a specified density will not be required for ACP placed on bridge decks and end Panels. Perform the same rolling pattern, without vibration, as established by 00745.49(b)(1). In the absence of a rolling pattern established by 00745.49(b)(1), perform breakdown and intermediate rolling until the entire surface has been compacted by at least six coverages of the rollers. Perform additional coverages, as directed, to obtain finish rolling of the ACP.

Temporary

00745.50 Temporary Surfacing Course - Provide ACP for temporary Surfacing that is a well-graded, uniform, durable commercial mix. All new materials, or a combination of new materials and reclaimed materials, may be used, according to 00745.10(b). The Contractor is responsible for the quality of material furnished according to Section 00165 and for maintaining the surface in a condition appropriate for the facility. Mix used for temporary Surfacing will not be eligible for price adjustment under 00745.95.

Maintenance

00745.60 Correction of Defects - Correct all defects in material and Work, as directed, at no additional cost to the Agency, according to the following:

(a) Fouled Surfaces - Before the ACP cools repair, clean, and retack fouled surfaces that would prevent full bond between successive Lifts of mixture.

(b) Boils, Slicks, and Oversized Material - Before the ACP cools replace boils, slicks, and oversized material with fresh mixture.

(c) Segregation - Take corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved.

(d) Roller Damage to Surface - Before the ACP cools correct surface damage from rollers with additional fresh mixture or by other approved means.

(e) Longitudinal Joints - Take corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved.

(f) Non-specification Compaction - Take corrective measures when the specified compaction density is not being achieved.

(g) Other Defects - Remove and replace any ACP that:

- Is loose, broken, or mixed with dirt.
- Shows visually too much or too little asphalt.

Finishing and Cleaning Up

00745.70 Pavement Smoothness - Furnish a 12-foot straightedge and, when required a 12-foot rolling straightedge, and test as specified. Additional testing may be required. Mark areas not meeting the surface tolerance.

(a) Level 1 and Level 2 ACP - Test with the 12-foot straightedge in travel lanes parallel to and perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

(b) Level 3 and Level 4 ACP:

(1) Single Course Construction - Test with the 12-foot straightedge in travel lanes parallel to and perpendicular to the centerline, as directed. The Pavement surface shall not vary by more than 1/4 inch.

(2) Multiple Course Construction - Test the surface of the Course on which the wearing Course is placed according to 00745.70(a).

Test the wearing surface with the rolling straightedge in the designated wheel path of a 0.1 mile strip of each travel lane per mile, where directed, and on each transverse joint throughout the Project. Operate the rolling straightedge parallel to the centerline. The surface shall not vary more than 0.015 foot.

Also test the wearing surface with a 12-foot straightedge placed perpendicular to the centerline at least once within the above-mentioned 0.1 mile strip. It shall not vary by more than 1/4 inch.

If the 0.1 mile testing strip meets the Specifications, no further testing of the mile represented by the testing strip will be required, except at the transverse joints. If any part of the testing strip does not meet the Specifications, test both wheel paths of the entire mile.

(c) Utility Appurtenances - If the Contractor constructs or adjusts Utility appurtenances, manhole covers, and valve boxes, the tolerances of 00745.70(a) and 00745.70(b) apply. If the Utility appurtenances are adjusted by others, these tolerances do not apply.

(d) Shoulders and Paved Medians - Test the Base and wearing Course with the 12-foot straightedge parallel to and perpendicular to the centerline for Shoulders and paved Medians where permanent traffic barriers will be located. The Pavement surface shall not vary by more than 1/4 inch.

00745.75 Correction of Pavement Roughness - Correct Equipment or paving operation procedures when tests show the Pavement smoothness does not comply with 00745.70. In addition, do the following:

(a) Methods - Correct surface roughness to the required tolerances, using one of the following methods as approved by the Engineer:

(1) Base Course:

- Profile to a maximum depth of 0.4 inch with Equipment meeting the requirements of 00620.20.
- Profile to a maximum depth of 0.4 inch with abrasive grinders equipped with a cutting head comprised of multiple diamond blades.
- Remove and replace the Base Lift.

(2) Wearing Course:

- Remove and replace the wearing surface Lift.
- Profile to a maximum depth of 0.3 inch with abrasive grinders equipped with a cutting head comprised of multiple diamond blades and apply an emulsion fog seal as directed.

(b) Time Limit - Complete correction of all surface roughness within 14 Calendar Days following notification, unless otherwise directed.

Measurement

00745.80 Measurement - The quantities of ACP will be measured on the weight basis, with separate measurement being made for the asphalt concrete mixture and the asphalt cement contained in the mixture. No deduction will be made for lime or any other additive used in the mixture.

The quantities of ACP shown in the Contract Schedule of Items are based on the estimated bulk specific gravity of Aggregates listed in the Special Provisions. Determine the actual bulk specific gravity for the Aggregates, recompute the quantities of ACP to be used, and inform the Agency in writing. The quantities of ACP will be adjusted accordingly with no adjustment in Contract unit prices.

When listed in the Contract Schedule of Items, extra or additional Work for approaches, driveways, walks, and other miscellaneous asphalt appurtenances will be measured according to 00749.80 through 00749.82.

If there is no separate item listed in the Contract Scheduled of Items for Leveling Work, the quantities will be included in the appropriate ACP items.

Payment

00745.90 Payment - The accepted quantities of ACP incorporated into the Project, whether or not recycled Materials are used, will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Level ____, ____ ____ ACP ____	Ton
(b)	____ Asphalt in ____ ACP	Ton

In item (a), the following will be inserted in the blanks:

- The level of ACP (1, 2, 3, 4) will be inserted in the first blank.
- The type of ACP (3/4 inch, 1/2 inch, 3/8 inch) will be inserted in the second blank.
- The words "Lime Treated" will be inserted in the third blank when applicable.
- The words "in Leveling", "in Temporary", or "in Leveling and Temporary" will be inserted in the fourth blank when applicable.

In item (b), the performance graded asphalt binder will be inserted in the first blank. The types of ACP will be inserted in the second blank. This item applies to all asphalt used in ACP, including residual asphalt in RAP, RAS, or combined RAP and RAS. Substituted asphalt cement described in 00745.11(a) will be paid for under the asphalt specified in the Contract Schedule of Items.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- reconditioning existing roadway
- Leveling Work
- lime
- QC testing
- sawing, cleaning, and filling joints on bridge deck overlays

When specified by other Pay Items in the Contract Schedule of Items, separate payment will be made for Work described in 00745.42, 00749.91 and 00749.92.

When a Panel consists of both temporary and permanent Courses, payment for the entire Panel will be based on the permanent Course.

Anti-stripping asphalt cement additives will be paid for at the Contractor's actual documented costs with no percentage allowance or markup allowed. No additional payment will be made for anti-stripping additives or treatments that are not anti-stripping asphalt cement additives.

00745.95 Price Adjustments - The Composite Pay Factor (CPF), calculated according to 00165.40, 00745.16, and 00745.95, will be applied to the Contract unit price for Pay Items (a) and (b) of 00745.90 and to the applicable lot quantities. The CPF will be made available to the Contractor within 24 hours of receipt of the required quality control test results. If less than three samples are tested, the CPF will be computed as outlined in 00745.17 and 00745.95, the maximum CPF for material represented by less than three samples will be 1.0.

To accommodate the lot definition of 00745.02, interpret the upper specification limit (USL) and the lower specification limit (LSL) in 00165.40 to allow adjustments to a JMF according to 00745.16 without changing lots. Include all material from the original JMF and revisions of that JMF in the statistical analysis unless a change in the lot is required by 00745.02. If JMF target values are modified according to 00745.16, the CPF will be calculated in the following manner:

- The adjusted target value will be evaluated as zero with the USL and LSL representing the allowable tolerances of 00745.14. All sample test values for the changed constituents will be compared to the target for each sublot. The differences between the target values and sample test values are the adjusted sample test values for each sublot. These will be analyzed for determination of the pay factor for the constituent.

The Pay Factor (PF) for compaction will be:

Type/Method	PF	Maximum PF
Normal Pavement		
Control Strip Method		1.00
MAMD Method		1.05
Thin Pavement	1.00	
Other Areas	1.00	

Use the following table to determine price adjustments in the CPF for constituents of ACP.

	Gradation Constituents		
All Aggregate Passing	**3/4"**	**1/2"**	**3/8"**
1 1/2"			
1"	1		
3/4"	1	1	
1/2"	1	1	1
3/8"	–	–	1
No. 4	5	5	5
No. 8	5	6	6
No. 30	3	3	3
No. 200	12	12	12
Other Constituents			
Asphalt Content	28	28	28
Compaction	44	44	44

Those ACP constituents statistically evaluated will be eligible for a maximum PF of 1.05 (see 00165.50(b)(1)), unless otherwise specified.

When the CPF is greater than 1.000 for Material used in Leveling Courses for ACP, it will be reduced as follows:

Reduction in CPF = (CPF-1) x 0.5

If the Specifications do not require measurement of a constituent, its individual PF will be considered 1.00 in calculating the CPF according to 00165.40.

A price adjustment will be determined by the following formulas:

(CPF - 1) x [(JMF% ÷ 100 x Asphalt Unit Price) + (ACP Unit Price)] x (LQ) = ____

Where:

JMF% is the asphalt cement % from the JMF
LQ is the quantity of mixture in the lot

Section 00746 - Crack Sealing Flexible Pavements

Description

00746.00 Scope - This Work consists of repairing and resealing cracks in flexible Pavements at locations designated by the Engineer.

Materials

00746.10 Sealants - Furnish all sealant Materials for crack repair of flexible Pavements that is approved by the Engineer before being incorporated into the Work. Before beginning Work, furnish a complete written statement of the origin, composition and manufacturer of materials that are to be used.

Furnish hot poured sealants of the type intended for use in sealing cracks in asphalt concrete Pavement that meet the requirements of 02440.30.

Equipment

00746.20 Equipment - Use proper sealing Equipment for the specific material listed according to the manufacturer's recommendations. The Equipment for sealing compounds shall be a melting kettle of the double boiler, indirect heating type, using oil as a heat-transfer medium. The kettle shall be an effective, mechanically operated agitator equipped with a positive, thermostatic temperature control.

Construction

00746.40 General - Provide traffic control according to Sections 00220 and 00221.

00746.41 Mixing and Heating - Follow the manufacturer's recommendations for application. Mix and heat the sealant materials to a minimum temperature of 280 °F. Do not heat the material above 400 °F.

00746.42 Installation Procedure - Where installation procedures, or any part of the procedures are required to be done according to the recommendations of the manufacturer of the sealing compound, submit catalogue data and copies of the recommendations before installing the materials.

Clean all cracks designated for sealing of loose and foreign matter. Use a hot lance to perform this cleaning. Use this wand to both clean and dry the crack just prior to sealing.

Do not place any sealant without the prior approval of the Engineer. The Engineer will inspect all cracks.

The face of the crack shall be surface dry, and the ambient and Pavement temperatures shall both be at least 45 °F and rising at the time of application of the sealant.

Install the sealant so that the in-place sealant is well bonded to the Pavement and free of voids or entrapped air.

Seal the cracks from the bottom up in a neat manner, so that upon completion of the Work the surface of the sealant material is flush to 3/16 inch below the adjacent Pavement surface. Refill or "spot" all low areas before continuing Work.

Level sealant material flush to the surface with a 'V' shaped squeegee device. Squeegee the excess material so it does not exceed 1 1/2 inches on either side of the crack. If any sealant remains in the

squeegee when the end of the crack is reached, distribute this excess material over the crack in a return motion.

00746.43 Cleaning and Sanding - Perform the following Work when crack sealing prior to a hot mix asphalt overlay or to prevent traffic damage and "pickup":

- Completely cover the sealed cracks with a clean sanding material, then sweep the Pavement surface and leave in a clean condition.
- Do not allow any traffic or construction Equipment on the newly sealed cracks for at least 1 hour after placement of the sealant and refilling has been completed.

Measurement

00746.80 Measurement - The quantities of sealed cracks will be measured on either the length basis, or the weight basis.

Payment

00746.90 Payment - The accepted quantities of sealed cracks will be paid for at the Contract unit price, per foot or pound, as appropriate, for the item "Crack Sealing".

Payment will payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for required cleaning and routing.

Section 00748 - Asphalt Concrete Pavement Repair

Description

00748.00 Scope - This Work consists of excavating and removing existing asphalt concrete surfaces, Aggregate bases, and Aggregate Subbases and constructing new Subbases, bases, and asphalt concrete surfaces to the lines and grades shown or directed.

Materials

00748.10 Materials - Furnish Materials meeting the following requirements:

Aggregate Base 02630
Subbase Aggregate..... 00641.10(b)
Asphalt Concrete Pavement (ACP).....00744 and 00745
Emulsified Asphalt Concrete (EAC).....00735
Stone Embankment.....00330.16
Subgrade Geotextile.....02320
Subgrade Reinforcement Geogrid.....02320
Water.....00340

00748.16 Acceptance of Material - All material will be accepted by visual inspection by the Engineer. The Engineer may perform tests to verify that the materials meet the appropriate Specifications.

Equipment

00748.20 Equipment - Provide appropriate Equipment necessary to perform the Work according to Sections 00320, 00330, 00340, 00350, 00620, 00641, 00735, 00744, and 00745.

Construction

00748.40 Excavation - Excavate and remove material to the lines and grades shown or directed. Dispose of the excavated material according to 00330.41(a)(5).

00748.41 Cold Plane Pavement Removal - Remove the existing Pavement to the depth, width, grade, and Cross Section as shown or directed. Perform cold plane Pavement removal according to 00620.40.

00748.42 Geosynthetics:

(a) Geotextile - Place geotextile as shown.

(b) Subgrade Reinforcement Geogrid:

(1) Placement - Prepare the surface receiving geogrid to a smooth, uncompacted condition to the depth shown and as follows:

- Orient the geogrid rolls parallel to the roadway centerline.
- Unroll the geogrid in the same direction as Aggregate Base placement. If the geogrid shifts or becomes misaligned, realign it and anchor it according to the manufacturer's recommendations.

(2) Overlaps - Overlap the geogrid a minimum of 24 inches. Overlap the geogrid in the same direction as Aggregate Base placement with the preceding layer lapped on top of the following layer.

(3) Protection of Geogrid - Drive rubber tired Equipment on the geogrid at no more than 5 mph. Drive tracked Equipment on the geogrid only after placing a minimum of 6 inches of Aggregate Base on top of the geogrid. Do not turn or make sudden stops or starts on the geogrid or the Aggregate Base.

During installation cover the geogrid with the Aggregate Base as soon as possible. Do not leave uncovered for more than 5 Calendar Days.

(4) Repair - Repair or replace damaged or torn geogrid according to manufacturer's recommendations at no cost to the Agency.

00748.43 Aggregates - Place Aggregate according to 00641.43 and to lines and grades shown or directed. Compact each layer of material until there is no reaction or yielding under the compactor.

00748.44 Asphalt Concrete - Place EAC or ACP to the lines and grades shown or directed. Compact the EAC according to 00735.46. Compact ACP according to 00744.49 and 00745.49(d), as applicable.

00748.45 Stone Embankment - Place stone embankment according to 00330.42(d) and to lines and grades shown or directed.

Measurement

00748.80 Measurement - The quantities of asphalt concrete Pavement repair will be measured on the area basis, of Surfacing area repaired to the full depth as shown. The Surfacing area will be determined by horizontal measurements. In areas where directed to repair to a depth other than shown, the areas will be adjusted by converting to an equivalent number of square yards on a proportionate volume basis.

EAC and ACP will be measured according to 00735.80, 00744.80, and 00745.80, as applicable.

Payment

00748.90 Payment - The accepted quantities of asphalt concrete Pavement repair will be paid for at the Contract unit price, per square yard, for the item "____ Inch Asphalt Concrete Pavement Repair".

The depth will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

EAC and ACP will be paid for according to 00735.90, 00744.90, and 00745.90, as applicable.

No separate or additional payment will be made for excavation, cold plane Pavement removal, geosynthetics, stone embankment, Aggregate, or water.

Section 00749 - Miscellaneous Asphalt Concrete Structures

Description

00749.00 Scope - This Work consists of furnishing and placing asphalt concrete in road approaches, street connections, driveways, guardrail flares, mailbox turnouts, raised traffic islands, sidewalks, footpaths, gutters, ditch linings, spillways, dikes, and other miscellaneous or minor items of asphalt concrete except asphalt curbs as shown, specified, or directed. These items in this Section will be collectively referred to as "Structures". See Section 00480 for asphalt curbs.

This Work does not include asphalt concrete construction on Traffic Lanes, auxiliary lanes, Shoulders, Median areas, tapers, widenings, parking areas, exit and entrance ramps, Patching and Leveling on similar areas.

00749.02 Limited Application - This Section applies only when separate Pay Items for the Work appears in the Contract Schedule of Items according to 00749.91 and 00749.92, or when called for by the Special Provisions.

Materials

00749.11 Aggregate Base - Furnish Aggregate base Materials for Base, foundation Courses, Leveling Courses, and bedding meeting the requirements of Section 02630. If a designated size is not shown, or given, furnish either 1" - 0 or 3/4" - 0, as the Contractor elects.

00749.12 Asphalt Tack Coat - Furnish asphalt tack coat Material meeting the requirements of Section 00730.

00749.13 Asphalt Concrete - Unless another class is shown, furnish Level 2, 1/2 inch ACP according to Sections 00744 and 00745, as applicable. When conditions justify, the mixture may be varied, if approved. Acceptance will be based on testing the Engineer deems appropriate. Statistical analysis will not apply.

00749.14 Concrete - Furnish Commercial Grade Concrete meeting the requirements of Section 00440.

Equipment

00749.20 Equipment - Provide plant and Equipment meeting the requirements of Section 00745.

Construction

00749.41 Earthwork - Make excavations and backfills for the Structures according to Section 00330 and to the depths, widths and cross sections shown, specified, or directed.

00749.42 Foundations - Construct foundations or other bedding using selected granular backfill material according to Section 00330 or using Aggregate base when shown or directed.

For Aggregate Base, do one of the following:

- When existing Aggregate base materials of the kind specified in 00749.11 are already in place, salvage and reuse.
- Use new Aggregate base materials conforming to 00749.11.

00749.43 Foundation Preparation - Bring areas on which Structures are to be constructed to established grade, and make firm, dry and free of Unsuitable Material before placing asphalt concrete.

Tack contact areas where asphalt concrete is to come in contact with previously placed portland cement concrete, asphalt concrete, or bituminous surfaces according to Section 00730.

00749.44 Placing Asphalt Concrete - Place asphalt concrete according to 00744.43(c) and 00745.46(c), as applicable, except place asphalt concrete Structures of uniform width by either mechanical extrusion methods or between suitable forms, as the Contractor elects. Other Structures may be constructed without the use of forms unless otherwise directed.

The Engineer may allow small or special pavers, spreader boxes, or blade graders for placing asphalt concrete. Where allowed, the Engineer may allow mixture to be placed by hand methods.

Construct all Structures within the following lines and grades:

- 0.08 foot of true line
- 0.04 foot of established surface grade, Cross Section and Slope
- 0.04 foot of specified thickness

00749.45 Compacting Asphalt Concrete - Compact asphalt concrete according to the following or as directed:

- Compaction to a specified density will not be required, regardless of thickness. Perform breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the rollers. Perform additional coverages, as directed, to obtain finish rolling of the ACP.
- Along curbs and walls, on walks, irregular areas, and other areas not practically accessible to rollers conforming to 00744.24 or 00745.24, compact the mixture with small, self-propelled rollers, mechanical tampers, hot hand tampers, or hand rollers. On depressed areas a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

00749.46 Pavement Smoothness - Finish asphalt concrete to a uniform texture.

Test top surfaces with a 12-foot straightedge furnished and operated by the Contractor under the Engineer's direction. The surface shall not vary more than 1/4 inch from the straightedge except at grade changes.

00749.47 Concrete - Construct concrete curbs according to the applicable provisions of Section 00759.

Measurement

00749.80 Measurement - Work performed under this Section will be measured by one of the methods described in 00749.81 and 00749.82. Street connections which occur at the beginning or end of the Project, or which have a line designation, Typical Section and profile, and are not noted on the Plans as being Pay Items will not be measured for payment.

The quantities of Structures will be measured according to the following:

- **Unit Basis** - Measurement will be the actual count of each location where the Structure is constructed.

- **Area Basis** - Measurement will be the ground surface, limited to the Neat Lines of the Structure as shown or directed.

- **Length Basis** - Measurement will be from end to end of the pertinent Structure along its longitudinal axis for each separate item or continuous run.

00749.81 Method "A" - Weight and Extras Basis - Under this method, asphalt concrete actually incorporated into the Structure will be measured for payment according to 00744.80 and 00745.80, as applicable. In addition, measurement will be made for extra costs of placing asphalt concrete in the Structures if Pay Items are included in the Contract Schedule of Items.

00749.82 Method "B" - Complete in Place Basis - Under this method, measurement will be of the Structure complete in place.

Payment

00749.90 Payment - The accepted quantities of Structures placed under this Section will be paid for at the Contract unit price, per unit of measurement, for the items listed in 00749.91 and 00749.92.

When earthwork is included as separate Pay Items, payment will be made according to 00330.90 through 00330.94 as appropriate.

When earthwork is not included as separate Pay Items, no separate or additional payment will be made for earthwork.

Aggregate will be paid for according to 00640.90 and 00641.90 as appropriate.

Payment for street connections, or the extra costs for them, which meet the criteria described in 00749.80 will be included in payment for the Pavement items.

00749.91 Method "A" - Weight and Extras Basis - The items to be paid for under Method "A" are:

	Pay Item	Unit of Measurement
(a)	Extra for Asphalt Approaches	Each
(b)	Extra for Asphalt Drains	Each
(c)	Extra for Pedestrian Landings	Each
(d)	Extra for Asphalt Dikes	Foot
(e)	Extra for Asphalt Islands	Square Foot
(f)	Extra for Asphalt Walks	Square Foot
(g)	Extra for Asphalt Ditch Lining	Square Foot
(h)	Extra for Asphalt Slope Paving	Square Foot
(i)	Extra for Pavement Repair	Square Foot

Item (a) includes road approaches, street connections, alley approaches, driveways, guardrail flares, non-flared guardrail terminals, and mailbox turnouts.

Item (e) includes raised traffic islands and raised traffic separators.

Item (f) includes sidewalks, footpaths, and narrow strips of asphalt concrete abutting curbs not intended for vehicular use.

Item (g) includes gutters, ditch linings, spillways, and other such Structures specifically designed and provided for conveyance of surface water.

Payment will be payment in full for all extra or additional costs involved in placing asphalt concrete in the respective Structures as specified. These costs are in addition to those which are included in the payment made for the asphalt concrete incorporated into the Structures.

00749.92 Method "B" - Complete in Place Basis - The items to be paid for under Method "B" are:

	Pay Item	Unit of Measurement
(a)	Asphalt Approaches	Each
(b)	Asphalt Dikes	Foot
(c)	Asphalt Islands	Square Foot
(d)	Asphalt Walks	Square Foot
(e)	Asphalt Ditch Lining	Square Foot
(f)	Asphalt Slope Paving	Square Foot

Item (a) includes road approaches, street connections, alley approaches, driveways, guardrail flares, and mailbox turnouts.

Item (c) includes raised traffic islands, traffic separators, and concrete curbs necessary for the islands.

Item (d) includes sidewalks, footpaths, and narrow strips of asphalt concrete abutting curbs, not intended for vehicular use.

Item (e) includes gutters, ditch linings, spillways and other such Structures specifically designed and provided for conveyance of surface water.

Payment will be payment in full for furnishing and placing all materials, including asphalt concrete and asphalt tack coat, and for furnishing all Equipment, labor, and Incidentals necessary to complete the respective Structures in place as specified.

Section 00755 - Continuously Reinforced Concrete Pavement

Description

00755.00 Scope - This Work consists of constructing continuously reinforced portland concrete Pavement with metal reinforcement, and associated reinforced concrete Pavement as shown and specified.

00755.01 Abbreviations:

GPT - Graphic Profile Test
LSL - Lower Specification Limit
PI - Profile Index
SSD - Saturated Surface-Dry
SSFC - Stationary Side Form Construction
SSTV - Sublot Strength Test Value
USL - Upper Specification Limit

00755.02 Definitions:

Localized Roughness - An area that exceeds 160.0 inches per mile in a continuous International Roughness Index (IRI) evaluation over a 25.0 foot base length.

00755.04 Aggregate Production and Prepaving Conference:

(a) Aggregate Production Conference - Supervisory personnel of the Contractor and any Subcontractors or Suppliers who are to be involved in the Aggregate production Work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing Aggregate production.

(b) Prepaving Conference - Supervisory personnel of the Contractor and any Subcontractors who are to be involved in the concrete paving Work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing all phases of the paving Work.

Materials

00755.10 Materials - Furnish materials meeting the following requirements:

Bonding Agents.....02070
Concrete.....02001
Curing Materials.....02050
Dowels.....02510.50
Galvanizing.....02530.70
Grout.....02080
Hot Applied Joint Sealant.....02440.30
Poured Joint Sealant.....02440.11
Preformed Joint Fillers for Concrete.....02440.10
Reinforcement.....02510

00755.11 Classes of Concrete - Furnish Class 4000 - 1 1/2 paving concrete unless otherwise shown or specified.

00755.13 Concrete Mix Designs - Prepare and submit either new mix designs or current mix designs for each class of concrete required according to Section 02001.

00755.15 Quality Control - Provide quality control according to Section 00165, Section 02001, and the following:

(a) Concrete Mixture - If the results of any test are outside of the Specification limits, stop the placement of the load. Correct the load or reject it and do not incorporate it into the Work. Test subsequent loads before any further concrete placement. Correct the subsequent loads if any of the tests are still outside the Specification limits. If the load cannot be corrected, reject it and do not incorporate it into the Work. Testing of subsequent loads may return to the specified frequency when the test results from two consecutive loads are shown to meet the Specification limits.

(b) Records - Deliver all batch tickets, water-cement ratio calculations, and all other records required to the Engineer upon availability but no later than the morning of the next Day.

00755.16 Acceptance of Concrete:

(a) General - Acceptance of concrete will be based on the results of the Contractor's quality control testing according to Section 00165.

(b) Aggregate - Acceptance will be based on the Contractor's quality control testing, if verified by the Agency according to Section 00165.

(1) Aggregate Gradation - A stockpile contains specification Aggregate gradation when the quality level for each sieve size calculated according to 00165.40 is equal to or greater than the quality level in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the quality level in Table 00165-2 yields a PF of less than 1.00 for any constituent, the material is non-specification.

(2) Non-specification Aggregate Gradation - Stockpiled Aggregates that contain non-specification Aggregate gradation will be rejected by the Engineer unless non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material is removed so that the quality level for each constituent is equal to or greater than the quality level in Table 00165-2 for a 1.00 PF.

(c) Plastic Concrete - Acceptance of the plastic concrete will be based on the tests performed by the Contractor's QCT, according to the tolerances and limits of Section 02001.

(d) Hardened Concrete - Acceptance of hardened concrete will be based on statistical analysis, according to Section 00165, of the compressive strength tests of the cylinders cast by the QCT. Test the cylinders at an ODOT certified laboratory.

(1) Random Sampling and Testing - Obtain samples from each sublot on a random basis. Cast a minimum of 3 cylinders. Cast and cure the test specimens according to AASHTO T 23 in 6 inch x 12 inch single-use plastic molds and test at 28 days according to AASHTO T 22.

(2) Lots - A lot is the total quantity of concrete produced for each mix design with the same Specification limits of all constituents in each stage. Slipformed and non-slipformed concrete will be sampled and evaluated as separate lots.

In lots with less than three sublots, the valid individual cylinders each will be considered a sublot and statistically evaluated. Obtain at least one set of cylinders for each lot.

(3) Sublot Strength Test Value - The average of the 28-Day compressive strength tests of the three cylinders will constitute the SSTV.

Any cylinders in a sublot showing definite evidence (other than low strength) of improper sampling, molding, curing or testing will be discarded, and the average of the strengths of the remaining cylinders will constitute the SSTV. If all three cylinders comprising a sublot are discarded, the lot will be evaluated on the basis of the reduced number of sublots.

If the compressive strength of the lowest strength cylinder in a sublot is lower than the average strength of the remaining cylinders in that sublot by more than 10 percent, that cylinder strength will be discarded and the average of the remaining cylinders will comprise the SSTV.

(4) Quality Level Analysis - Statistically analyze the SSTV's and determine the PF for each lot of concrete, except that there will be no USL, and the LSL will equal the specified design strength.

00755.18 Bond Breaker - Furnish one of the following bond breakers:

- Non-woven geotextile meeting the property requirements listed in Table 02320-4.
- Liquid curing compound evenly applied as a bond breaker in two applications, at a rate of 1 gallon per 130 to 165 square feet for each application, over the entire surface area.

Equipment

00755.20 Batch Plant - Provide batch plants according to Section 02001.

00755.21 Mixers - Provide mixers according to Section 02001 except mix concrete in the batch plant mixer. Truck mixers may be used only as allowed in 00755.45.

00755.22 Hauling Equipment - Transport concrete in non-agitating Equipment. Truck mixers may be used to transport concrete only as allowed in 00755.45. Hauling Equipment shall conform to AASHTO M 157.12 or AASHTO M 157.11.6 when allowed.

00755.23 Paving Equipment - Provide self-propelled paving machines conforming to the following:

(a) Placer/Spreader - Provide a placer/spreader that will:

- Receive the concrete mixture in its hopper on the Shoulder area.
- Deliver the concrete mixture to the slipform paver and uniformly spread at the proper thickness for the full width of the area being paved.
- Not segregate the concrete mixture or displace the reinforcing steel.

(b) Slipform Paver - Provide a slipform paver that is:

- Equipped with electronic or hydraulic controls to automatically control line and grade from both sides.
- Able to vibrate, consolidate and finish the slab to proper grade and Cross Section for the full width and depth of the concrete being placed.
- Equipped with vibrating tubes or arms to Work in the concrete.
- Equipped with sliding forms held together rigidly to prevent them from spreading.
- Equipped with sliding forms long enough so that slumping of the concrete does not exceed 1/4 inch, according to 00755.49(a).

- Equipped with a positive interlock system to stop all vibration and tamping elements when the forward motion of the machine is interrupted.
- For projects that have more than 1,000 feet of concrete paving, equipped with an electronic monitoring device that:
  - Is near the operator's controls visible to the paver operator and Engineer.
  - Operates continuously while paving.
  - Displays the operating frequency of each individual internal vibrator for both manual and automatic sequencing.
  - Records the time of Day, station location, paver track speed and the operating frequencies.

00755.24 Concrete Saws - Provide power driven concrete saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. Also provide a standby saw on the Project Site.

00755.25 Smoothness Testing Equipment - Provide all Equipment and supplies for determining smoothness according to 00755.55.

(a) Straightedge - Provide two 12-foot straightedges.

(b) Inertial Profiler - Provide a profiling device meeting the requirements of ODOT TM 772 and certified according to ODOT TM 769.

Provide competent and experienced operator(s) for the Equipment, certified with the profiler according to ODOT TM 769. The profiler operator shall meet with the Engineer at a mutually agreed upon time prior to beginning smoothness measurements to discuss all aspects of smoothness measurement on the Project.

00755.26 Concrete Drills - Provide a drilling system consisting of drilling Equipment and drilling supports that:

- Is capable of drilling holes of the required diameter and depth.
- Can produce holes parallel to the Pavement surface and parallel to the longitudinal joint within a tolerance of ± 1/8 inch.
- Can provide hole alignments at mid-depth of PCC Pavement.

Labor

00755.30 Quality Control Personnel - Provide technicians having CAgT, CSTT, CCT, and QCT technical certifications.

Additional Contractor quality control responsibilities include the following:

- Provide and designate an individual who shall be present at the placement site at all times during concrete placements, and who is authorized and responsible for acceptance and rejection of materials.
- Reject loads which arrive at the Project Site without a batch ticket.
- Require the truck driver to record on the batch ticket and initial the amounts of water added in transit and at the Project Site.
- Reject plastic concrete that is outside of the specified limits.

Construction

00755.40 Weather Limitations - Coordinate all operations involved in constructing the Pavement so the Work will result in a finished Pavement conforming to the Specifications regardless of the daily or seasonal variations in weather, temperature and humidity under which the Work is allowed to proceed.

Do not place PCC during periods of rain. Do not place PCC on frozen bases. Stop placement when descending air temperature falls below 35 °F. Do not begin placement until the air temperature is 35 °F in the shade and rising and is forecast to remain above 35 °F.

Protect the Pavement from weather damage. Protect unhardened PCC from precipitation with protective material. When PCC is placed during cold weather and the air temperature is forecast to drop below 33 °F, prevent the concrete from freezing for a minimum of 7 days after placement.

Remove and replace weather damaged Pavement at no additional cost to the Agency.

00755.41 Preparation of Base:

(a) Condition - Before paving operations begin, bring the Base on which the Pavement is to be constructed to a finished condition required by the Specifications.

Clean the surface of all loose material. Remove all pooling and flowing water. Place concrete on existing and new asphalt only when the asphalt surface is less than 90 °F.

(b) Area - Bring the full width and length of the area on which the tracks of the paving Equipment are to operate to the density and surface tolerance required of the base material.

(c) Grade - Before paving, verify the line and grade of the Base to ensure the PCC pavement can be placed at the thickness shown.

00755.42 Construction Widths - When the Pavement consists of two or more Traffic Lanes, construct at least two Traffic Lanes in one strip Panel unless shown otherwise.

If the Contractor proposes a method of placement other than that shown or specified, the Contractor shall pay all costs to implement the change. Any changes require Engineer's approval.

00755.43 Placing Reinforcement:

(a) General - Place reinforcement as shown and specified. The Contractor's Equipment hauling reinforcement to the site will not be allowed on the concrete Subgrade or Base.

The reinforcement shall be straight, clean, and free of scale or other matter which would interfere with its bonding to the concrete.

Place the reinforcement on transverse bar assemblies as shown. Do not use a tube feeder to place the rebar in plastic concrete mix.

(b) Deformed Bar Reinforcement - Clip at each transverse bar intersection in a manner that does not allow for displacement. Tie or clip every lap splice as shown.

(c) Support Devices - Support devices used to hold reinforcement in proper position in the concrete shall:

- Hold the reinforcement within 1/2 inch of the position shown.
- Consist of transverse bar assemblies.

Obtain approval of the proposed support devices before use.

If concrete placement operations displace the reinforcement, stop production and place additional support devices.

(d) Tie Bars - Place tie bars required for contact-type longitudinal joints by one of the following methods:

(1) By drilling the hardened concrete section and then inserting and grouting the tie bars into place. Drill the holes large and deep enough to insert the tie bars with adequate epoxy or non-epoxy grout. Take care not to damage the reinforcement when drilling the holes. Drill after the concrete attains enough strength so no damage to the concrete is caused by the drilling. Replace loose tie bars at no additional cost to the Agency.

(2) By inserting the tie bars into the plastic slipformed concrete before vibrating and finishing the concrete. The tie bars may be bent before insertion. Replace any loose tie bars by drilling and grouting, as described in 00755.43(e)(1), at no additional cost to the Agency.

(3) By using threaded mechanical splice couplers from the QPL. Submit splices for approval before using. Rebar splices shall be:

- Accompanied by manufacturer's quality compliance certificate according to 00165.35.
- Installed according to manufacturer's recommendations.

(e) Dowel Bars - Provide smooth, round, epoxy coated dowel bars. Coat dowel bars with a lubricant or bond-breaking compound approved by the Engineer.

Use a framework to place dowels that is:

- continuous across the entire lane width;
- holds the dowels parallel with each other;
- holds the dowels parallel with the surface of the Pavement;
- holds the dowels parallel to the Roadway centerline; and
- holds the dowels at locations shown.

Furnish dowel caps as shown.

For dowels placed across an expansion joint, use a dowel bar basket or other system of support that leaves no permanent incompressible members in place within the joint.

Maximum alignment tolerance shall be 5 degrees or 3/16 inch in the length of the dowel. Place dowels within 3/8 inch of the center of the slab vertically.

Place dowel bars for joint contact at existing concrete Pavement surfaces by drilling the existing concrete section and then inserting the dowel bars and grouting them in place. Drill the holes large and deep enough to insert the dowel bars with adequate epoxy or non-epoxy grout. Adjust hole locations to avoid damaging any existing reinforcement when drilling the holes. Blow the dowel bar holes clean with compressed air before grouting. Center the bar in the hole for the full length of embedment before grouting. Pump the grout into the hole around the bar so the back of the hole is filled first. Do not allow blocking or shimming to impede the flow of the grout into the hole. If dams are needed, place them at the front of the holes to confine the grout. Place the dams to permit the escape of air without leaking grout. Do not remove dams until grout has cured in the hole.

00755.44 Handling, Measuring, and Batching Materials - The plant site, layout, Equipment and provisions for transporting material shall be adequate to assure a continuous supply of material to the Project Site.

(a) Aggregates - Stockpile and remove the Aggregate from stockpiles in a manner that holds segregation to a minimum.

Do not use Aggregates that become segregated, mixed with earth or foreign material, or contain lumps of hardened material. Thaw frozen Aggregates or Aggregates containing frozen lumps before use.

(b) Batching - Batch materials according to 02001.40.

00755.45 Mixing Concrete - Mix the concrete according to 02001.40. Mix the concrete in a batch plant mixer, except truck mixers may mix and deliver concrete only to areas inaccessible to paving Equipment.

00755.46 Placing Concrete:

(a) Delivery To Spreader - Deliver the concrete from the hauling vehicles to the placer/spreader hopper on the Shoulder area. Do not permit Equipment hauling concrete on the Subgrade or on the Base, except for a minimum number of approved right angle or near right angle crossings. Correct damage to the Subgrade or Base due to the Contractor's operations to the satisfaction of the Engineer at no additional cost to the Agency. Keep the surface of the Subgrade or Base moist in front of the paving operation.

(b) One Lift - Place the concrete in final position by the slipform method in one Lift, so a minimum of finishing will be necessary to provide a dense, homogenous Pavement conforming to true grade and Cross Section, except when 00755.50 applies.

(c) Spreading and Finishing Construction - Except for concrete Pavement to be placed and finished at locations inaccessible to slipform paving Equipment, place the concrete with slipform paving Equipment designed to spread, consolidate, screed, and float-finish the plastic concrete in one complete Pass of the machine to provide a dense and homogeneous Pavement surface with a minimum of hand finishing. Use hand screeding and float finishing only on small irregular areas.

Consolidate the plastic concrete by internal vibration with transverse vibrating units located within the specified thickness of Pavement sections for the full width of Pavement. A series of equally spaced longitudinal vibrating units may be used to supplement or replace the transverse vibrating units.

Maintain the frequency of vibration of each vibrating unit above 7,500 cycles per minute. Maintain the frequency or amplitude of vibration to consolidate the plastic concrete along the entire length of the vibrating unit and for a distance of at least 1 foot. Vary the frequency or vibration of amplitude proportionately with the rate of travel to result in a uniform density and air content.

Horizontally space vibrators according to the manufacturer's recommendations or not more than 18 inches, center-to-center, whichever is less. Do not exceed a 9 inch space from the outer edge of the Pavement to the outside vibrator.

(d) Continuous Forward Motion - Coordinate all operations of mixing, delivering and spreading concrete to provide uniform progress. Operate the slipform paver with as nearly continuous forward movement as possible. Hold stopping and starting the paver to an absolute minimum. If, for any reason, it is necessary to stop the forward motion of the paver, the vibratory and tamping elements shall also be stopped immediately. Apply no external force to the paver.

(e) Provision for Joints and Other Devices - While placing concrete, make provision for constructing joints, placing dowels, tie bars, and other devices, as shown and directed, and as provided in 00755.43 and 00755.48.

(f) Reject Concrete Material - Reject concrete if it:

- Is not in place within 1 hour after being mixed.
- Has begun to take an initial set before placement.
- Has been retempered with water.

(g) Protect Surface - Equip supports of the slipform paver, and other Equipment which ride on previously placed Pavement to meet the requirements of 00755.60, to prevent marring, edge breaking or chipping of the previously placed Pavement.

When concrete is placed adjacent to an existing Pavement, equip that part of the Equipment which is supported on the existing Pavement with protective pads on crawler tracks or use rubber-tired wheels. Offset the track or wheels to run a sufficient distance from the edge of the Pavement to avoid breaking the Pavement edge.

(h) Hand Operated Equipment - Use shovels, not rakes, to hand spread and distribute the concrete. Do not foul the concrete with foreign matter, or disturb joint devices during such operations. Furnish hand operated mechanical vibrators satisfactory to the Engineer. Use these vibrators to consolidate the concrete Pavement at least 6 feet each side of construction and expansion joints and any other areas as directed.

(i) Illumination - During hours of darkness, adequately illuminate Work areas at no additional cost to the Agency.

00755.47 Test Strip - At the beginning of paving operations, construct one initial test strip of concrete Pavement at least 0.1 mile, but not more than 0.2 mile in length at the specified paving width. Use the same Equipment for the remainder of the paving. Do not perform further paving until the test strip is evaluated according to 00755.55. An additional test strip will be required when:

- The Contractor proposes using different paving equipment.
- Any portion of a test strip fails to meet the smoothness requirements of 00755.55.

Change methods and/or Equipment and construct additional test strips until a test strip meets smoothness requirements without grinding or other corrective Work. Limit these additional test strips to 0.1 mile in length.

If three test strips fail to meet smoothness requirements before grinding, remove all three strips and construct additional test strips at no additional cost to the Agency.

The Engineer may waive the initial test strip if the Contractor is proposing to use a batch plant mixer and paving Equipment that were satisfactorily used on a Department project within the preceding 12 months and the mixer hasn't been altered or moved.

00755.48 Joints:

(a) General - Construct joints of the kinds shown and where shown or directed. Joint types in the concrete Pavement will be contraction, construction or expansion. They shall be transverse or longitudinal, as shown or directed. Extend all joints and joint filler to Pavement edges or to each other.

Construct all joints at right angles to the surface of the Pavement. Joints shall not vary from specified or indicated line by more than 1/4 inch. The tops of joint filler, when required, shall be slightly, but not more than 1/8 inch, below and paralleling finished Pavement grade and Cross Section. Protect top edges of filler from damage by paving operations.

All joints which contain preformed filler are to be constructed before the final floating and surface finishing of the concrete, unless otherwise directed.

(b) Longitudinal Joints - Longitudinal joints shall be the contact type or weakened plane type as shown.

(1) Longitudinal Contact Joints - Construct longitudinal contact joints when concrete is placed against hardened concrete, between strips of Pavement or between a strip of Pavement and a concrete gutter.

(2) Longitudinal Weakened Plane Joints - Construct weakened plane joints by sawing to the depths and maximum width shown. Saw longitudinal weakened plane joints at the earliest possible time following placement of the concrete to prevent uncontrolled cracking without damaging the Pavement or joint. Saws may be single or tandem, as the Contractor elects, and be controlled by guides to true line. Restore curing agents broken or damaged by the sawing operations.

If the top width of sawed joints exceeds 1/4 inch, fill the joint with a poured joint filler.

(c) Construction Joints - Construct construction joints when there is an interruption of 45 minutes in the concrete placing operations.

The new concrete placed against the joint shall conform closely to the proportions and consistency of the previously placed concrete except vibrate and consolidate it to a greater degree and with more care than normal.

(1) Continuously Reinforced Pavement - Furnish a self-supported working platform at each construction joint. This working platform shall be at least 4 feet wide and long enough to span the entire width of the Pavement Panel being constructed. Construct and support the platform so it does not rest upon or touch the reinforcing steel. Have the workers use this platform when working in the area around construction joints and do not walk on the reinforcing steel. Remove any debris or spilled concrete at and beyond the joint, and support the reinforcement in proper position.

Form construction joints with a special header board. Take care when forming construction joints to assure that the reinforcement and its supports are not displaced, distorted or otherwise disturbed. When concrete placement resumes, remove the header board so neither the reinforcement nor the bond between the reinforcement and the previously placed concrete is disturbed.

(2) Other Pavements - Unless otherwise shown, do not construct construction joints within 10 feet of a transverse expansion or contraction joint. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, remove the concrete back to the last joint and dispose of as directed.

(d) Terminal Expansion Joints - Locate terminal expansion joints at the ends of runs of continuously reinforced concrete Pavement and construct to the dimensions and details shown. For the terminal expansion joint, place dowel bars according to 00755.43(f).

The concrete in sleeper slabs shall conform to 00755.11. The steel reinforcement shall conform to Section 02510.

Vibrate concrete in sleeper slabs until it is completely consolidated and the excavations are completely filled. Construct sleeper slabs at least 24 hours before paving operations, unless otherwise allowed. Cure the surfaces of sleeper slab concrete according to 00755.53 until covered with concrete Pavement.

00755.49 Surface Finishing - After the concrete has been given a preliminary finish by the finishing devices in the slipform paving Equipment, check the surface of the fresh concrete in the longitudinal and transverse direction with a 12-foot straightedge. Correct surface deviations more than allowed by 00755.55(a). Lap each successive check with the previous check path by at least half the length of the straightedge. This longitudinal checking and correction on areas to be profiled for IRI smoothness will be waived if it is successfully demonstrated that a Pavement surface is otherwise produced which conforms to 00755.55(b)(1)(a).

(a) Edge Slump - Correct any edge slump of the concrete in excess of 1/4 inch before the concrete hardens.

(b) Textured Finish - Upon completion of the machine floating, straightedge testing, edge tooling and, if necessary, hand floating, and before initial set of the surface concrete, give the surface of the concrete a textured finish.

Accomplish the textured finish with a steel-tine tool with 1/8 inch wide tines spaced 3/4 inches apart that will mark the finished surface to a depth of 1/8 to 3/16 inch without tearing the surface. Avoid overlaps of the texturing. Texture the surface parallel to the roadway centerline and full roadway width.

00755.50 Stationary Side Form Construction - Consolidate and finish according to 00755.51.

(a) Mandatory SSFC - Use stationary side form construction on the standard reinforced concrete Pavement at the ends of Structures.

(b) Optional SSFC - With the approval of the Engineer, Pavement may be constructed between stationary side forms in:

- Areas inaccessible to slipform paving Equipment.
- Irregular areas.
- Short sections of Pavement which are necessary to facilitate traffic movement.

00755.51 Modification of Strike-off, Consolidation, Final Floating, and Surface Finishing - Where the width of Pavement is narrow, tapering, or of irregular pattern not lending itself to being constructed by prescribed machine methods, the Contractor will be allowed to perform the strike-off, consolidation, final floating and surface finishing with Equipment, tools, means, labor and methods other than those specified, provided the Work meets with the approval of the Engineer and the following requirements:

- Without causing segregation, vibrate throughout the concrete being placed until it is uniformly consolidated.
- Strike off the concrete with templates or screeds designed and manipulated to shape the concrete to specified Cross Section between the forms, carrying a slight excess of concrete in front of the leading edge of templates or screeds at all times.

- Following the vibrating and strike-off operations, float the concrete. Include transverse floating or other smoothing and finishing actions as necessary. Check and correct the surface according to 00755.49. Keep the surface free from laitance, soupy mortar, marks or irregularities.
- Finish the surface according to 00755.49.

00755.52 Edge Tooling and Filling - Tool edges at transverse joints and longitudinal joints of new Pavement and clean joints of previously placed concrete to remove laitance and mortar resulting from finishing operations, and to provide clean rounded edges without ridges on the surface.

Fill any areas of minor honeycomb or other minor defect in composition of the concrete along the exposed sides of concrete with a stiff mortar of cement and fine Aggregate, and apply to the moistened concrete to the satisfaction of the Engineer. Remove and replace areas showing serious defects in composition of the concrete with specified quality concrete for full Panel width between longitudinal joints or edges, and for a length not less than 10 feet. Low spots exceeding 1/4 inch in depth, if in hardened concrete, may be filled with an epoxy grout, provided the filling is neat and blends inconspicuously with adjoining concrete. Prepare the area according to the grout manufacturer's recommendations.

00755.53 Curing Concrete - Immediately after the final floating, surface finishing and edging have been completed, and while the concrete surface is still moist, cover and cure the entire exposed surface of the newly placed concrete for at least 72 hours according to one of the following provisions:

(a) Liquid Membrane-Forming Compounds - Apply liquid membrane-forming compound uniformly to the concrete by pressure-spray methods at a rate of at least 1 gallon per 150 square feet. Mix the liquid membrane-forming compound thoroughly before and during use.

Liquid membrane-forming compounds are not allowed when an asphalt concrete Pavement is placed on the new portland cement concrete Pavement.

(b) Other Coverings - Apply the covering to damp concrete as soon as it can be placed without marring the surface. Place the membrane in contact with the surface, extend beyond the sides or edges of the slabs or forms, and weight down as required to hold it in position as a waterproof and moisture-proof covering. Laps shall be sufficient to maintain tightness equivalent to the sheeting and use:

(1) Polyethylene Film - Sheeting shall be clear or white.

(2) Waterproof Paper - Transverse laps shall be at least 18 inches, and cement longitudinal seams.

(3) Cotton or Jute Mats - Before placing, saturate the mats with water and keep fully wetted during the curing period.

00755.54 Longitudinal Pavement Cracks - Within 28 days after concrete placement and before opening the Pavement to Public Traffic, the Engineer will perform a Pavement crack survey. Clean the Pavement before the crack survey. Pavement with uncontrolled longitudinal cracks which are visible without magnification will be considered unacceptable and be repaired or removed as determined by the Engineer. Perform all remedial Work at the no additional cost to the Agency.

00755.55 Surface Tolerance, Testing, and Correction - The surface of finished Pavement shall not deviate from longitudinal and transverse smoothness more than the prescribed limits. Perform straightedge testing and IRI profile testing under the supervision of the Engineer with Equipment furnished and operated by the Contractor as soon as the hardness of the concrete permits.

(a) Straightedge Testing and Tolerance - Test the longitudinal and transverse smoothness of the Pavement surface with a 12-foot straightedge. The extent of the testing will be as the Engineer

determines necessary or expedient. The Pavement surface shall not deviate from the straightedge at any point by more than 1/8 inch for all areas that are constructed by the prescribed machine methods and for all Traffic Lanes and ramps. Other areas shall not deviate by more than 1/4 inch. Longitudinal 12-foot straightedge testing is not required for Pavement accepted under 00755.55(b).

(1) Transverse Joints - Test with the 12-foot straightedge parallel to the centerline, as directed. The Pavement surface shall not vary by more than 1/8 inch.

(b) International Roughness Index Smoothness Testing and Tolerance:

(1) General - Test the longitudinal surface of all Traffic Lanes, ramps, Shoulders and Bridges for smoothness by the IRI method according to ODOT TM 772. Before paving commences on the Project, demonstrate the inertial profiler operation by conducting calibration testing according to ODOT TM 772, and running the machine twice over a 0.1 mile section of Pavement with repeating results.

a. Daily Surface Test - The Pavement shall have an average IRI of 65.0 inches, or less. If the average 0.1 mile IRI exceeds 95.0 inches per mile for any segment of Pavement constructed in any Day's production, discontinue paving operations and construct one or more test strips as described in 00755.47. The test strip may be comprised of Pavement placed during the shift, but in no case shall it be less than 0.1 mile in length.

Start the profiles that represent a Day's production 50 feet before the beginning of that Day's production and stop 50 feet before the end of that Day's production.

Run the profiles for each Day's production as soon as possible without damaging the surface. Analyze the Daily Surface Test profiles according to 00755.55(c)(2), and give the profiles and results to the Engineer within 24 hours of the conclusion of the Day's production.

b. Quality Control Surface Test - Run the profiling device over each Traffic Lane for the full length of the Project.

In the presence of the Engineer and according to ODOT TM 772 obtain profiles on the Pavement surface in the right and left wheel path of the Traffic Lane along a line parallel to longitudinal pavement markings, at 3 feet and 9 feet offsets form the left edge of the Traffic Lane. Take the profile on transition areas of entrance and exit ramps, as close to the right and left wheel path of the through Traffic Lane as practical. Submit data files to the Engineer at the completion of each shift in which profiling has taken place. For the Pavement sections tested, provide the raw data files and electronic copies of the profile data in PPF and manufacturer proprietary formats, as required by the Engineer.

Analyze profiles according to 00755.55(c), give the results to the Engineer no later than 24 hours following completion of required smoothness testing. The results consist of a table showing the areas of Localized Roughness in each wheel path, left wheel path IRI, right wheel path IRI, and mean IRI (average of left and right wheel path IRI) at 0.10 mile intervals.

c. Quality Assurance - At the discretion of the Engineer, the Agency may perform Quality Assurance of Profiles on Projects according to ODOT TM 772.

(c) Determination of the International Roughness Index:

(1) General - Analyze profiles in 0.10 mile segments and partial segments. Begin segments 50 feet into the Project and run consecutively in the direction of travel. A segment ends as a partial segment and a new segment begins when the segment sequence is interrupted by stage

construction or by profiled areas excluded from the smoothness requirements. Minimize the number of partial segments.

The following areas of Pavement are excluded from IRI smoothness requirements:

- Profiles extending beyond the Project ends.
- Bridge decks, Bridge end panels, and Pavement within 50 feet of Bridge end panels.
- First and last 50 feet of the paving limits of the Project.
- The 50 feet before and after No Work Areas within the Project limits.
- Ramps and auxiliary lanes, with a posted speed of less than 35 mph.
- Shoulders.
- First 200 feet of entry ramps and the last 200 feet of exit ramps.
- The 25 feet before and after Utility appurtenances in the Traffic Lane.
- Continuous portions of Traffic Lanes with less than 0.05 mile between excluded areas.
- Portions of the Project with posted speed limits less than 35 mph.

Locate IRI profiling excluded areas prior to smoothness measurement. Areas excluded from longitudinal profile measurement shall meet the straightedge requirements of 00755.55(a).

(2) Method of Analysis - Determine IRI and areas of Localized Roughness for each wheel path according to ODOT TM 772, with the limits established per 0755.55(c). Maximum averaged IRI is 95.0 inches/mile for 0.1 mile segments and partial segments and 160.0 inches/mile for areas of Localized Roughness.

(d) Shoulders and Paved Medians - Test the Pavement with the 12-foot straightedge parallel to and perpendicular to the centerline for shoulders and paved medians, as directed by the Engineer. The Pavement surface shall not vary by more than 1/4 inch.

(e) Correcting Deficiencies - Should testing described in 00755.49, 00755.51, and 00755.55 show the Pavement does not conform to the prescribed limits of deviation, the following shall apply:

(1) Failure to Meet Straightedge Requirements:

a. Plastic Concrete - If the requirements of 00755.49 or 00755.51 are not met, stop the paving operations until revised methods, changes in Equipment, or correction of procedures are made or proposed for trial, and are approved by the Engineer for trial. Also stop those revisions, changes and corrections if they do not produce a specified surface.

b. Hardened Concrete - If the requirements of 00755.51 or 00755.55(a) are not met, correct according to 00755.55(e)(2)(a), or 00755.55(e)(2)(b) and retest.

(2) Failure to Meet IRI Smoothness Requirements - If testing described in 00755.55(b) shows that the Pavement does not conform to the prescribed limits, the Contractor is responsible for locating areas that require corrective work. All segments with an IRI value more than 95.0 inches per mile and areas of Localized Roughness are subject to corrective action. Disagreements will be resolved by the Engineer.

Correct all areas of Localized Roughness, segments and partial segments identified for corrective work, and any transverse joint and excluded areas that exceed the requirements of 00755.55(b), by one of the methods listed below and to the specified limits:

a. Remove - Remove the non-specification concrete Pavement as determined by the Engineer and replace with specification concrete Pavement.

b. Grind - Profile with abrasive grinders, equipped with a cutting head comprised of multiple diamond blades, to a maximum depth of 0.3 inches. Areas ground are subject to the requirements of 00755.56 and 00755.93. Mark the areas to be profile ground. For all areas corrected by grinding, restore the required surface texture, as specified in 00755.49(b), by longitudinal sawing with diamond blade saws.

c. Time Limit - Complete correction of all surface roughness within 14 Calendar Days following notification, unless otherwise directed.

Retest their entire length, according to 00755.55(b), all segments requiring corrective Work with the inertial profiler under the supervision of the Engineer.

Perform all corrective Work and intertial profiling, including traffic control, at no additional cost to the Agency.

00755.56 Pavement Thickness - Construct the Pavement to the thickness shown. Pavement not so constructed will be subject to replacement according to 00755.57, or to payment at adjusted prices according to 00755.93.

(a) Sticking Measurements - Determine conformance with minimum thickness requirements by random sticking measurements of the plastic concrete according to ODOT TM 775 under the Engineer's observation. Report thickness to the nearest 0.1 inch.

Divide the Panel into units and partial units equivalent to a maximum of 200 lane feet. Normally, unit lengths will be 200 feet for one lane, 100 feet for two lanes, 70 feet for three lanes and as appropriate for transition areas. When directed, take one sticking measurement at a randomly selected location in each unit and partial unit. Record measurements to the nearest 0.1 inch. Take the measurements:

- After consolidation and screeding and before the float finish.
- No closer than 2 feet from the Panel edges.
- Within 10 feet longitudinally and 1 foot transversely from the calculated random location determined by the Engineer.

If a sticking is not obtained for a unit or a partial unit, or is not available to represent the area of Pavement remaining after the limits of Pavement over 1.0 inch deficient is determined, the measurement will be assumed to be the same as the preceding or following sticking measurement, that is nearest in distance.

(b) Thickness 0.5 Inch Deficient - If a sticking measurement indicates the Pavement is 0.5 inch or more deficient in thickness, stop forward paving progress until appropriate adjustments are made or corrective action is taken.

(c) Coring Requirements - Perform required coring, or coring requested by the Engineer according to AASHTO T 24 and repair core holes as directed, at no additional cost to the Agency. Cores will be measured by the Engineer according to AASHTO T 148 and the measurements reported to the nearest 0.1 inch. Core measurements will replace sticking measurements.

(1) Corrective Grinding Areas - If corrective grinding required by 00755.55(e) is performed at a sticking measurement site where the measurement is the specified depth or less within a

segment or partial segment represented by the profile indexes, the Engineer may require a core after corrective grinding.

(2) Cores Requested By Contractor - If the Contractor believes that a sticking measurement or a core is not representative of the actual Pavement thickness, the Contractor may take a replacement core. Take replacement cores at a location as directed, 10 feet from the sticking measurement or core site in question and the same distance from centerline. The replacement core measurement will replace the original sticking or core measurement.

(d) Thickness Over 1.0 Inch Deficient - If a sticking measurement shows Pavement over 1.0 inch deficient, obtain a core at the sticking measurement site. If this core, or a core determined by 00755.56(c)(1), shows Pavement over 1.0 inch deficient, obtain additional cores. Take these additional cores at the same distance from the centerline and at 25 foot intervals each direction from the first core until a core in each direction shows Pavement 1.0 inch deficient or less. These two core locations will be considered the limits of the Pavement more than 1.0 inch deficient. The Pavement Panel between these two cores will represent the area of Pavement subject to removal and replacement under 00755.57 or no payment under 00755.93.

When it is suspected by the Engineer that the Pavement in the adjacent travel lanes in the Panel may be more than 1.0 inch deficient for a greater distance than determined by the above procedure, core the Pavement in the adjacent travel lanes in the nearest wheel track (3 feet from the nearest edge) opposite both limit cores. If these cores are more than 1.0 inch deficient, the above procedure shall be followed to determine the limits.

00755.57 Deficient Pavement - Remove and replace Pavement deficient in thickness by more than 1.0 inch, according to 00755.56(d), at no additional cost to the Agency. If allowed by the Engineer, the Pavement may be left in place without payment. Replacement Pavement shall be of the specified design, quality and thickness as follows:

- Be the full width of the Pavement Panel involved.
- Extend far enough to replace at least a 20 foot length.
- Extend to the construction joint if closer than 20 feet to a construction joint.

00755.58 Terminal Anchors - Furnish concrete for anchors according to 00755.11. Furnish steel meeting the requirements for standard Pavement reinforcement as shown.

Vibrate the concrete in anchors until it is consolidated and the excavations are filled. Construct anchors at least 24 hours before paving operations. Keep the surfaces of anchor concrete moist and clean until covered with Pavement concrete.

00755.59 Flexible to Rigid Pavement Transition Systems - Furnish the concrete in Pavement transition systems according to 00755.11. Furnish steel meeting the requirements for standard Pavement reinforcement as shown.

Vibrate the concrete in Pavement transition systems until it is consolidated and the excavations are filled. Construct Pavement transition systems at least 24 hours before paving operations.

Maintenance

00755.60 Protection of Concrete - Repair or replace any part of the Pavement damaged by traffic or damaged from any other cause before its official acceptance, according to 00170.80.

The maturity method, AASHTO T 325, may be used to estimate concrete strength for opening Pavement to construction traffic. Install at least two maturity thermocouples for each Day's placement

in areas where the maturity method will be used for early opening. Install the thermocouples near the Day's final placement for areas being evaluated for early opening.

When the maturity method is used, the Engineer may verify the maturity method with strength specimens. Establish a new strength-maturity relationship if strength specimens deviate more than 10 percent from the maturity-estimated strengths. Suspend use of the maturity method for opening Pavements to traffic when the strength-maturity relationship deviates by more than 10 percent until a new strength-maturity relationship is established.

Do not operate construction Equipment on newly placed concrete until the requirements of (a), (b), and (c) are met. Do not allow Public Traffic on newly placed concrete until all of the following requirements are met:

(a) The Contractor complies with 00150.60.

(b) The concrete attains a compressive strength of at least 70 percent of the specified 28-Day strength as determined by testing at least three cylinders cured according to AASHTO T 23 (field cure) and tested according to AASHTO T 22.

(c) The surface of the concrete is protected from scarring or abrasion and kept free of stones, loose mortar and other matter apt to be deleterious to the concrete in the paths of Equipment.

(d) The Pavement meets all of the requirements of 00755.55.

Measurement

00755.80 Measurement - The quantities of concrete Pavement will be measured on the area basis. The area will be determined by measuring the width and length of each separately constructed Panel of Pavement. The width is the design width or measured edge-to-edge width on the surface of the Pavement, whichever is less. The length is the horizontal measurement from end to end of Pavement along the center line of the strip.

The measurement of extra thickness of Pavement, as shown or as ordered, will be determined by conversion on a proportionate volume basis to an equivalent number of square yards of specified thickness Pavement.

The quantities of terminal anchors will be measured on the length basis, along the center line of each anchor as constructed.

The quantities of flexible to rigid Pavement transition systems will be measured on the unit basis where each unit is one lane width.

Payment

00755.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Continuously Reinforced Concrete Pavement	Square Yard
(b)	Continuously Reinforced Concrete Pavement ___ Inches Thick	Square Yard
(c)	Reinforced Concrete Pavement	Square Yard
(d)	Reinforced Concrete Pavement ___ Inches Thick	Square Yard
(e)	Terminal Anchors	Foot
(f)	Flexible to Rigid Pavement Transitions	Each

In items (b) and (d), the thickness of the Pavement will be inserted in the blank when more than one thickness is required under the Contract.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for splices due to staged construction, tie bars, dowel bars, curing materials or sawcutting.

00755.92 Price Adjustment for Strength - For each lot of concrete for which a PF is determined, the following will apply:

- In no case will the actual payment exceed the Contract Unit Price.
- When the PF is less than 1.00, the price adjustment will be determined as follows:

$$\text{Price Adjustment} = 0.3 \times (PF - 1) \times \text{Unit Price}$$

00755.93 Price Adjustment for Variation in Thickness - No additional payment over the Contract unit price will be made for Pavement having a thickness greater than shown or ordered by the Engineer. When the Pavement is found deficient in thickness by more than 0.2 inch, but not more than 1.0 inch, as determined according to 00755.56, payment will be made at an adjusted price according to the following table:

Deficiency in Thickness (Inch)	Proportional Part of Contract Unit Price Allowed
0.00 to 0.20	100%
0.21 to 0.30	83%
0.31 to 0.40	76%
0.41 to 0.50	73%
0.51 to 0.75	63%
0.76 to 1.00	59%

No payment will be made for any area of Pavement found deficient in thickness by more than 1.0 inch even though such Pavement is allowed by the Engineer to remain in place under the provisions of 00755.57.

00755.95 Smoothness Price Adjustment - No separate or additional payment will be made for smoothness testing.

(a) General - A price adjustment based on the results of the IRI will be made for each 0.10 mile segment or partial segment of Traffic Lane CRCP requiring IRI measurement according to 00755.55(b). The price adjustment will be based on the IRI values determined according to ODOT TM 772 for each 0.10 mile segment and partial segment. Partial segments less than 0.10 mile in length will be evaluated with the IRI price adjustment value multiplied by the ratio of the partial segment length to 0.10 mile segment, as determined in 00755.55(b). A 0.10 mile segment, or partial segment is only eligible for a positive price adjustment if the following apply:

- The average of the IRI for both wheel paths is 60.0 inches per mile or less.
- These requirements are met without any corrective action specified in 00755.55(e)(1)(b).

A smoothness price adjustment will be made for all segments, or partial segments based on the average IRI value of both wheel paths and the following equations:

Averaged IRI (inches/mile)	Equation
≤ 35.00	Y = $900.00
35.01 - 60.00	Y = (- $36 × X) + $2,160
60.01 - 65.00	Y = $0.00
65.01 - 95.00	Y = (- $36 × X) + $2,340
> 95.00	Corrective Action
Y = The price adjustment for the segment or partial segment X = The averaged IRI value for the segment or partial segment	

The smoothness price adjustment will be made on the next monthly progress estimate following the satisfactory completion of all corrective Work and the submission of all test data for all Traffic Lane paving on the Project.

00755.95(b) applies when corrective action is taken by the Contractor.

(b) Adjustments for Sections Requiring Corrective Work - Segments or partial segments containing corrective Work according to 00755.55(c) will be subject to the price adjustments described in 00755.95(a), except that no positive price adjustment (bonus) will be due to the Contractor. If a segment or partial segment containing corrective Work is retested according to ODOT TM 772 and 00755.55(b)(2), the retested average IRI value will be used for payment, except that no positive price adjustment will be made for a segment or partial segment containing corrective work.

Segments or partial segments containing corrective Work with an IRI value of more than 95.0 inches per mile are subject to additional corrective action according to 00755.55(c). The Engineer may waive corrective action in partial segments with the application of a smoothness price adjustment based on an IRI value of 95.0 inches per mile.

Section 00756 - Plain Concrete Pavement

Description

00756.00 Scope - This Work consists of constructing portland cement concrete Pavement as shown and specified.

00756.01 Abbreviations:

GPT - Graphic Profile Test
LSL - Lower Specification Limit
PI - Profile Index
SSD - Saturated Surface-Dry
SSFC - Stationary Side Form Construction
SSTV - Sublot Strength Test Value
USL - Upper Specification Limit

00756.02 Definitions:

Localized Roughness - An area that exceeds 160.0 inches per mile in a continuous International Roughness Index (IRI) evaluation over a 25.0 foot base length.

00756.04 Aggregate Production and Prepaving Conference:

(a) Aggregate Production Conference - Supervisory personnel of the Contractor and any Subcontractors or Suppliers who are to be involved in the Aggregate production Work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing Aggregate production.

(b) Prepaving Conference - Supervisory personnel of the Contractor and any Subcontractors who are to be involved in the concrete paving Work shall meet with the Engineer, at a mutually agreed time, to discuss methods of accomplishing all phases of the paving Work.

Materials

00756.10 Materials - Furnish Materials meeting the following requirements:

Bonding Agents.....02070
Concrete.....02001
Curing Materials.....02050
Dowels.....02510.50
Galvanizing.....02530.70
Grout.....02080
Hot Applied Joint Sealant.....02440.30
Poured Joint Sealant.....02440.11
Preformed Joint Fillers for Concrete.....02440.10
Reinforcement.....02510

00756.11 Classes of Concrete - Furnish Class 4000 - 1 1/2 paving concrete unless otherwise shown or specified.

00756.13 Concrete Mix Designs - Prepare and submit either new mix designs or current mix designs for each class of concrete required according to Section 02001.

00756.15 Quality Control - Provide quality control according to Section 00165, Section 02001, and the following:

(a) Concrete Mixture - If the results of any test are outside of the Specification limits, stop the placement of the load. Correct the load or reject it and do not incorporate it into the Work. Test subsequent loads before any further concrete placement. Correct the subsequent loads if any of the tests are still outside the Specification limits. If the load cannot be corrected, reject it and do not incorporate it into the Work. Testing of subsequent loads may return to the specified frequency when the test results from two consecutive loads are shown to meet the Specification limits.

(b) Records - Deliver all batch tickets, water-cement ratio calculations, and all other records required to the Engineer upon availability but no later than the morning of the next Day.

00756.16 Acceptance of Concrete:

(a) General - Acceptance of concrete will be based on the results of the Contractor's quality control testing according to Section 00165.

(b) Aggregate - Acceptance will be based on the Contractor's quality control testing, if verified by the Agency according to Section 00165.

(1) Aggregate Gradation - A stockpile contains specification Aggregate gradation when the quality level for each sieve size calculated according to 00165.40 is equal to or greater than the quality level specified in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the quality level specified in Table 00165-2 yields a PF of less than 1.00 for any constituent, the material is non-specification.

(2) Non-specification Aggregate Gradation - Stockpiled Aggregates that contain non-specification Aggregate gradation will be rejected by the Engineer unless non-specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material is removed so that the quality level for each constituent is equal to or greater than the quality level in Table 00165-2 for a 1.00 PF.

(c) Plastic Concrete - Acceptance of the plastic concrete will be based on the tests performed by the Contractor's QCT, according to the tolerances and limits of Section 02001.

(d) Hardened Concrete - Cast and cure the test specimens according to AASHTO T 23 in 6 inch x 12 inch single-use plastic molds and test at 28 days according to AASHTO T 22.

(1) General - For all classes of concrete, acceptance of hardened concrete will be based on an analysis of compressive strength tests of cylinders cast by the QCT. Test the cylinders at an ODOT certified laboratory.

(2) Sampling and Testing - Sampling and testing shall be according to the MFTP.

(3) Acceptance - The ASTV shall exceed the $f'c$ (specified strength) for the mix design. If a set of cylinders has an ASTV less than $f'c$, the Engineer will review the results to determine if the concrete represented by the cylinders shall be removed. In any case, concrete that has an ASTV of less than 85 percent of the specified strength shall be removed unless otherwise authorized, in writing, by the Engineer. The cost of removal, replacement and all related Work shall be the Contractor's responsibility, subject, if the concrete is allowed to remain in place, to a price adjustment according to 00150.25.

If an ASTV falls below the $f'c$, the Contractor may submit a written plan within 3 days of the test for review by the Engineer. The plan shall outline a proposed alternate method of evaluating compressive strength. The plan shall provide evidence that a reasonable $f'cr$ (over-design) was maintained and that there is credible evidence (besides low strength) which warrants consideration of this option. If the Engineer determines that the compressive strength test results are suspect from definable external factors, the Engineer may allow an alternate method of acceptance.

Equipment

00756.20 Batch Plant - Provide batch plants according to Section 02001.

00756.21 Mixers - Provide mixers according to Section 02001 except mix concrete in the batch plant mixer. Truck mixers may be used only as allowed in 00756.45.

00756.22 Hauling Equipment - Transport concrete in non-agitating Equipment. Truck mixers may be used to transport concrete only as allowed in 00756.45. Hauling Equipment shall conform to AASHTO M 157.12 or AASHTO M 157.11.6 when allowed.

00756.23 Paving Equipment - Provide self-propelled paving machines that conform to the following:

(a) Placer/Spreader - Provide a placer/spreader that will:

- Receive the concrete mixture in its hopper on the Shoulder area.
- Deliver the concrete mixture to the slipform paver and uniformly spread at the proper thickness for the full width of the area being paved.
- Not segregate the concrete mixture or displace the reinforcing steel.

(b) Slipform Paver - Provide a slipform paver that is:

- Equipped with electronic or hydraulic controls to automatically control line and grade from both sides.
- Able to vibrate, consolidate and finish the slab to proper grade and Cross Section for the full width and depth of the concrete being placed.
- Equipped with vibrating tubes or arms to Work in the concrete.
- Equipped with sliding forms held together rigidly to prevent them from spreading.
- Equipped with sliding forms long enough so that slumping of the concrete does not exceed 1/4 inch, according to 00756.49(a).
- Equipped with a positive interlock system to stop all vibration and tamping elements when the forward motion of the machine is interrupted.
- For projects that have more than 1,000 feet of concrete paving, equipped with an electronic monitoring device that:
  - Is near the operator's controls visible to the paver operator and Engineer.
  - Operates continuously while paving.
  - Displays the operating frequency of each individual internal vibrator for both manual and automatic sequencing.
  - Records the time of Day, station location, paver track speed and the operating frequencies.

(c) Paving Machine - If a paving machine riding on stationary side forms is used, conform to the following:

- The machine used for initial strike-off and consolidation of PCC shall be self-propelled, screening type and shall ride on and be guided by steel side forms or the edge of contiguous PCC Pavement. The machine shall be designed and operated to strike-off, consolidate and compact the PCC to prescribed line, grade and Cross Section. Make provision to prevent chipping or marring previously placed PCC.
- Vibratory Equipment shall be of the surface pan type or internal type with immersed tube or multiple spuds. The vibrator shall provide full slab width vibration to the concrete. The rate of vibration shall be not less than 3,500 cycles per minute for surface vibrators and shall be not less than 7,000 cycles per minute for internal vibrators and as necessary for proper consolidation and compaction.
- Floating and finishing machines shall be self-propelled and shall ride on and be guided by steel side forms or the edge of contiguous PCC Pavement. The machine shall provide floating action to the PCC surface by means of screeds, floats, rollers or combinations of them. Screed type machines shall have at least two oscillating type transverse screeds. The machines shall have sufficient wheel base length, weight, float surface and adjustments to true up the PCC surface to accurate Cross Section and grade without dragging, marking or defacing the surface.

00756.24 Concrete Saws - Provide power driven concrete saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. Also provide a standby saw on the Project Site.

00756.25 Smoothness Testing Equipment - Provide all Equipment and supplies for determining smoothness according to 00756.55.

(a) Straightedge - Provide two 12-foot straightedges.

(b) Inertial Profiler - Provide a profiling device meeting the requirements of ODOT TM 772 and certified according to ODOT TM 769.

Provide competent and experienced operator(s) for the Equipment, certified with the profiler according to ODOT TM 769. The profiler operator shall meet with the Engineer at a mutually agreed upon time prior to beginning smoothness measurements to discuss all aspects of smoothness measurement on the Project.

Labor

00756.30 Quality Control Personnel - Provide technicians having CAgT, CCT, CSTT, and QCT technical certifications.

Additional Contractor quality control responsibilities include the following:

- Provide and designate an individual who shall be present at the placement site at all times during concrete placements, and who is authorized and responsible for acceptance and rejection of materials.
- Reject loads which arrive at the Project Site without a batch ticket.
- Require the truck driver to record on the batch ticket and initial the amounts of water added in transit and at the Project Site.
- Reject plastic concrete that is outside of the specified limits.

Construction

00756.40 Weather Limitations - Coordinate all operations involved in constructing the Pavement so the Work will result in a finished Pavement conforming to the Specifications regardless of the daily or seasonal variations in weather, temperature and humidity under which the Work is allowed to proceed.

Do not place PCC during periods of rain. Do not place PCC on frozen bases, or when descending air temperature falls below 35 °F. Placement shall not resume until ascending air temperature reaches 35 °F. Measure air temperature in the shade and away from artificial heat.

Protect the Pavement from weather damage. Protect unhardened PCC from precipitation with protective material. When PCC is being placed during cold weather, and the air temperature is forecast to drop below 33 °F, prevent the PCC from freezing for a minimum of 7 days after placing.

Remove and replace weather damaged Pavement at no additional cost to the Agency.

00756.41 Preparation of Base - Before paving operations begin, bring the Base to the finished condition and shown grade required by the Specifications. If the Equipment used by the Contractor requires additional width for support, provide the support necessary to assure the Equipment maintains proper grade and Cross Section.

The Base shall be moist before the concrete is placed. When the Base is a treated Base the surface shall be clean and free of all loose material. Place concrete on existing and new treated Base only when the surface temperature is less than 90 °F. If water is used for cooling, remove all excess water standing in pools or flowing on the surface before placing concrete.

Manholes, inlets and other such Structures shall be completed, adjusted, cured and otherwise prepared, as applicable, and ready to have concrete placed in contact with them. Prepare manhole frames and other independent metal Structures in the Pavement area with an approved bond-preventing agent.

00756.42 Construction Widths - When the Pavement consists of two or more Traffic Lanes, construct at least two Traffic Lanes in one strip Panel unless shown otherwise.

If the Contractor proposes a method of placement other than that shown or specified, the Contractor shall pay all costs to implement the change. Any changes require the Engineer's approval.

00756.43 Placing Dowel Bars and Tie Bars:

(a) Dowel Bars - Provide smooth, round, epoxy coated dowel bars. Coat dowel bars with a lubricant or bond breaking compound approved by the Engineer. Use a framework to place dowels that is continuous across the entire lane width, holds the dowels parallel with each other, holds the dowels parallel with the surface of the Pavement, and holds the dowels parallel to the roadway centerline. For dowels placed across an expansion joint, use a dowel bar basket or other system of support that leaves no permanent incompressible members in place within the joint. Maximum alignment tolerance shall be 5 degrees or 3/16 inch in the length of the dowel. Place dowels within 3/8 inch of the center of the slab vertically.

Place dowel bars for joint contact at existing concrete Pavement surfaces by drilling the existing concrete section and then inserting the dowel bars and grouting them in place. Drill the holes large and deep enough to insert the dowel bars with adequate epoxy or non-epoxy grout. Adjust hole locations to avoid damaging any existing reinforcement when drilling the holes. Blow the dowel bar holes clean with compressed air before grouting. Center the bar in the hole for the full length of embedment before grouting. Pump the grout into the hole around the bar so the back of the hole will be filled first. Do not allow blocking or shimming to impede the flow of the grout into the hole.

If dams are needed, place them at the front of the holes to confine the grout. Place the dams to permit the escape of air without leaking grout. Do not remove dams until grout has cured in the hole.

(b) Tie Bars - Provide epoxy coated tie bars and place them for contact-type longitudinal joints by one of the following methods:

- By drilling the hardened concrete section and then inserting and grouting the tie bars into place. Drill the holes large and deep enough to insert the tie bars with adequate epoxy or non-epoxy grout. Take care not to damage the reinforcement when drilling the holes. Drill after the concrete attains enough strength so no damage to the concrete is caused by the drilling. Replace loose tie bars at no additional cost to the Agency.
- By inserting the tie bars into the plastic slipformed concrete before vibrating and finishing the concrete. The tie bars may be bent before insertion. Replace any loose tie bars by drilling and grouting, as described above, at no additional cost to the Agency.
- By using threaded mechanical splice couplers from the QPL. Submit splices for approval before using. Rebar splices shall be:
  - Accompanied by manufacturer's quality compliance certificate according to 00165.35.
  - Installed according to manufacturer's recommendations.

00756.44 Handling, Measuring, and Batching Materials - The plant site, layout, Equipment and provisions for transporting material shall be adequate to assure a continuous supply of material to the Project Site.

(a) Aggregates - Stockpile and remove the Aggregate from stockpiles in a manner that holds segregation to a minimum.

Do not use Aggregates that become segregated, mixed with earth or foreign material or contain lumps of hardened material. Thaw frozen Aggregates or Aggregates containing frozen lumps before use.

(b) Batching - Batch materials according to 02001.40.

00756.45 Mixing Concrete - Mix materials according to 02001.40. Mix the concrete in a batch plant mixer, except truck mixers may mix and deliver concrete only to areas inaccessible to paving Equipment.

00756.46 Placing Concrete - Place the concrete Pavement with a slipform paving machine as described in (a), (b), (c), and (d) below. Concrete Pavement may be constructed between stationary side forms as described in (e) below only when:

- Areas of continuous concrete Pavement are less than 1,000 square yards.
- Areas are inaccessible to slipform paving Equipment.
- In areas of irregular geometry.
- In short sections of Pavement which are necessary to facilitate traffic movement.

(a) Delivery To Spreader - Deliver the concrete from the hauling vehicles to the placer/spreader hopper on the Shoulder area. Do not permit Equipment hauling concrete on the Subgrade or on the Base, except for a minimum number of approved right angle or near right angle crossings. Correct damage to the Subgrade or Base due to the Contractor's operations, to the satisfaction of the Engineer, at no additional cost to the Agency. Keep the surface of the Subgrade or Base moist in front of the paving operation.

(b) One Lift - Place the concrete in final position by the slipform method in one Lift, so a minimum of finishing will be necessary to provide a dense, homogenous Pavement conforming to true grade and Cross Section.

(c) Spreading and Finishing Construction - Place the concrete with slipform paving Equipment designed to spread, consolidate, screed, and float-finish the plastic concrete in one complete Pass of the machine to provide a dense and homogeneous Pavement surface with a minimum of hand finishing. Use hand screeding and float finishing only on small irregular areas.

Consolidate the plastic concrete by internal vibration with transverse vibrating units located within the specified thickness of Pavement sections for the full width of Pavement. A series of equally spaced longitudinal vibrating units may be used to supplement or replace the transverse vibrating units.

Maintain the frequency of vibration of each vibrating unit above 7,500 cycles per minute. Maintain the frequency or amplitude of vibration to consolidate the plastic concrete along the entire length of the vibrating unit and for a distance of at least 1 foot. Vary the frequency or vibration of amplitude proportionately with the rate of travel to result in a uniform density and air content.

Horizontally space vibrators according to the manufacturer's recommendations or not more than 18 inches, center-to-center, whichever is less. Do not exceed a 9 inch space from the outer edge of the Pavement to the outside vibrator.

(d) Continuous Forward Motion - Coordinate all operations of mixing, delivering and spreading concrete to provide uniform progress. Operate the slipform paver with as nearly continuous forward movement as possible. Hold stopping and starting the paver to an absolute minimum. If, for any reason, it is necessary to stop the forward motion of the paver, immediately stop the vibratory and tamping elements. Apply no external force to the paver.

(e) Stationary Side Form Method - Place the PCC between stationary side forms by means that will prevent segregation of constituents of the PCC, displacement or deformation of the forms or Base, forming of piles, and unequal consolidation.

Spread and distribute the PCC with a mechanical concrete spreader which will fill all corners and spaces with PCC and leave it at such height that after consolidation and finishing it will be at specified grade and Cross Section. Spread and vibrate the PCC against and along the forms, and in the vicinity of joints comprising load transfer devices, with care to avoid displacement of the forms or devices.

Use shovels or muckrakes, not rakes, for hand spreading and distributing. Do not foul the PCC with foreign matter.

After being placed, strike-off, vibrate and consolidate the PCC with Equipment conforming to the requirements of 00756.23. If more than one machine is required to properly handle production, the vibrating of PCC shall normally precede or accompany the first or leading machine only.

Perform the operations above within 15 minutes after the PCC is placed. The operations shall be continuous until the surface has been worked the equivalent of not less than two Passes of a single screed machine. In each Pass of the machine, maintain a roll of PCC ahead of the screed for the entire width of Pavement being placed. The strike-off, vibrating and consolidating shall leave a surface of uniform texture, true to grade and Cross Section.

Equipment shall be in good mechanical condition at all times and be adjusted for wear at the direction of the Engineer. Keep forms and other controls of line and grade clean and true to line and grade.

(f) Provision for Joints and Other Devices - While placing concrete, make provision for constructing joints, placing dowels, tie bars, and other devices as shown and directed, and as provided in 00756.43 and 00756.48.

(g) Reject Concrete Material - Reject concrete if it:

- Is not in place within 1 hour after being mixed (90 minutes when delivered in ready mix truck).
- Has begun to take an initial set before placement.
- Has been retempered with water.

(h) Protect Surface - Equip supports of the slipform paver, and other Equipment which ride on previously placed Pavement to meet the requirements of 00756.60, to prevent marring, edge breaking, or chipping of the previously placed Pavement.

When concrete is placed adjacent to an existing Pavement, equip that part of the Equipment which is supported on the existing Pavement with protective pads on crawler tracks or use rubber-tired wheels. Offset the track or wheels to run a sufficient distance from the edge of the Pavement to avoid breaking the Pavement edge

(i) Hand Operated Equipment - Use shovels and muckrakes, not rakes, for hand spreading and distributing. Do not foul the concrete with foreign matter, or disturb joint devices during such operations. Furnish hand operated mechanical vibrators satisfactory to the Engineer. Use these vibrators to consolidate the concrete Pavement at least 6 feet on each side of construction and expansion joints and any other areas as directed.

(j) Illumination - During hours of darkness, adequately illuminate work areas at no additional cost to the Agency.

00756.47 Test Strip - At the beginning of paving operations, construct one initial test strip of concrete Pavement at least 0.1 mile long at the specified paving width. Do not perform further paving until the test strip is evaluated according to 00756.55. An additional test strip will be required when:

- The Contractor proposes using different paving equipment.
- Any portion of a test strip fails to meet the smoothness requirements of 00756.55.

Change methods and/or Equipment and construct additional test strips until a test strip meets smoothness requirements without grinding or other corrective Work. Limit these additional test strips to 0.1 mile in length.

If three test strips fail to meet smoothness requirements before grinding, remove all three strips and construct additional test strips at no additional cost to the Agency.

00756.48 Joints:

(a) General - Construct joints of the kinds shown and where shown or directed. Joint types in the concrete Pavement will be contraction, construction or expansion. They shall be transverse or longitudinal, as shown or directed. Extend all joints and joint filler to Pavement edges or to each other.

Joints shall not vary from specified or indicated line by more than 1/4 inch. The tops of joint filler, when required, shall be slightly, but not more than 1/8 inch, below and paralleling finished Pavement grade and Cross Section. Protect top edges of filler from damage by paving operations.

All joints which contain preformed filler are to be constructed before the final floating and surface finishing of the concrete, unless otherwise directed.

(b) Longitudinal Joints - If the Contractor elects to pour the entire width of Pavement at one time, construct the longitudinal joint as shown. Longitudinal joints shall be the contact type or weakened plane type as shown:

(1) Longitudinal Contact Joints - Construct longitudinal contact joints when concrete is placed against hardened concrete regardless of age, between strips of Pavement or between a strip of Pavement and a concrete gutter.

(2) Longitudinal Weakened Plane Joints - Construct weakened plane joints by sawing to the depths and maximum width shown. Saw longitudinal weakened plane joints at the earliest possible time following placement of the concrete to prevent uncontrolled cracking without damaging the Pavement or joint. Saws may be single or tandem, as the Contractor elects, and be controlled by guides to true line. Restore curing agents broken or damaged by the sawing operations.

(c) Construction Joints - Construct construction joints when there is an interruption of 45 minutes in the concrete placing operations.

The new concrete placed against the joint shall conform closely to the proportions and consistency of the previously placed concrete except vibrate and consolidate it to a greater degree and with more care than normal. Unless otherwise shown, do not construct construction joints within 10 feet of a transverse expansion or contraction joint. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, remove the concrete back to the last joint and dispose of as directed.

(d) Transverse Contraction Joints - Form transverse contraction joints by sawing to the required dimensions shown on the Plans. Saw transverse contraction joints at the earliest possible time following placement of the concrete to prevent uncontrolled cracking without damaging the Pavement or joint. Repair any damage to the curing material during the sawing operations immediately after the sawing is completed.

(e) Sealing Sawed Joints - Fill sawed longitudinal weakened plane joints and transverse contraction joints with poured joint filler. Thoroughly clean joints at the time of sealing. Ensure the curing period for joints is complete before allowing construction Equipment and vehicles on the Pavement.

00756.49 Surface Finishing - After the concrete has been given a preliminary finish by the finishing devices in the slipform paving Equipment, check the surface of the fresh concrete in the longitudinal and transverse direction with a 12-foot straightedge. Correct surface deviations more than allowed by 00756.55(a). Lap each successive check with the previous check path by at least half the length of the straightedge. This longitudinal checking and correction on areas to be profiled for IRI smoothness will be waived if it is successfully demonstrated that a Pavement surface is otherwise produced which conforms to 00756.55(b)(1)(a).

Following hand floating, use a 12 foot proof (grout) rod. Each Pass of the proof rod in the longitudinal direction, over the entire surface of the Pavement placement, shall overlap the previous Pass by half of its width. Check the transverse direction as required. Use of a proof rod on areas to be graphically

profiled will be waived if it is successfully demonstrated that required Pavement profile surface is otherwise produced which conforms to 00756.55(b)(1)(a).

(a) Edge Slump - Correct any edge slump of the concrete in excess of 1/4 inch before the concrete hardens.

(b) Textured Finish - Upon completion of the machine floating, straightedge testing, edge tooling and, if necessary, hand floating, and before initial set of the surface concrete, give the surface of the concrete a textured finish.

Accomplish the textured finish with a steel-tine tool with 1/8 inch wide tines spaced 3/4 inches apart that will mark the finished surface to a depth of 1/8 to 3/16 inch without tearing the surface. Avoid overlaps of the texturing. Texture the surface parallel to the roadway centerline and full roadway width.

00756.51 Modification of Strike-off, Consolidation, Final Floating, and Surface Finishing - Where the width of Pavement is narrow, tapering or of irregular pattern, not lending itself to being constructed by prescribed machine methods, the Contractor will be allowed to perform the strike off, consolidation, final floating, and surface finishing with Equipment, tools, means, labor and methods other than those specified, provided the Work meets with the approval of the Engineer and the following requirements:

- Without causing segregation, vibrate throughout the concrete being placed until it is uniformly consolidated.
- Strike-off the concrete with templates or screeds designed and manipulated to shape the concrete to specified Cross Section between the forms, carrying a slight excess of concrete in front of the leading edge of templates or screeds at all times.
- Following the vibrating and strike-off operations, float the concrete. Include transverse floating or other smoothing and finishing actions as necessary. Check and correct the surface according to 00756.49. Keep the surface free from laitance, soupy mortar, marks or irregularities.
- Finish the surface according to 00756.49.

00756.52 Edge Tooling and Filling - Tool edges at longitudinal contact joints and construction joints of new Pavement and clean joints of previously placed concrete to remove laitance and mortar resulting from finishing operations, and to provide clean rounded edges without ridges on the surface. Perform tooling of the edges of concrete Pavement so that a nominal 5/8 inch radius is produced. Perform tooling of edges at construction joints so that no more than a 1/8 inch radius is produced.

Fill any areas of minor honeycomb or other minor defect in composition of the concrete along the exposed sides of concrete with a stiff mortar of cement and fine Aggregate, and apply to the moistened concrete to the satisfaction of the Engineer. Remove and replace areas showing serious defects in composition of the concrete with specified quality concrete for full Panel width between longitudinal joints or edges, and for a length not less than 10 feet. Low spots exceeding 1/4 inch in depth, if in hardened concrete, may be filled with an Epoxy Grout from the QPL provided the area is prepared according to grout manufacturer's directions and the filling is neat and blends inconspicuously with adjoining concrete.

00756.53 Curing Concrete - Immediately after the final floating, surface finishing and edging have been completed, and while the concrete surface is still moist, cover and cure the entire exposed surface of the newly placed concrete for at least 72 hours according to one of the following provisions:

(a) Liquid Membrane-Forming Compounds - Apply liquid membrane-forming compound uniformly to the concrete by pressure-spray methods at a rate of at least 1 gallon per 150 square feet. Mix the liquid membrane-forming compound thoroughly before and during use.

(b) Other Coverings - Apply the covering to damp concrete as soon as it can be placed without marring the surface. Place the membrane in contact with the surface, extend beyond the sides or edges of the slabs or forms, and weight down as required to hold it in position as a waterproof and moisture-proof covering. Laps shall be sufficient to maintain tightness equivalent to the sheeting and use:

(1) Polyethylene Film - Sheeting shall be clear or white.

(2) Waterproof Paper - Transverse laps shall be at least 18 inches, and cement longitudinal seams.

(3) Cotton or Jute Mats - Before placing, saturate the mats with water and keep fully wetted during the curing period.

00756.54 Pavement Cracks - Within 28 days after concrete placement and before opening the Pavement to Public Traffic, the Engineer will perform a Pavement crack survey. Clean the Pavement before the crack survey. Pavement with uncontrolled longitudinal or transverse cracks which are visible without magnification will be considered unacceptable and be repaired or removed as determined by the Engineer. Perform all remedial Work at no additional cost to the Agency.

00756.55 Surface Tolerance, Testing, and Correction - The surface of finished Pavement shall not deviate from longitudinal and transverse smoothness more than the prescribed limits. Perform straightedge testing and IRI profile testing under the supervision of the Engineer with Equipment furnished and operated by the Contractor as soon as the hardness of the concrete permits.

(a) Straightedge Testing and Tolerance - Test the longitudinal and transverse smoothness of the Pavement surface with a 12-foot straightedge. The extent of the testing will be as the Engineer determines necessary or expedient. The Pavement surface shall not deviate from the straightedge at any point by more than 1/8 inch for all areas that are constructed by the prescribed machine methods and for all Traffic Lanes and ramps. Other areas shall not deviate by more than 1/4 inch. Longitudinal 12-foot straightedge testing is not required for Pavement accepted under 00756.55(b).

(1) Transverse Joints - Test with the 12 foot straightedge parallel to the centerline, as directed. The Pavement surface shall not vary by more than 1/8 inch.

(b) International Roughness Index Smoothness Testing & Tolerance:

(1) General - Test the longitudinal surface of all Traffic Lanes, ramps, Shoulders and Bridges for smoothness by the IRI method according to ODOT TM 772. Before paving commences on the Project, demonstrate the inertial profiler operation by conducting calibration testing according to ODOT TM 772, and running the machine twice over a 0.1 mile section of Pavement with repeating results.

a. Daily Surface Test - The Pavement shall have an average IRI of 65.0 inches, or less. If the average 0.1 mile IRI exceeds 95.0 inches per mile for any segment of Pavement constructed in any Day's production, discontinue paving operations and construct one or more test strips as described in 00756.47. The test strip may be comprised of Pavement placed during the shift, but in no case shall it be less than 0.1 mile in length.

Start the profiles that represent a Day's production 50 feet before the beginning of that Day's production and stop 50 feet before the end of that Day's production.

Run the profiles for each Day's production as soon as possible without damaging the surface. Analyze the Daily Surface Test profiles according to 00756.55(c)(2), and give the profiles and results to the Engineer within 24 hours of the conclusion of the Day's production.

b. Quality Control Surface Test - Run the profiling device over each Traffic Lane for the full length of the Project.

In the presence of the Engineer and according to ODOT TM 772 obtain profiles on the Pavement surface in the right and left wheel path of the Traffic Lane along a line parallel to longitudinal Pavement markings, at 3 feet and 9 feet offsets from the left edge of the Traffic Lane. Take the profile on transition areas of entrance and exit ramps, as close to the right and left wheel path of the through Traffic Lane as practical. Submit data files to the Engineer at the completion of each shift in which profiling has taken place. For the Pavement sections tested, provide the raw data files and electronic copies of the profile data in PPF and manufacturer proprietary formats, as required by the Engineer.

Analyze profiles according to 00756.55(c), give the results to the Engineer no later than 24 hours following completion of required smoothness testing. The results consist of a table showing the areas of Localized Roughness in each wheel path, left wheel path IRI, right wheel path IRI, and mean IRI (average of left and right wheel path IRI) at 0.10 mile intervals.

c. Quality Assurance - At the discretion of the Engineer, the Agency may perform Quality Assurance of Profiles on Projects according to ODOT TM 772.

(c) Determination of the International Roughness Index:

(1) General - Analyze profiles in 0.10 mile segments and partial segments. Begin segments 50 feet into the Project and run consecutively in the direction of travel. A segment ends as a partial segment and a new segment begins when the segment sequence is interrupted by stage construction or by profiled areas excluded from the smoothness requirements. Minimize the number of partial segments.

The following areas of Pavement are excluded from IRI smoothness requirements:

- Profiles extending beyond the Project ends.
- Bridge decks, Bridge end panels, and Pavement within 50 feet of Bridge end panels.
- First and last 50 feet of the paving limits of the Project.
- The 50 feet before and after No Work Areas within the Project limits.
- Ramps and auxiliary lanes, with a posted speed of less than 35 mph.
- Shoulders.
- First 200 feet of entry ramps and the last 200 feet of exit ramps.
- The 25 feet before and after Utility appurtenances in the Traffic Lane.
- Continuous portions of Traffic Lanes with less than 0.05 mile between excluded areas.
- Portions of the Project with posted speed limits less than 35 mph.

Locate IRI profiling excluded areas prior to smoothness measurement. Areas excluded from longitudinal profile measurement shall meet the straightedge requirements of 00756.55(a).

(2) Method of Analysis - Determine IRI and areas of Localized Roughness for each wheel path according to ODOT TM 772, with the limits established per 0756.55(c). Maximum averaged IRI is 95.0 inches/mile for 0.1 mile segments and partial segments and 160.0 inches/mile for areas of Localized Roughness.

(d) Shoulders and Paved Medians - Test the Pavement with the 12 foot straightedge parallel to and perpendicular to the centerline for shoulders and paved medians, as directed by the Engineer. The Pavement surface shall not vary by more than 1/4 inch.

(e) Correcting Deficiencies - Should testing described in 00756.49, 00756.51, and 00756.55 show the Pavement does not conform to the prescribed limits of deviation, the following shall apply:

(1) Failure to Meet Straightedge Requirements:

a. Plastic Concrete - If the requirements of 00756.49 or 00756.51 are not met, stop the paving operations until revised methods, changes in Equipment, or correction of procedures are made or proposed for trial, and are approved by the Engineer for trial. Also stop those revisions, changes and corrections if they do not produce a specified surface.

b. Hardened Concrete - If the requirements of 00756.51 or 00756.55(a) are not met, correct according to 00756.55(e)(2)(a) or 00756.55(e)(2)(b) and retest.

(2) Failure to Meet IRI Smoothness Requirements - If testing described in 00756.55(b) shows that the Pavement does not conform to the prescribed limits, the Contractor is responsible for locating areas that require corrective work. All segments with an IRI value more than 95.0 inches per mile and areas of Localized Roughness are subject to corrective action. Disagreements will be resolved by the Engineer.

Correct all areas of Localized Roughness, segments and partial segments identified for corrective work, and any transverse joint and excluded areas that exceed the requirements of 00756.55(b), by one of the methods listed below and to the specified limits:

a. Remove - Remove the non-specification concrete Pavement as determined by the Engineer and replace with specification concrete Pavement.

b. Grind - Profile with abrasive grinders, equipped with a cutting head comprised of multiple diamond blades, to a maximum depth of 0.3 inches. Areas ground are subject to the requirements of 00756.56 and 00756.93. Mark the areas to be profile ground. For all areas corrected by grinding, restore the required surface texture, as specified in 00756.49(b), by longitudinal sawing with diamond blade saws.

c. Time Limit - Complete correction of all surface roughness within 14 Calendar Days following notification, unless otherwise directed.

Retest their entire length, according to 00756.55(b), all segments requiring corrective Work with the inertial profiler under the supervision of the Engineer.

Perform all corrective Work and inertial profiling, including traffic control, at no additional cost to the Agency.

00756.56 Pavement Thickness - Construct the Pavement to the thickness shown. Pavement not so constructed will be subject to replacement according to 00756.57, or to payment at adjusted prices according to 00756.93.

(a) Sticking Measurements - Determine conformance with minimum thickness requirements by random sticking measurements of the plastic concrete according to ODOT TM 775 under the Engineer's observation. Report thickness to the nearest 0.1 inch.

Divide the Panel into units and partial units equivalent to a maximum of 200 lane feet. Normally, unit lengths will be 200 feet for one lane, 100 feet for two lanes, 70 feet for three lanes and as appropriate for transition areas. When directed, take one sticking measurement at a randomly selected location in each unit and partial unit. Record measurements to the nearest 0.1 inch. Take the measurements:

- After consolidation and screeding and before the float finish.
- No closer than 2 feet from the Panel edges.
- Within 10 feet longitudinally and 1 foot transversely from the calculated random location determined by the Engineer.

If a sticking is not obtained for a unit or a partial unit, or is not available to represent the area of Pavement remaining after the limits of Pavement over 1.0 inch deficient is determined, the measurement will be assumed to be the same as the preceding or following sticking measurement, that is nearest in distance.

(b) Thickness 0.5 Inch Deficient - If a survey depth measurement indicates the Pavement is 0.5 inch or more deficient in thickness, stop forward paving progress until appropriate adjustments are made or corrective action is taken.

(c) Coring Requirements - Perform required coring, or coring requested by the Engineer according to AASHTO T 24 and repair core holes as directed, at no additional cost to the Agency. Cores will be measured by the Engineer according to AASHTO T 148 and the measurements reported to the nearest 0.1 inch. Core measurements will replace survey methods.

(1) Corrective Grinding Areas - If corrective grinding required by 00756.55(e) is performed at a sticking measurement site where the measurement is the specified depth or less within a segment or partial segment represented by the profile indexes, the Engineer may require a core after corrective grinding.

(2) Cores Requested By Contractor - If the Contractor believes that a depth measurement determined according to 00756.56(a), or a core obtained according to 00756.56(c), is not representative of the actual Pavement thickness, the Contractor may take a replacement core. Take replacement cores at a location as directed, 10 feet from the depth measurement or core site in question and the same distance from centerline. The replacement core measurement will replace the original depth or core measurement.

(d) Thickness Over 1.0 Inch Deficient - If a depth measurement determined according to 00756.56(a) shows Pavement over 1.0 inch deficient, obtain a core at the depth measurement site. If this core, or a core determined by 00756.56(c), shows Pavement over 1.0 inch deficient, obtain additional cores. Take these additional cores at the same distance from the centerline and at 25 foot intervals each direction from the first core until a core in each direction shows Pavement 1.0 inch deficient or less. These two core locations will be considered the limits of the Pavement more than 1.0 inch deficient. The Pavement Panel between these two cores will represent the area of Pavement subject to removal and replacement under 00756.57 or no payment under 00756.93.

When it is suspected by the Engineer that the Pavement in the adjacent travel lanes in the Panel may be more than 1.0 inch deficient for a greater distance than determined by the above procedure, core the Pavement in the adjacent travel lanes in the nearest wheel track (3 feet from the nearest edge) opposite both limit cores. If these cores are more than 1.0 inch deficient, the above procedure shall be followed to determine the limits.

00756.57 Deficient Pavement - Remove and replace Pavement deficient in thickness by more than 1.0 inch, according to 00756.56(d), at no additional cost to the Agency. If allowed by the

Engineer, the Pavement may be left in place without payment. Replacement Pavement shall be of the specified design, quality and thickness as follows:

- Be the full width of the Pavement Panel involved.
- Extend far enough to replace at least a 20 foot length.
- Extend to the construction joint if closer than 20 feet to a construction joint.

Maintenance

00756.60 Protection of Concrete - Repair or replace any part of the Pavement damaged by traffic or damaged from any other cause before its official acceptance, according to 00170.80.

Do not operate construction Equipment on newly placed concrete until the requirements of (a), (b), and (c) are met. Do not allow Public Traffic on newly placed concrete until all of the following requirements are met:

(a) The Contractor complies with 00150.60.

(b) The concrete attains a compressive strength of at least 70 percent of the specified 28-Day strength as determined by testing at least three cylinders cured according to AASHTO T 23 (field cure) and tested according to AASHTO T 22.

The maturity method, AASHTO T 325, may be used to estimate concrete strength for opening Pavement to construction traffic. Install at least two maturity thermocouples for each Day's placement in areas where the maturity method will be used for early opening. Install the thermocouples near the Day's final placement for areas being evaluated for early opening.

When the maturity method is used, the Engineer may verify the maturity method with strength specimens. Establish a new strength-maturity relationship if strength specimens deviate more than 10 percent from the maturity-estimated strengths. Suspend use of the maturity method for opening Pavements to traffic when the strength-maturity relationship deviates by more than 10 percent until a new strength maturity relationship is established.

(c) The surface of the concrete is protected from scarring or abrasion and kept free of stones, loose mortar and other matter apt to be deleterious to the concrete in the paths of Equipment.

(d) The Pavement meets all of the requirements of 00756.55.

Measurement

00756.80 Measurement - The quantities of concrete Pavement will be measured on the area basis. The area will be determined by measuring the width and length of each separately constructed Panel of Pavement. The width is the design width or measured edge-to-edge width on the surface of the Pavement whichever is less. The length is the horizontal measurement from end to end of Pavement along the center line of the strip.

The measurement of extra thickness of Pavement, as shown or as ordered, will be determined by conversion on a proportionate volume basis to an equivalent number of square yards of specified thickness Pavement.

Payment

00756.90 Payment - The accepted quantities of plain concrete Pavement will be paid for at the Contract unit price, per unit of measurement for the following items:

Pay Item	Unit of Measurement
(a) Plain Concrete Pavement, Undowelled, ____ Inches Thick	Square Yard
(b) Plain Concrete Pavement, Dowelled, ____ Inches Thick	Square Yard

In items (a) and (b) the thickness of Pavement will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for construction joint reinforcement bars, tie bars, dowel bars, curing materials, or saw cutting.

00756.92 Price Adjustment for Strength - For each lot of concrete for which a PF is determined, the following will apply:

- In no case will the actual payment exceed the Contract Unit Price.
- When the PF is less than 1.00, the price adjustment will be determined as follows:

$$\text{Price Adjustment} = 0.3 \times (PF - 1) \times \text{Unit Price}$$

00756.93 Price Adjustment for Variation in Thickness - No additional payment over the Contract unit price will be made for Pavement having a thickness greater than shown or ordered by the Engineer. When the Pavement is found deficient in thickness by more than 0.2 inch, but not more than 1.0 inch, as determined according to 00756.56, payment will be made at an adjusted price according to the following table:

Deficiency in Thickness (inch)	Proportional Part of Contract Unit Price Allowed
0.00 to 0.20	100%
0.21 to 0.30	83%
0.31 to 0.40	76%
0.41 to 0.50	73%
0.51 to 0.75	63%
0.76 to 1.00	59%

No payment will be made for any area of Pavement found deficient in thickness by more than 1.0 inch even though such Pavement is allowed by the Engineer to remain in place under the provisions of 00756.57.

00756.95 Smoothness Price Adjustment - No separate or additional payment will be made for smoothness testing.

(a) General - A price adjustment based on the results of the IRI will be made for each 0.10 mile segment or partial segment of Traffic Lane plain concrete Pavement requiring IRI measurement according to 00756.55(b). The price adjustment will be based on the IRI values determined according to ODOT TM 772 for each 0.10 mile segment and partial segment. Partial segments less than 0.10 mile in length will be evaluated with the IRI price adjustment value multiplied by the

ratio of the partial segment length to 0.10 mile segment, as determined in 00756.55(b). A 0.10 mile segment, or partial segment is only eligible for a positive price adjustment if the following apply:

- The average of the IRI for both wheel paths is 60.0 inches per mile or less.
- These requirements are met without any corrective action specified in 00756.55(e)(1)(b).

A smoothness price adjustment will be made for all segments, or partial segments based on the average IRI value of both wheel paths and the following equations:

Averaged IRI (inches/mile)	**Equation**
≤ 35.00	Y = $900.00
35.01 - 60.00	Y = (- $36 × X) + $2,160
60.01 - 65.00	Y = $0.00
65.01 - 95.00	Y = (- $36 × X) + $2,340
> 95.00	Corrective Action
Y = The price adjustment for the segment or partial segment X = The averaged IRI value for the segment or partial segment	

The smoothness price adjustment will be made on the next monthly progress estimate following the satisfactory completion of all corrective Work and the submission of all test data for all Traffic Lane paving on the Project.

00756.95(b) applies when corrective action is taken by the Contractor.

(b) Adjustments for Sections Requiring Corrective Work - Segments or partial segments containing corrective Work according to 00756.55(c) will be subject to the price adjustments described in 00756.95(a), except that no positive price adjustment (bonus) will be due to the Contractor. If a segment or partial segment containing corrective Work is retested according to ODOT TM 772 and 00756.55(b)(2), the retested average IRI value will be used for payment, except that no positive price adjustment will be made for a segment or partial segment containing corrective work.

Segments or partial segments containing corrective Work with an IRI value of more than 95.0 inches per mile are subject to additional corrective action according to 00756.55(c). The Engineer may waive corrective action in partial segments with the application of a smoothness price adjustment based on an IRI value of 95.0 inches per mile.

Section 00759 - Miscellaneous Portland Cement Concrete Structures

Description

00759.00 Scope - This Work consists of furnishing, placing and finishing Commercial Grade Concrete curbs, concrete curb ramps with curbs, islands, traffic separators, driveways, sidewalks, monolithic curb and sidewalks, miscellaneous surfaces, and stairs in close conformity to the lines, grades and dimensions shown or established.

This Work consists of furnishing, placing and finishing concrete bus pads according to Section 00756.

The Commercial Grade Concrete items in this Section will be collectively referred to as "Structures".

00759.02 Definitions:

Pedestrian Access Routes - An area for the use of pedestrians to navigate along sidewalks, driveways, curb ramps, crossings, and pedestrian facilities.

00759.03 Required Submittals - Do not begin any curb ramp Work before the plan for completing the Work has been approved. Material ordered or Work done before the Engineer reviews and returns the documents will be at the Contractor's risk.

Before the preplacement conference, submit the following:

(a) Working Drawings - At least 10 Calendar Days before the preplacement conference, submit six copies of unstamped Working Drawings according to 00150.35 for all curb ramp Work. Include field verification of each ramp location, and all dimensions and grades necessary to demonstrate compliance with the Standard Drawings and Plans. Notify the Engineer of any deficiencies or non-compliance with the Standard Drawings or Plans. The Engineer will provide additional or modified Plans as needed.

(b) Curb Ramp Plan - At least 21 Calendar Days before the curb ramp Work is scheduled to begin, submit a plan for accomplishing all phases of the curb ramp Work, including but not limited to the following:

- Surface preparation
- Compliance with Working Drawings and details submitted under 00759.02
- Compliance with current Standard Drawings and Plans
- Waste handling and disposal

(c) ADA Certification for Contractors - For all supervisory personnel who directly supervise the curb ramp Work, submit the names, telephone numbers, and copies of the ODOT ADA Certification for Contractors at least 10 Calendar Days before the preconstruction conference.

00759.04 Preplacement Conference - Before beginning any curb ramp Work, meet with the Contractor's supervisory personnel and quality control manager, any curb ramp Subcontractors' supervisory personnel, and the Engineer at a mutually agreed upon time.

If the Contractor's personnel change, or if the Contractor proposes a significant revision to the plan for accomplishing the curb ramp Work, the Engineer may require additional preplacement conferences.

All supervisory personnel who have an active ODOT ADA Certification for Contractors and directly supervise the curb ramp Work are required to attend the preplacement conference.

Materials

00759.10 Materials - Furnish Materials meeting the following requirements:

Bar Reinforcement	02510
Commercial Grade Concrete	00440
Dowels	02510.50
Epoxy Bonding Agent	02070
Paving Concrete	02001
Preformed Expansion Joint Filler	02440.10
Welded Wire Fabric	02510.40

Furnish Class 4000 - 1 1/2 paving concrete for bus pads.

00759.11 Aggregate Base - Furnish Aggregate base Materials for Base, foundation courses, Leveling courses, or bedding meeting the requirements of Section 02630. If a designated size is not shown or given, furnish either 1" - 0 or 3/4" - 0, as the Contractor elects.

00759.12 Curb Ramp Treatment - Furnish truncated dome detectable warning surfaces for curb ramps and accessible route islands from the QPL. Furnish truncated dome detectable warning surfaces that are safety yellow in color on or along State Highways.

Use only adhesives recommended or supplied by the manufacturer.

Equipment

00759.21 Concrete Extruding Machine - Concrete extruding machines shall operate under sufficient restraint to forward motion to produce a well consolidated mass of concrete.

00759.22 Smart Level - Use ODOT approved smart level devices to measure cross slopes and curb ramp slopes. Calibrate smart levels at the time of inspection. Use percentage mode to record all slope measurements to the nearest tenth of a percent relative to a true horizontal plane (zero).

(a) Qualified Smart Levels - Slopes will be measured with the use of a 24 inch SmartTool level model 92379 or model 92500, and a 6 inch SmartTool level model 92346.

Labor

00759.31 Qualifications - Use supervisory personnel who have an active ODOT ADA Certification for Contractors to directly supervise the curb ramp Work.

Construction

00759.41 Earthwork - Make excavations and backfills for the Structures according to Section 00330 and to the depths, widths, and cross sections shown, specified, or directed.

Remove and dispose of existing concrete sidewalks, curbs, and curb ramps that are scheduled for removal according to Section 00310.

00759.42 Foundations - Construct foundations or other bedding using selected granular backfill material according to Section 00330 or using Aggregate base when shown or directed.

For Aggregate Base, do one of the following:

- When existing Aggregate base materials of the kind specified in 00759.11 are already in place, salvage and reuse.
- Use new Aggregate base materials conforming to 00759.11.

00759.43 Foundation Preparation - Bring areas on which Structures are to be constructed to established line, and make firm, dry and free of all Unsuitable Material before placing concrete. Existing concrete surfaces shall be clean and moist at the time of placing new concrete.

When placing concrete by the extrusion method, vertical dowel fastening to underlying concrete may be eliminated if the bond between surfaces is developed by applying epoxy bonding agent. Apply epoxy bonding agent according to the manufacturer's recommendations.

00759.44 Joining New to Existing Concrete - Construct suitable connections between new and existing concrete where existing driveways, walks, and other Structures are cut back to permit the new construction or where the new construction abuts the existing concrete. Unless shown or directed otherwise, furnish and place minimum 3/4 inch thick preformed expansion joint filler between new and existing concrete.

00759.45 Reinforcement, Dowels, and Tie Bars - Furnish and place reinforcement, dowels, and tie bars according to 00755.43 and as shown or directed.

Provide dowels with "slip sleeves" and place as load transfer devices where shown. Place dowels without "slip sleeves" as fastenings or ties between new and existing underlying concrete when shown.

00759.46 Concrete - Construct the Structures between suitable forms or by the extrusion method. Before placing concrete, verify that forms are correctly positioned to produce curb ramps with proper Slopes and dimensions to comply with the Standard Drawings and Plans. Place concrete according to Section 00440 subject to this Section.

00759.48 Expansion Joints - Construct expansion joints of the preformed filler type in concrete Structures as shown and the following:

- Not less than 1/2 inch wide, except where abutting or underlying concrete joints are larger, then the width shall match those joints.
- At right angles to the Structure alignment and normal to the Structure surface.
- Which completely separate the concrete segments.
- Placed flush or no more than 1/8 inch below the concrete surface.

(a) Curbs, Islands, and Traffic Separators - Provide expansion joints:

- Opposite abutting expansion joints in abutting concrete.
- Over existing expansion joints in concrete underlying the new concrete Structure.
- At each point of tangency in the Structure alignment.
- Not over 200 foot spacing.

(b) Driveways, Walks, Monolithic Curbs and Sidewalks, and Surfacings - Do not provide expansion joints within the curb ramp, and between separate concrete pours on the same project.

Provide expansion joints:

- Between driveways and concrete Pavement.

- Transversely in walks opposite expansion joints in adjoining curbs and elsewhere so the distance between joints does not exceed 45 feet.
- Transversely in walks at a distance of 16 feet to 8 feet from ends of walks which abut curbs.
- Around poles, posts, boxes, and other fixtures which protrude through or against the Structures.

(c) Stairs - Provide expansion joints for stairs at the top and bottom landings as shown.

00759.49 Contraction Joints - Construct transverse contraction joints of the weakened plane or dummy type in the exposed surfaces of the concrete Structures as shown and the following:

(a) Locations - Locate contraction joints:

- Over contraction joints in concrete underlying the new concrete Structure.
- Opposite contraction joints in abutting concrete.
- At locations to confine joint spacing to a maximum of 15 feet.
- For bus pads, where shown.

(b) Methods - Construct contraction joints by:

- Inserting and removing plates, or other devices.
- Inserting and leaving in place preformed expansion joint filler even and flush with the concrete surface.
- Sawing as soon as practicable after concrete placement but before any uncontrolled cracking occurs.
- Tooling.
- Other approved methods.

(c) Requirements - Contraction joints shall:

- Be not less than 1/8 inch or more than 1/4 inch wide.
- Be a depth of one-third the thickness of the concrete.
- Have clean, unfilled grooves (if preformed expansion joint filler is not used).

00759.50 Surface Finishing:

(a) General - Remove forms, if any, from Structures after the concrete has taken its initial set and while the concrete is still green. Repair minor defects with mortar containing one part portland cement and two parts sand. Do not plaster exposed surfaces.

The top and face of Structures shall be true and straight, free from humps, sags, or other irregularities. The surface shall not vary more than 1/4 inch from the edge of 12 foot long straightedge laid on the top or face of the Structure, except in curves. Furnish the straightedge and operate it as directed. Unless otherwise shown or directed, tool edges to 1/4 inch radius.

(b) Curbs, Islands, and Stairs - While the concrete is still green, finish the exposed surfaces as required to produce a smooth surface and uniform texture.

(c) Driveways, Walks, and Surfacings - Finish concrete surfaces to smooth and uniform texture by troweling, floating and cross brooming. Lightly groove or mark surfaces into squares or other shapes to match markings on similar existing surfaces in the vicinity, as directed.

On all curb ramps and accessible route islands, install truncated domes as shown. Place according to the manufacturer's recommendation.

In addition, finish concrete surfaces of curb ramps to be within the established Slopes and dimensions allowed by the Standard Drawings and Plans. Repair or remove and replace curb ramps not meeting the Standard Drawings and Plans at no additional cost to the Agency.

The 24-inch smart level will be used to measure driveway and sidewalk cross slopes on the pedestrian access route.

(d) Curb Ramps - The 6 inch smart level will be used to measure curb running slope. The 6 inch smart level will be used to measure slopes on portions of the curb ramp, gutter pan, or adjacent surfaces that cannot accommodate a 24 inch smart level. All other curb ramp locations will use a 24 inch smart level to measure slopes.

(e) Bus Pads - Finish bus pad concrete surfaces according to 00756.51.

00759.51 Curing - Cure and protect concrete after placing and finishing according to Section 00440.

Keep the concrete Structure free from contact, strain and Public Traffic for at least 7 Calendar Days or longer as directed. Do not apply curing compounds to the designated truncated dome areas of curb ramps and accessible route islands.

00759.53 Welding - Welding, welder qualifications, prequalification of weld details and inspection of welds shall conform to AWS D1.1. Submit all welding procedure specifications to the Engineer for approval.

00759.54 Bolt Holes:

(a) Punched Holes - Use a die with a diameter not exceeding the diameter of the punch by more than 1/16 inch. Ream any holes that are required to be enlarged to admit the anchor bolts. Make clean cut holes without torn or ragged edges.

(b) Accuracy of Punched Holes - Locate all holes punched full size so accurately that when multiple anchor plates are stacked with the edges even, a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the plate without drifting in each of the connecting holes in the same plane. Non-conforming pieces will be rejected.

Measurement

00759.80 Measurement - The quantities of Structures constructed under this Section will be measured according to the following:

- **Volume Basis** - Measurement will be limited to the Neat Lines of the finished Structure as shown or directed.

- **Area Basis** - Measurement will be the finished surface, limited to the Neat Lines shown or directed.

  Measurement of concrete walks will include the total area of concrete walk, including the area of concrete curb ramps within the footprint of the concrete walk.

When monolithic curb and sidewalks are measured on the area basis, measurement will include the total area of monolithic curb and sidewalk, including the area of concrete curb ramps within the footprint of the monolithic curb and sidewalk.

Measurement of concrete islands will include the total area of concrete islands, including the area of concrete curb ramps within the footprint of the concrete islands.

When concrete curb ramp construction is not adjacent to concrete walk, monolithic curb and sidewalk, or concrete island Work, the area of the concrete curb ramp Work will be included in the measurement of concrete walks.

- **Length Basis** - Measurement of concrete items will be along the face of the Structure, from end to end including curb tapers or depressed lengths at driveways and ramps.

- **Each Basis** - Measurement will be by actual count. Extra for Curb Ramps will be counted for each instance of where a curb ramp crosses a curb at the transition between a pedestrian facility and a roadway.

Payment

00759.90 Payment - The accepted quantities of Structures will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Concrete Curbs, ____	Foot or Cubic Yard
(b)	Concrete Islands	Square Foot
(c)	Concrete Driveways	Square Foot
(d)	Concrete Driveways, Reinforced	Square Foot
(e)	Concrete Walks	Square Foot
(f)	Monolithic Curb and Sidewalks	Square Foot or Foot
(g)	____ Concrete Surfacing	Square Foot
(h)	Concrete Stairs	Cubic Yard
(i)	Concrete Bus Shelter Pads	Each
(j)	Concrete Mowing Strip	Foot
(k)	Extra for New Curb Ramps	Each
(l)	Truncated Domes on New Surfaces	Square Foot
(m)	Truncated Domes on Existing Surfaces	Square Foot
(n)	Bus Pads	Square Foot

In item (a) the type of curb will be inserted in the blank, if appropriate. Item (a) includes the curb runs constructed adjacent to the curb ramps.

Item (b) includes traffic separators.

Items (c) and (d) include monolithic curb at driveway locations.

Items (e) and (f) include the area of new concrete curb ramps within the footprint of the Concrete Walks or Monolithic Curb and Sidewalks.

Item (f) includes the curb runs constructed adjacent to the curb ramps.

In item (g), the specified thickness, or type, of concrete Surfacings will be inserted in the blank, if appropriate.

Item (h) includes pipe handrail.

Item (k) includes the additional Work required to construct a curb ramp or replace an existing curb ramp. When replacing an existing curb ramp or retrofitting a curb ramp into an existing concrete pedestrian facility, Item (k) also includes saw cutting and removal. Payment for the area of the curb ramp will be made under the concrete walks Pay Item.

Item (l) includes installation of truncated domes on a new concrete or asphalt surface.

Item (m) includes installation of truncated domes on an existing concrete or asphalt surface.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

When earthwork is included as separate Pay Items, payment will be made according to 00330.90 through 00330.94 as appropriate.

When earthwork is not included as separate Pay Items, no separate or additional payment will be made for earthwork.

Aggregate will be paid for according to 00640.90 or 00641.90 as appropriate.

No separate or additional payment will be made for Curb Ramp Working Drawings, Curb Ramp Plan, Preplacement Conference, concrete form verification, or any necessary repair or removal and replacement of Curb Ramps. No separate or additional payment will be made for providing supervisory personnel who have an active ODOT ADA Certification for Contractors to directly supervise the curb ramp Work.

PART 00800 - PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES

Section 00810 - Metal Guardrail

Description

00810.00 Scope - This Work consists of constructing metal guardrail and metal median barrier to the lines and grades shown or established and includes the assembly and erection of all components, parts and materials complete at the locations shown or directed.

Metal guardrail and metal median barrier will be referred to in this Section as "guardrail". The types of guardrail will be shown.

Materials

00810.10 Materials - Furnish materials meeting the following requirements:

Guardrail Anchor Hardware	02820.40
Guardrail Hardware	02820.30
Metal Beam Rail	02820.10
Metal Posts	02820.20
Guardrail Blocks	02110.20
Wood Guardrail Posts	02110.10

Use guardrail terminals from the QPL.

00810.11 Posts - Posts, except as specified for use on Bridges or otherwise shown or directed, may be of steel or wood, as the Contractor elects. Once a type has been selected, use it throughout the continuous run of guardrail except in the transitions and terminals.

00810.12 Median Barrier on Bridges - Metal median barrier on bridge decks shall be comprised of metal beam rail, metal posts, and hardware conforming to 00810.10.

At expansion joints on bridge decks, the slots in the rail member for post bolt and rail joint bolts shall be of special dimensions as shown.

00810.13 Guardrail Anchors - Guardrail anchors shall be steel.

Furnish one guardrail anchor cable assembly per project for testing according to AASHTO M 30.

00810.14 Condition of Materials - All materials will be subject to inspection of condition at the latest practical time available before or during incorporation of materials in the Work.

00810.15 Salvaged Materials - Materials salvaged as part of removal Work on the Project may be reused in new construction, if the Engineer determines the materials conform to current design, 00810.10, and the following:

(a) Wood Posts - Furnish all new wood posts and blocks. Existing wood posts and blocks may not be incorporated into new guardrail Work.

(b) Metal Beam Rail Members - Metal beam rail members shall be unpainted, straight and free of breaks, kinks, dents, damage to galvanized coating, or any other damage that would affect the integrity of the member. If paint is removed from metal beam rail members salvaged from the

Project, remove the paint at a location outside of the highway right of way, and in a manner that will not damage the galvanizing. Repair minor damage to galvanizing according to 00810.43.

Construction

00810.40 Timing and Coordination of Work - Time and coordinate construction of guardrail to hold disturbance of Bases, Surfacings and Pavements to a minimum.

Place all salvaged metal guardrail or metal median barrier materials in continuous runs.

Do not leave posts installed for guardrail and median barrier exposed to traffic for more than 24 hours before installing the rail members, rail end pieces and anchors and tightening all bolts, except replacement rail shall be installed according to 00310.40(a).

00810.41 Excavation and Backfill - Subject to 00810.42, excavate to the lines, grades and depths shown or established. Make cuts through Pavement by mechanical means, such as knife-edge cutters or rotary drills. Make cuts below the Pavement by auger or other means that will prevent undue disturbance of abutting areas. Avoid fouling existing bases and Pavements. Repair or replace, as directed, all materials that become fouled, at no additional cost to the Agency. Remove water and Unsuitable Material that would impair stability of the backfill, from areas to be backfilled.

In areas occupied by Aggregates, bituminous material and Pavements, backfill with like materials to the same thickness and density as the adjacent materials. In other areas, backfill with granular backfill materials meeting the requirements of 00330.14. Place all backfill in layers not exceeding 6 inches and compact each layer to a firm, dense condition.

Remove, replace, repair, or restore, as directed, adjoining areas that become misshapen or disturbed during excavating and backfilling operations at no additional cost to the Agency. Dispose of excess materials according to 00330.41(a)(4).

00810.42 Installation of Posts and Anchors - Place posts and anchors as shown. If directed, install 8 foot guardrail posts. Set posts in excavated holes or drive them in place. If posts are driven through the Bases, Surfacings, or Pavement, repair all damage as directed. Remove and replace posts, anchors or other components damaged during installation with sound components. Firmly set all posts at proper line, grade and spacing within a tolerance of 1/2 inch. Rigidly attach anchors, terminals and connections to other Structures as shown.

When metal posts are required over box culverts, cattle passes, Equipment passes or other concrete Structures, place steel posts, base plates, or base plate concrete anchors as shown or directed.

00810.43 Erection of Rails and Other Components - Normally, all fabrication of metal beam rail members and other components shall be done in the shop or by the manufacturer. Limit field cutting, drilling and other field fabrication to the minimum and perform in a manner that will not impair the appearance or structural quality of the material. Burning new holes in metal beam rail members will not be allowed.

Restore to specified condition, surface finishes and protections that are damaged before or during erection. Repair the cut ends of galvanized bolts, rail elements and back-up plates, and any holes drilled or punched after galvanizing according to ASTM A780. Minimum zinc content for Method A2 is 94 percent on the dry film.

Toe nail blocks to post with two 16d, galvanized, flat head nails to prevent rotation.

Draw tight all bolts. Bolts shall be of sufficient length to extend slightly beyond the nuts.

00810.45 Painted Guardrail - Projects that include the removal and dismantling of painted metal guardrail require that environmental protection and worker safety precautions be established. If painted guardrail is reused in any application, comply with DEQ/EPA and OSHA regulations pertaining to paint removal.

Measurement

00810.80 Measurement - The quantities of guardrail items constructed under this Section will be determined as follows:

- **Length** - Measurement will be on the length basis, measured by one of the following methods:
  - **Count Method** - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this Subsection, a "standard section" is defined as 12 1/2 feet of complete guardrail or median barrier, without regard to the number of posts or rail elements used. Non-standard sections will be measured from center of post to center of post, and added to the total calculated length of the standard sections for each run.
  - **Length Method** - Measurement will be from center to center of end posts, or as otherwise shown, along the line and grade of each run of each type.
- **Unit** - Measurement will be by actual count.

Payment

00810.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Guardrail, Type ____	Foot
(b)	Metal Median Barrier	Foot
(c)	Guardrail Anchors, Type ____	Each
(d)	Guardrail End Pieces, Type ____	Each
(e)	Guardrail Transition	Each
(f)	Guardrail Connections	Each
(g)	Guardrail Terminals, ____	Each
(h)	Extra for ____ Foot Posts	Each
(i)	Guardrail Posts	Each
(j)	Extra for Hand Dug Guardrail Post Holes	Each
(k)	Midwest Guardrail System, Type ____	Foot
(l)	Guardrail Height Conversion, Type ____	Each

In item (a), the type of guardrail will be inserted in the blank. Item (a) includes all posts including steel, base plates, and base plate concrete anchors.

Items (a), (b), and (k) include constructing the respective items except for:

- end pieces
- anchors
- transitions
- extra costs involved in constructing guardrail connections to existing Bridges
- terminals

- guardrail height conversions

In item (c), the type of anchor will be inserted in the blank.

In item (d), the type of guardrail end piece will be inserted in the blank.

Item (e) includes preparing the bridge rail or concrete barrier for the transition and includes posts, rail elements, terminal connectors, connection plates, anchor bolts, and all necessary appurtenances and hardware.

Item (f) includes preparing the bridge rail or concrete barrier for the connection and installing the terminal connectors when there is no guardrail transition item and includes connection plates, anchor bolts, and all necessary appurtenances and hardware.

In item (g) the type of terminal will be inserted in the blank. Item (g) includes guardrail terminals, posts, anchors, rails, guards, end pieces, struts, Soil tubes, and all necessary appurtenances and hardware.

In item (h) the length of post will be inserted in the blank. Item (h) includes installing 8 foot long or longer posts instead of standard 6 foot long posts, The extra costs for the longer posts are costs that are not covered and included in the unit price for one or more of the other listed Pay Items.

Item (i) includes only installing posts when upgrading or repairing existing guardrail installations.

In item (j), the extra costs for hand dug holes are costs that are not covered and included in the unit price for one or more of the other listed Pay Items.

Payment for item (j) performed beyond the quantity shown in the Contract Schedule of Items will be made at the Contract unit price if the Engineer determines that the Contract unit price does not exceed the value of the Work as determined according to Section 00197. If the Engineer determines that the Contract unit price exceeds the value of the Work, payment for the Additional Work will be made according to 00195.20.

In item (k), the type of guardrail will be inserted in the blank. Item (k) includes all posts including steel, base plates, and base plate concrete anchors.

In Item (l), the type of guardrail will be inserted in the blank. Item (l) includes posts, rails, and all necessary appurtenances and hardware to construct the guardrail height conversion.

Payment will be payment in full for furnishing and placing all Materials, and furnishing all Equipment, labor and Incidentals necessary to complete the Work, as specified.

No separate or additional payment will be made for excavation and backfill.

Section 00811 - Cable Barrier

Description

00811.00 Scope - This Work consists of furnishing and installing cable barrier to the lines, grades, and at the locations shown or directed.

Materials

00811.10 Cable Barrier - Furnish cable barrier from the QPL. Provide all cable barriers on the Project from the same manufacturer regardless of the number of runs of cable barrier required and regardless of the types of cable barrier required.

Use precast or cast-in-place concrete socketed foundation line posts. Furnish and place concrete meeting the requirements of Section 00440.

00811.11 Cable Barrier Terminals - Use the following options as specified:

- **Option 1** - Use cable barrier terminals from the QPL that matches the system used.
- **Option 2A** - Tie the cable barrier to new guardrail as approved by the cable barrier manufacturer.
- **Option 2B** - Tie the cable barrier to existing guardrail as approved by the cable barrier manufacturer.

Equipment

00811.20 Tension Measuring Device - Measure the cable barrier tension with a manufacturer supplied measuring device.

Labor

00811.30 Manufacturer's Representative - If it is a requirement of the manufacturer to have a manufacturer's representative on-site during installation, provide the services of a manufacturer's representative at no additional cost to the Agency.

Construction

00811.40 Cable Barrier - Install cable barrier according to the manufacturer's directions at the locations shown. Cable anchors and cable overlap as shown are approximate. Locate and overlap the actual anchor according to manufacturer's instructions.

Keep a tension log and give it to the Engineer upon completion of installation. The tension log shall show the time, date, location, ambient temperature, and the final tension readings, and be signed by the person performing the tension readings. Provide a copy of the manufacturer's recommended tension chart along with the tension log.

Perform all tension checks or adjustments required by the manufacturer within a 30 Day period of installation.

00811.41 Cable Barrier Terminals - Place terminals according to the manufacturer's directions, at locations shown, and as required by the cable barrier manufacturer to meet their minimum requirements. Ensure that there is compatibility between terminals and the cable barrier system installed.

00811.42 Placement - Place the concrete anchors and footings, and backfill them at least 2 weeks prior to tensioning the cables. Set the concrete anchors into the excavation as shown. Set the bottom of the anchor so it has full and even bearing in the surface under it. Excavate and backfill according to 00810.41.

Maintenance

00811.60 Training - After installation, provide at least one 4 hour manufacturer presented training session to Agency maintenance personnel at no additional cost to the Agency.

Measurement

00811.80 Measurement - The quantities of cable barrier will be measured on the length basis, from center of end post to center of end post along the line and grade of each separate run. Measurement will be made through the ends of the terminals and guardrail connections.

The quantities of cable barrier terminals and cable barrier guardrail connections will be measured on the unit basis.

Payment

00811.90 Payment - The accepted quantities of cable barrier will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Cable Barrier, Test Level 3	Foot
(b)	Cable Barrier, Test Level 4	Foot
(c)	Cable Barrier Terminals	Each
(d)	Cable Barrier Guardrail Connections	Each

Items (c) and (d) include all special rail elements, brackets, posts, and all necessary appurtenances and hardware.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00812 - Adjusting and Repairing Guardrail

Description

00812.00 Scope - This Work consists of adjusting and repairing existing guardrail as shown or directed.

Materials

00812.10 Materials - Furnish replacement metal beam rails, posts, blocks, and hardware meeting the requirements of 00810.10.

Construction

00812.40 General - Install all guardrail components during the same Day they are removed. Repair minor damage to galvanizing according to ASTM A780. Minimum zinc content for Method A2 is 94 percent on the dry film.

00812.41 Adjusting Guardrail - Adjust existing guardrail by one of the following methods:

(a) Posts Remain in Place:

- Remove the existing metal beam rails and blocks in a manner that will not damage galvanizing.
- If required, drill new bolt holes in posts.
- Treat all existing and all new holes with a preservative from the QPL.
- Reinstall the metal beam rails and blocks.
- Perform all other required Work as shown.

(b) Replace Posts:

- Do not raise existing posts. Replace posts as necessary according to 00812.43 to achieve required guardrail height.
- Backfill and compact any voids caused by removal of the post before installation of the new post.

(c) Replace Blocks - Replace blocks according to 00812.43.

(d) Terminal Ends - Adjust existing terminal ends by raising the Soil tubes and ground struts to the required height and placing and compacting matching material under the ground struts.

00812.43 Repairing Guardrail - Repair existing guardrail by replacing metal beam rails, posts, blocks, and hardware. Install new metal beam rails, posts, blocks, and hardware according to 00810.42 and 00810.43.

Measurement

00812.80 Measurement - The quantities of Work performed under this Section will be determined as follows:

- **Adjusting Guardrail** - Adjusted guardrail will be measured on the length basis, of existing guardrail adjusted. Measurement will be by one of the following methods:

- **Count Method** - The number of standard sections will be counted and multiplied by 12 1/2 feet. For purposes of this Subsection, a standard section is defined as 12 1/2 feet of complete guardrail, without regard to the number of existing posts or existing rail elements. Non-standard sections will be measured from center of post to center of post and added to the total calculated length of the standard sections for each run.

- **Length Method** - Measurement will be from center to center of terminal end posts, or as otherwise shown, along the line and grade of each run of each type.

- **Repairing Guardrail** - Repaired guardrail metal beam rails, posts, and blocks will be measured on the unit basis. For purposes of this Subsection, a metal beam rail is defined as 12 1/2 feet long.

Payment

00812.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Adjusting Guardrail	Foot
(b)	Metal Beam Rails	Each
(c)	Guardrail Posts	Each
(d)	Guardrail Blocks	Each

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- hardware
- adjusting terminal ends
- replacement metal beam rails, posts, and blocks that are damaged by Contractor Equipment or operation

Section 00815 - Bollards

Description

00815.00 Scope - This Work consists of furnishing and installing bollards at locations shown or as directed.

Materials

00815.10 Materials - Furnish Materials meeting the following requirements:

Commercial Grade Concrete.....00440
Granular Drain Backfill 00430.11
Reflective Sheeting (Type III and Type IV)..... From QPL

00815.11 Posts and Sleeves - Use Schedule 40 steel pipe for the posts and either Schedule 40 or Schedule 80 steel pipe for the sleeves, as shown. Use steel pipe conforming to ASTM A53, Type E, Grade A.

00815.12 Plates, Shapes, Fasteners, and Hardware - Use plates and shapes conforming to ASTM A36. Use fasteners and hardware conforming to ASTM A449.

00815.13 Galvanizing - Hot-dip galvanize all metal components after fabrication according to AASHTO M 111 (ASTM A123) or AASHTO M 232 (ASTM A153), as applicable.

00815.14 PVC Pipe - Use Schedule 40 PVC pipe.

00815.15 Painting Bollards - Paint the exposed portion of designated bollards with one coat of the type and color of coating, as shown or specified.

Construction

00815.40 Bollards - Install bollards as shown or as directed.

Measurement

00815.80 Measurement - The quantities of bollards will be measured on a unit basis.

Payment

00815.90 Payment - The accepted quantities of bollards will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Bollards	Each
(b)	Removable Bollards	Each
(c)	Hydrant Bollards	Each

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for excavation, backfill, or painting.

Section 00820 - Concrete Barrier

Description

00820.00 Scope - This Work consists of constructing precast and fixed form cast-in-place portland cement concrete barrier, to the lines and grades shown or established. This Work also consists of removing existing concrete barrier and reinstalling the barrier in its original location, as shown.

Materials

00820.10 Materials - Furnish Materials meeting the following requirements:

Commercial Grade Concrete.....00440, except as provided in this Section
Concrete Coating 02210
Deformed Bar Reinforcement.....02510.10
Granular Wall Backfill.....02630.11
Portland Cement Grout 02080.40
Preformed Joint Filler.....02440.10
Welded Wire Reinforcement 02510.40

00820.11 Other Materials:

(a) Concrete - Concrete shall meet the requirements of Section 00440, except that Aggregates shall be modified as follows:

(1) Fine Aggregate - Fine Aggregate shall meet the test requirements of 02690.30(c) and 02690.30(d). Test results shall be no more than 1 year old.

(2) Coarse Aggregate - Coarse Aggregate shall meet the test requirements of 02690.20(b) and 02690.20(c). Test results shall be no more than 1 year old.

(b) Hardware - Pins, bolts, and dowels shall conform to ASTM A449 and shall be hot-dip galvanized according to AASHTO M 232 (ASTM A153).

(c) Loop Bars - Fabricate loop bars from ASTM A36, hot-rolled round bar and hot-dip galvanize according to AASHTO M 232 (ASTM A153) and ASTM A143.

(d) C-shape Connectors - Furnish perforated C-shape connectors fabricated from ASTM A36 channel, hot-dip galvanized after fabrication according to AASHTO M 232 (ASTM A153) and ASTM A143.

(e) Identification - Permanently cast into the top surface or into the side lower vertical face of each precast concrete barrier piece an identifying code consisting of the initials of the barrier manufacturer, the date of casting and the form number. Barrier pieces without identifying code will not be accepted.

00820.12 Re-use of Concrete Barriers - Used precast concrete barriers may be placed in permanent installations according to the following:

(a) New Barrier Used for Temporary Application - New precast concrete barriers used in temporary applications on the Project may be reused in permanent installations, provided they:

- Are in good condition, without visible cracks, chips or spalls.
- Present a surface of uniform texture and appearance.

- Are free of markings, except as required by 00820.11(e).
- Are given two coats of a water-based coating material meeting the requirements of 02210.30 after installation in final position.

(b) Barrier Used on Previous Projects - Precast concrete barriers used on previous projects may be reused in permanent installations, provided they meet all the requirements of this Section and, prior to delivery to the Project Site:

- The Contractor furnishes documentation required by 00165.10(b).
- Barriers are restored to like-new condition, without visible cracks, chips, spalls or corroded loops.
- Barriers present a surface of uniform texture and appearance.
- Barriers are free of markings, except as required by 00820.11(e).

Apply two coats of a water-based coating material meeting the requirements of 02210.30 after installation in final position.

(c) Repair of Damage - If any concrete barrier segment is damaged by the Contractor during or after installation, immediately repair it to the Engineer's satisfaction or replace it with an undamaged section, at no additional cost to the Agency.

00820.15 Quality Control - Provide quality control according to Section 00165.

Labor

00820.30 Quality Control Personnel - Provide a technician having a QCT technical certification.

Construction

00820.40 General - Construct cast-in-place barrier using fixed forms unless specifically directed otherwise. Use the same barrier design in any continuous run of barrier.

00820.41 Line and Grade - Place precast barrier sections on the Pavement surface. New Pavement surfaces placed as a part of this Project shall meet the appropriate smoothness requirement prior to placing the barrier. If corrective Work is required for existing surfaces to receive concrete barrier, it will be paid according to 00195.20.

Place the barrier sections so that the joints offset no more than 1/4 inch transversely and no more than 1/2 inch vertically.

Construct the top and face of finished barriers true and straight. The top surface of the barriers shall be uniform width and free from humps, sags, or other irregularities. When a 12-foot straightedge is laid on the top or face of the barrier, the surface shall not vary more than 1/4 inch from the edge of the straightedge, except at grade breaks or curves. To compensate for variations in the roadway grade and cross Slope, adjust the height of the barrier at no additional cost to the Agency.

00820.42 Concrete Construction - Construct concrete barrier according to Section 00440 except as provided in this Section.

00820.43 Curing - Cure barriers as follows:

(a) Cast-In-Place Barriers - Cure cast-in-place concrete surfaces by one of the following methods:

(1) Water Cure - Cover with burlap, canvas or other satisfactory material and keep moist for at least 7 Calendar Days.

(2) Latex Paint Cure - If approved, barrier may be cured with latex paint, using the following procedures:

- Allow free moisture to flash off, but only until the concrete surface does not glisten, and never for more than 1 hour.
- Apply latex paint from the QPL as follows:
  - Apply first coat at an application rate of 150 square feet per gallon.
  - Allow first coat to air dry for 1 hour.
  - Apply second coat at the same rate as above, with application direction transverse to the direction that the first coat was applied.

Barriers cured in this manner will be considered to have met the surface finishing requirements of 00820.45 except that additional coats may be necessary to provide uniform coverage and appearance to correct construction damage.

(b) Precast Barriers - Cure precast concrete surfaces by one of the following methods:

(1) Water Cure - Water cure concrete surfaces by covering with burlap, canvas or other satisfactory material and keep moist for at least 7 Calendar Days.

(2) Steam Cure - Steam curing can be substituted for water curing if done under a suitable enclosure constructed to contain live steam and to minimize moisture and heat loss. The steam shall be at 100 percent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of cement. Do not apply the steam directly to the concrete.

Equip the steam supply line to the enclosure with a motor-operated, modulating steam control valve operated by a temperature-sensing element that measures the temperature within the enclosure. Distribute the steam within the enclosure through suitable ports located on each side of the enclosure at not more than 30 foot centers, or closer if necessary, to keep the units being cured completely and uniformly surrounded with live steam.

Equip the enclosure with a 24-hour recording thermometer, and record the temperature on a single chart for each 24-hour period.

Apply the steam after the initial set of the concrete as determined by ASTM C403. Continue steam curing until the barrier concrete reaches a minimum compressive strength of 2,000 psi as determined by Contractor test cylinders or as approved.

00820.44 Joints for Cast-in-Place Concrete Barriers:

(a) Construction Joints - Make construction joints at an expansion or contraction joint location. If the placement of the barrier is stopped at a normal contraction joint location, construct an expansion joint at that location, before proceeding with the placement of the barrier, as shown.

(b) Contraction Joints - Score or saw contraction joints before initial set to the depth and width shown.

(c) Expansion Joints - Fill expansion joints with a preformed joint filler. Place the filler in correct position on one side of the joint before placing concrete on the other side.

00820.45 Surface Finishing - After stripping forms and while the concrete is still green, remove all fins and form marks, and repair all rock pockets and holes having a surface opening over 3/8 inch in diameter with portland cement grout conforming to 02080.40. Prevent grout from drying prematurely. Additional finishing after precast concrete barrier is set in its permanent position may be required to present a surface of uniform texture and appearance.

Coat the top and sides of all permanent barriers with a minimum of two coats of a latex paint from the QPL. Use additional coats as necessary to provide uniform coverage and appearance. Clean and thoroughly saturate with water the surfaces to be coated. Coat while damp. The second coat may be applied when the previous coat does not adhere to the fingers when touched lightly.

00820.46 Remove and Reinstall Existing Barrier - Remove, protect, and reinstall existing barrier as shown. Documentation is not required for existing barrier that is removed and reinstalled within the Project Site.

Repair any damage according to 00820.12(c). Apply two coats of a water-based coating Material meeting the requirements of 02210.30 after installation in the final position.

00820.47 Replacement or Price Reduction - Remove and replace barrier represented by cylinders that fail to meet the minimum strength requirement, at no additional cost to the Agency. If the Engineer determines the low-strength barrier is suitable for the purpose intended, the barrier may be accepted according to 00150.25.

00820.48 Inspection - Fabrication of barrier outside of the State of Oregon creates additional inspection costs to the Agency. The Contractor's payment for barrier will be reduced according to 00165.91.

00820.49 Slipform Construction for Single Slope Barrier - Single-slope, 42 inch high, concrete barrier may be slipformed if the plans contain details for slipforming.

Prior to slipforming permanent single-slope concrete barrier, comply with one or both of the following requirements as directed:

(a) Test Section - Cast a test section at least 25 foot long which shall:

- Be placed off the final barrier location site
- Have the same section and reinforcement as detailed
- Include one typical contraction or expansion joint.
- Be removed and disposed of at no additional cost to the Agency

(b) Prior Performance - Identify at least two recent projects on which the Contractor installed slipformed single-slope concrete barrier. For each project, provide the name and phone number of a person the Engineer may contact to determine the success of the installation. The Engineer will determine whether to allow slipforming on the current project.

If slipforming single-slope concrete barrier is permitted, comply with the following:

- Meet the requirements for cast-in-place construction.
- Use Class 3300 - 1 1/2 or Class 3300 - 3/4 portland cement concrete meeting the requirements of Section 02001.
- Provide concrete with a slump of 1 inch ± 1/2 inch.
- Brush-finish single-slope concrete barrier surfaces with vertical strokes and then paint according to 00820.45.

- Keep the top and faces of the finished single-slope barrier free from sags, humps and other irregularities.
- Maintain contraction joints and expansion joints to the dimensions shown until the concrete sets.
- Use slipforming only for section of single-slope barrier with constant dimensions. Use fixed forms where dimensions vary, as at luminaire or signal supports and at barrier end transitions.
- Remove and replace any unsatisfactory work at no additional cost to the Agency.

Measurement

00820.80 Measurement - The quantities of concrete barrier will be measured on the length basis, according to the following:

- **Cast-In-Place Barriers** - Cast-in-place barrier will be measured along the line and grade of each separate run, including terminal sections and transition sections.

- **Precast Barriers** - Precast barrier will be the laying length of a standard section, as shown on the applicable Standard Drawings, multiplied by the number of standard sections installed in each separate run. Non-standard sections, terminal sections and transition sections will be measured separately and added to the total length of standard sections.
- **Remove and Reinstall Existing Concrete Barrier** - Removing and reinstalling existing concrete barrier will be measured along the line and grade of each separate run, including terminal section and transition sections, by actual length of barrier in place.

The quantities of concrete barrier around median obstacles will be measured on the unit basis.

Measurement for the removal of concrete barrier that will not be removed and reinstalled according to this Section will be measured and paid for according to Section 00310.

Payment

00820.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Concrete Barrier	Foot
(b)	Concrete Barrier, Tall	Foot
(c)	Median Obstacle Barrier	Each
(d)	Securing Concrete Barrier	Foot
(e)	Remove and Reinstall Existing Concrete Barrier	Foot
(f)	Remove and Reinstall Existing Concrete Barrier, Tall	Foot

Item (c) includes cast-in-place transitions, narrow base shoulder barrier secured to the roadway, granular wall backfill, 4-inch PCC slab with welded wire reinforcement, and required expansion joint filler.

Item (d) includes securing concrete barrier to the roadway or bridge deck surface with barrier pins, anchor rods, or similar devices.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- excavating and backfilling buried ends of concrete barrier
- securing concrete barrier to the roadway by means of grout or keyways
- moving, stockpiling, handling, and pinning removed and reinstalled concrete barrier.

Payment for removal of concrete barrier that will not be removed and reinstalled according to this Section will be measured and paid for according to Section 00310.

Section 00830 - Impact Attenuators

Description

00830.00 Scope - This Work consists of furnishing and installing impact attenuators for permanent installations.

00830.02 Required Submittals - If placement or method of installation of impact attenuators is different than the manufacturer's recommendations, submit stamped shop drawings, including concrete components, according to 00150.35.

Materials

00830.10 Materials - Furnish impact attenuators from the QPL and as specified.

The following types of impact attenuators are allowed:

Type A: Gating device, Test Level 3, for Shoulder use only, Narrow Width, Regular Maintenance

Type B: Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Regular Maintenance

Type C: Non-Gating device, Test Level 2, for Shoulder, Gore and Median uses, Narrow Width, Regular Maintenance

Type D: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Wide Width, Regular Maintenance

Type E: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Regular Maintenance

Type F: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Wide Width, Regular Maintenance

Type G: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Narrow Width, Low Maintenance

Type H: Non-Gating device, Test Level 2, for Shoulder, Gore and Median use, Wide Width, Low Maintenance

Type J: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Narrow Width, Low Maintenance

Type K: Non-Gating device, Test Level 3, for Shoulder, Gore and Median use, Wide Width, Low Maintenance

Type L: Non-Gating device, Test Level 3, High Speed, for Shoulder, Gore and Median use, Narrow Width, Low Maintenance

Type M: Non-Gating device, Test Level 3, High Speed, for Shoulder, Gore and Median use, Narrow Width, Regular Maintenance

Furnish concrete meeting the manufacturer's requirements, or if the manufacturer makes no recommendations, furnish concrete meeting the requirements of Section 00440. Furnish reinforcement meeting the requirements of Section 00530.

Furnish all hardware, epoxy resin, and miscellaneous items according to the manufacturer's recommendations.

Construction

00830.40 General - Construct and surface finish concrete according to Section 00440.

Prepare surfaces, mix, and place epoxy grout for epoxy grout pad construction according to the manufacturer's recommendations.

Assemble and install impact attenuator systems according to the manufacturer's recommendations and shop drawings.

Install fixed object markers on the head of the impact attenuator.

Measurement

00830.80 Measurement - The quantities of impact attenuators will be measured on the unit basis, by actual count at each location a system is installed.

Payment

00830.90 Payment - The accepted quantities of impact attenuators will be paid for at the Contract unit price, per each, for the item "Impact Attenuator, Type ____".

The type of impact attenuator will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for transitions, concrete bases, or object markers.

Section 00840 - Delineators and Milepost Marker Posts

Description

00840.00 Scope - This Work consists of furnishing and installing delineators and milepost marker posts at locations shown or established.

Materials

00840.10 Materials - Furnish Materials meeting the following requirements:

Barrier Markers ..... From QPL
Delineator Reflective Sheeting (Type III and Type IV)..... From QPL
Flexible Delineators..... From QPL

00840.11 Galvanized Milepost Marker Posts - Furnish milepost marker posts meeting the following requirements:

(a) General - Fabricate milepost marker posts from steel sections meeting either of the following requirements:

Metal Properties

Grade	Minimum Yield Strength, ksi	Minimum Ultimate Strength, ksi
Hot-rolled carbon steel - min. carbon content 0.32%	40	70
Hot-rolled rail steel *	50	80

* As defined in U.S. Department of Commerce Commercial Standard 1CS 150-48, rail steel products shall be rolled from standard tee-section steel rails. No other materials, such as those known by the terms "rerolled", "rail steel equivalent", and "rail steel quality", shall be substituted.

Fabricate milepost marker posts using channel sections of the nominal dimensions as shown, subject to the manufacturer's tolerances in dimensions, and a tolerance in weight of 3.5 percent in any one shipment and 5 percent under for any one post, and a tolerance in length of 1 inch under and 2 inches over. Ensure the milepost marker posts are straight and free of sharp corners and rough or burred edges or surfaces.

(b) Multiple Punching - Milepost marker posts with holes in addition to those called for on the Plans will be acceptable provided that the critical net width of the section measured on the frontal plane projection of the post is not less than 2 1/2 inches.

(c) Galvanizing - Galvanize milepost marker posts after fabrication according to AASHTO M 111 (ASTM A123).

(d) Acceptance - Acceptance of milepost marker posts will be according to 00165.35. Accompany each shipment of support posts with a quality compliance certificate.

Construction

00840.40 Lines, Grades, and Preparation Work:

(a) Delineator Posts - Install delineator posts to the lines, grades and spacings shown and as established. To avoid difficult installation at any individual post site, the spacing may be varied 5 percent in either direction and may deviate from line by 6 inches in either direction. Remove vegetative growth, litter and debris from the post sites.

(b) Milepost Marker Posts - Locate and install milepost marker posts as shown.

00840.41 Installation of Posts - Set posts firmly into the ground and vertical. Remove and discard posts that become split, cracked, twisted, or bent, or whose tops become badly misshapen during installation.

(a) Embedment Depth - Field verify post length. Posts set in sandy, gravelly or other unconsolidated material may require an anchor system or need to be longer to provide adequate anchorage. Posts may be shortened to avoid unnecessary penetration in solid Rock or in large Rock fragments. If set in Rock, drill a 9 inch deep hole, 1 inch greater in diameter than the large dimension of the post, and grout in place with a fine mortar grout.

(b) Guardrail Locations - At wood guardrail post installations, attach Type 4 delineators (alternate 1, plastic or alternate 2, steel) to the wood guardrail posts as shown on the Standard Drawings. At metal guardrail post installations, install full length Type 1, 1U, or 2 ground mounted delineators behind the rail, adjacent to metal guardrail posts.

(c) Concrete Barrier Locations - At concrete barrier installations, attach Type 5 delineators to the concrete barrier according to the manufacturer's recommendations and as shown on the Standard Drawings.

00840.42 Target Members for Delineator Posts - Assemble, fasten, set and align target members and reflective material appropriate to the type and color of delineators as shown. Attach reflective sheeting to the targets as recommended by the manufacturer.

00840.43 Signs For Milepost Marker Posts - Assemble, fasten, set, and align milepost marker signs and object marker signs according to Section 00940 and as shown.

Finishing and Cleaning Up

00840.70 General - Remove and dispose of excess excavated materials, litter, and debris resulting from the operations according to 00290.20. Finish the surface around the support to match the surrounding surface or as shown.

Measurement

00840.80 Measurement - The quantities of delineators and milepost marker posts will be measured on the unit basis.

Payment

00840.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Delineators, Type ____	Each
(b) Milepost Marker Posts	Each

In item (a) the type of delineator will be inserted in the blank regardless of the color or number of reflectors and targets.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for preparation Work, earthwork, grouting, backfilling, or cleaning up.

Signs mounted on milepost marker posts will be paid for according to 00940.90.

Section 00842 - Facility Identification Markers

Description

00842.00 Scope - This Work consists of furnishing and installing facility identification markers as shown.

Materials

00842.10 Materials:

(a) Stormwater Control Field Facility Markers:

(1) Type S1 Markers - Furnish green and red Type 2 flexible delineator meeting the requirements of 00840.10 except do not include the reflective sheeting. Provide green #24190 and red #11350 meeting SAE AMS-STD-595.

(2) Type S2 Markers - Furnish white markers made of aluminum alloy meeting the requirements of ASTM B209 approximately half-hard temper, suitable for enameling by continuous roller or other acceptable method. Fabricate from aluminum sheet having a nominal thickness of 0.050 inch, subject to standard manufacturer's tolerances and free of burrs, irregularities, and turned edges. When resting on a plane surface, the markers shall not show warp, twist, or variation from the surface in excess of 1/4 inch. Finish the markers as follows:

- Top band of non-reflective blue tape.
- Bottom band of non-reflective black tape.
- Non-reflective black type "C" font text and numbers.

Furnish galvanized Type IU support posts meeting the requirements of 00840.11.

(3) Type S3 Markers - Furnish manhole covers meeting the requirements of 2450.30 and permanently stamped with Type S3 markers as shown.

(b) Culvert Drainage Facility Markers:

(1) Type 1 Drainage Markers - Furnish 6 to 12 inch long by 4 inch wide green color Type B preformed fused thermoplastic film meeting the requirements of 00850.10.

(2) Type 2 Drainage Markers - Furnish white markers made of aluminum alloy meeting the requirements of ASTM B209 approximately half-hard temper, suitable for enameling by continuous roller or other acceptable method. Fabricate the aluminum sheet having a nominal thickness of 0.050 inch, subject to standard manufacturer's tolerances and free of burrs, irregularities, and turned edges. When resting on a plane surface, the markers shall not show warp, twist, or variation from the surface in excess of 1/4 inch. Finish the markers as follows:

- Top band of non-reflective green tape.
- Non-reflective black type "C" font text and numbers.

Furnish galvanized Type 1U support posts meeting the requirements of 00840.11.

(c) Bridge Facility Markers - Furnish markers meeting the requirements of Section 02910. Furnish galvanized Type 1 support posts meeting the requirements of 00840.11. Furnish 1/4 inch x 1 3/4 inch stainless steel mechanical anchors for concrete surfaces from the QPL.

Construction

00842.40 General:

(a) Stormwater Control Field Facility Markers - Install field markers for each facility according to the following:

- **Posts** - Locate and install the Type S1 and S2 marker posts as shown and according to 00840.40 and 00840.41.
- **Markers** - Attach the Type S2 markers to the Type 1U posts as shown. Install the Type S3 markers as shown.

(b) Culvert Drainage Facility Markers:

(1) Type 1 Drainage Markers - Install the Type B preformed fused thermoplastic film to clean dry Pavement surfaces and as shown.

(2) Type 2 Drainage Markers - Install Type 1U posts as shown. Twisted, bent, or damaged posts will not be accepted. If posts are set in Rock or large Rock fragments, shorten posts, drill 9 inch deep holes 1 inch greater in diameter than the large dimension of the post then grout the post in place with fine mortar grout.

Attach the markers to the Type 1U posts, wood guardrail posts, concrete barrier, and culvert headwalls as shown.

(c) Bridge Facility Markers - At bridge rail transition areas where wood guardrail posts are installed, install the bridge identification marker on a Type 1 post and attach it to a wood guardrail post according to the "Type 4, Alternate 2" detail shown on the Standard Drawings. At bridge rail transition areas where metal guardrail posts are installed, install the bridge identification marker on a Type 1 post behind and adjacent to the metal guardrail post as shown and according to 00840.41. Install bridge identification markers on vertical or near vertical Structure surfaces as shown.

Measurement

00842.80 Measurement - The quantities of Work performed under this Section will be measured on the unit basis.

Payment

00842.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Field Facility Markers, Type ____	Each
(b)	Culvert Drainage Markers, Type ____	Each
(c)	Bridge Identification Markers	Each

In item (a), the type of field facility marker will be inserted in the blank.

In item (b), the type of culvert drainage marker will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00850 - Common Provisions for Pavement Markings

Description

00850.00 Scope - This Work consists of furnishing, preparing, and installing all forms of pavement markings.

Materials

00850.10 Materials - Furnish the following Materials from the QPL:

- Adhesive for Pavement Markers
- High Performance Pavement Markings
- Methyl Methacrylate
- Pavement Markers
- Reflective Elements*
- Marking Paint
- Marking Tape
- Thermoplastic

* Reflective elements used with materials other than marking paint are not required to be from the QPL. Use reflective elements according to the manufacturer's recommendations.

00850.11 Flexible Bituminous Adhesive - At least 2 weeks before using, submit for Agency testing and approval a 15 pound brick sample of flexible bituminous adhesive for each manufacturer lot number, including previously tested and approved lot numbers that are over 1 year old, that will be used on the Project. All previously rejected lot number samples will not be retested. Agency testing and approval is only for acceptance of use of the adhesive.

Equipment

00850.20 Equipment - Use Equipment acceptable by the marking material manufacturer for the method specified and the following:

(a) Equipment for Pavement Legends and Bars - Use manual or automatic application Equipment.

(b) Equipment for Longitudinal Lines - Use applicators, sprayers or extruders made specifically for applying the specified pavement marking material at a uniform width and thickness on the roadway surface.

Except for tape applications, use automatic bead applicators that place a uniform layer of beads on the line.

Provide Equipment that can:

- Place two parallel lines simultaneously with 4 inch minimum to 12 inch maximum spacings between the two lines.
- Place the entire width of a line in one Pass.

Use a three-gun system for applying sprayed markings.

Hand units are allowed for tape applications only.

(c) Equipment for Inlaid/Grooved Markings - For thermoplastic and methyl methacrylate inlaid markings on dense graded asphalt concrete Pavement, provide grinders with either diamond cutting heads that create smooth, flat-bottomed cuts of uniform depth or carbide cutting heads that create smooth uniform depths and uniform patterned striations as the Contractor elects.

For all other operations, provide grinders with diamond cutting heads that create smooth, flat-bottomed cuts of uniform depth or sloped cuts as shown.

Labor

00850.30 Manufacturer's Representative - For Sections referencing 00850.30, provide the services of a manufacturer's representative on-site during the installation, authorized to sign a warranty on behalf of the manufacturer.

00850.31 Manufacturer-Certified Installers - For Sections referencing 00850.31, provide installers certified by the marking materials manufacturer for the specified marking material and method. Do not begin installation before receiving the Engineer's approval.

Construction

00850.40 Plans: For Projects with partial striping Plans or Projects without striping Plans, document all existing striping that is not shown in the Supplemental Drawings. Submit documentation to the Engineer at least 7 Calendar Days before the loss of existing pavement markings.

(a) Projects With Complete Striping Plans - When striping Supplemental Drawings are included in the Project, install striping as shown.

(b) Projects With Partial Striping Plans - When partial Supplemental Drawings are included in a Project, install striping according to the following:

- In areas where striping details are shown on the Supplemental Drawings, install striping as shown.
- In areas where striping details are not shown on the Supplemental Drawings, install striping to match the original striping configuration with the appropriate striping items listed in the Contract Schedule of Items.

(c) Projects Without Striping Plans - When striping Supplemental Drawings are not included in the Project, install striping to match the original striping configuration with the appropriate striping items listed in the Contract Schedule of Items.

00850.42 Pre-Striping Conference - Meet with the Engineer and striping Subcontractor, if striping is done by a Subcontractor, at least 2 weeks prior to beginning striping Work to discuss methods and practices of accomplishing all required striping Work. Submit the following in writing at least 5 Calendar Days before the pre-striping conference for approval:

- A striping schedule showing areas and timing of Work, and placing of material.
- A list of materials proposed for use and the application method.
- A copy of the manufacturer's installation instructions and Material Safety Data Sheets (MSDS).
- Proof of installer's certification for those Sections referencing 00850.31.
- Equipment specifications.
- A spill recovery plan including:
  - Name, address, and phone number of the Contractor's contact with the DEQ.

- Name, address, and phone number of the persons certified and on-call to do clean-up.

00850.43 Prepare and Prime Pavement - Prepare Pavement surfaces according to the following:

- **Existing Pavement Surfaces** - When required by the pavement marking manufacturer, remove pavement markings from existing Pavement surfaces that will adversely affect the bond of new pavement marking material to the roadway surface according to 00225.45.

  Remove all other contaminants from existing Pavement surfaces that may adversely affect the installation of new pavement markings by sandblasting, shot-blasting, or sweeping. Air blast the Pavement with a high-pressure system to remove extraneous or loose material.

- **New Asphalt Concrete Surfaces** - Remove contaminants from new AC surfaces that may adversely affect the installation of the pavement markings by sandblasting, shot-blasting, or sweeping. Air blast the Pavement with a high-pressure system to remove extraneous or loose material. Apply materials to new asphalt concrete that is sufficiently cured according to the manufacturer's recommendations.

- **New Portland Cement Concrete Surfaces** - Remove curing compounds and laitance by an approved mechanical means. Air blast the Pavement with a high-pressure system to remove extraneous or loose material. Apply materials to concrete that has reached a minimum compressive strength of 3,000 psi and that is sufficiently cured according to the manufacturer's recommendations.

After the Pavement surface is clean and dry, apply primer as recommended by the manufacturer to the area receiving the pavement markings. Apply the primer in a continuous, solid film according to the recommendations of the primer manufacturer and the pavement markings manufacturer.

00850.44 Alignment Layout - Place control points for lines every 50 feet on tangent and every 25 feet on a curve. Using these control points, layout a continuous narrow guideline for each line, along one edge of, or uniformly offset from the intended permanent line location. Do not proceed with installation until the guidelines are approved by the Engineer.

For inlaid/grooved markings, indicate the exact grind-out location with a 4 inch wide line as the guideline. For broken lines, lane drop lines, and dotted lines, use 10 feet, 3 feet, and 2 feet long sections respectively, at the cycle length shown. For solid lines, use a continuous line. Use marking paint from the QPL applied at a thickness of 6 mils. Reflective elements are not required.

00850.45 Installation - Apply pavement marking materials to clean dry Pavement surfaces and according the following:

- Place material between May 1 and October 15.
- Place material according to the manufacturer's installation instructions.
- Place parallel double lines in one Pass.
- Place the specified width of lines in one Pass.
- The Pavement surface shall not be visible in the striped areas.
- The top of pavement marking shall be smooth and uniform.
- Skip line ends shall be square and clean.
- Place pavement marking lines parallel and true to line.
- Place skip lines so that they are in cycle with at least one end of any adjacent project.
- Place markings in proper alignment with existing markings.
- Immediately clean up marking material dribbled beyond the cutoff.

For inlaid/grooved markings, grind the slot as shown. For each grinder operator and piece of Equipment, obtain the Engineer's and manufacturer representative's approval of the slot within the first 150 feet for solid lines and within the first 300 feet for skip lines. Do not proceed with grinding until the slot is approved. Repeat this process for each new grinder operator or new piece of Equipment used.

After grinding, obtain the Engineer's and manufacturer representative's approval before placing marking material. Clean the area with high pressure air immediately before placing the marking material.

00850.46 Placement Tolerance - Allowable tolerances for installation are:

- **Lateral location on roadway:** 1/2 inch on tangents; 1 inch on curves
- **40-foot skip cycle length:** ± 2 inches for skip length, ± 2 inches for gap length
- **12-foot skip cycle length:** ± 3/4 inch for skip length, ± 1 inches for gap length
- **8-foot skip cycle length:** ± 1/2 inch for skip length, ± 3/4 inches for gap length
- **Skip Cycle:** A tolerance of 1/10 of the skip line length on the first skip line of a run, but it shall be on cycle within one skip
- **Double lines:** Parallel, with a gap tolerance of ± 1/2 inch
- **Width of lines:** + 3/8 inch, - 1/16 inch
- **Thickness of flat, surface applied lines:** + 1/3 of the specified thickness, – 1/10 of the specified thickness
- **Divergence of parallel double lines:** ± 3/8 inch

00850.47 Quality Control - Record the following readings for each type and color of marking material and the locations where they were taken. Submit the results to the Agency within 1 Day of taking the readings.

(a) Placement Tolerances - Measure the following at the time of installation or application:

- For inlaid/grooved markings, measure the depth of the slot every 300 feet.
- For surface applied markings, except paint and tape applications, measure the thickness of the lines, at 300 foot intervals. Thickness is measured from the top of the pavement marking to the top of the wearing surface. Marking material placed in a depression left by pavement line removal will not be included in measuring the thickness of the line.

(b) Curing of Material -
At the time of installation, note and report to the Engineer all soft spots and darkened areas that may result in poor bonding and durability of the pavement markings.

(c) Retroreflectivity - Except for paint applications, evaluate longitudinal and transverse marking retroreflectivity according to ODOT TM 777. Acceptance will be according to the following:

- **Longitudinal Markings** - Each longitudinal marking sublot will be accepted if the average of the measurements and at least 90 percent of the individual measurements within the sublot meet or exceed the required minimum initial retroreflectivity.

If more than 10 percent but no more than 25 percent of the individual measurements in a sublot fail, take additional measurements within the sublot according to ODOT TM 777, Section 7.2.1 halfway between the measurements taken during initial evaluation. Combine these additional measurements with the initial measurements and re-evaluate the sublot. If the combined sublot measurements do not meet the 90 percent criteria, remove and replace the entire longitudinal marking sublot at no additional cost to the Agency.

If more than 25 percent of the individual measurements in a sublot fail remove and replace the entire longitudinal marking sublot at no additional cost to the Agency.

- **Transverse Markings** - Each transverse marking sublot will be accepted if the average of the measurements and at least 90 percent of the individual measurements within the sublot meet or exceed the required minimum initial retroreflectivity.

  If more than 10 percent but not more than 25 percent of the individual measurements in a sublot fail, take additional measurements within the sublot according to ODOT TM 777, Section 7.2.2. The Engineer will randomly select an equal number of untested transverse markings to test. Combine these additional measurements with the initial measurements and re-evaluate the sublot. If the combined sublot measurements do not meet the 90 percent criteria, remove and replace the entire transverse marking sublot at no additional cost to the Agency

  If more than 25 percent of the individual measurements in a sublot fail remove and replace the entire transverse marking sublot at no additional cost to the Agency.

Temporary

00850.50 General - Protect all applied markings from traffic until sufficiently cured so as not to be damaged or tracked by traffic movements.

Finishing and Cleaning Up

00850.70 Disposal of Waste - Dispose of all materials according to 00290.20.

00850.71 Removal and Repair of Unacceptable Work - Remove unacceptable materials according to 00225.45. If more than one repair is required in a single 300-foot section, grind and repair the entire 300-foot section.

Section 00855 - Pavement Markers

Description

00855.00 Scope - In addition to the requirements of Section 00850, install reflective and non-reflective pavement markers according to the following Specifications.

Construction

00855.40 Pavement Markers:

(a) General - Install reflective (Type I) and nonreflective (Type II) markers as shown.

(b) Surface Preparation - Remove contaminants from the wearing Course surface which would adversely affect the bond of the adhesive.

Sandblast or steel shot blast the Pavement surface to remove all surface contaminants. Use a blast of clean air to remove all loose particles from the surface.

(c) Installation - Apply pavement markers to a clean, dry surface.

Do not install markers spanning a Pavement joint or crack. To avoid longitudinal cracks and joints, adjust pavement markers up to one half the width of the marker. To avoid transverse cracks and joints, adjust pavement markers ahead or back on line $\pm$ 5 inches.

Place the adhesive uniformly on the prepared Pavement surface or on the bottom of the marker in a quantity sufficient to result in a complete coverage of the area of contact of the marker with no voids present and a slight excess of material after the marker has been pressed in place.

Place the marker in position and apply pressure until firm contact is made with the Pavement. Visually inspect the installation to ensure that a small bead approximately 1/8 inch thick forms around all edges and corners and the marker is fully supported on a pad of adhesive. Immediately remove excessive adhesive on the Pavement, and adhesive on the exposed surfaces of the markers.

Completely remove adhesive from the surfaces of pavement markers using an approved adhesive remover.

00855.41 Recessed Pavement Markers:

(a) Surface Preparation - Construct grooves in the Pavement to Neat Lines conforming to width, length and depth shown, and prepare the surface according to 00855.40(b).

(b) Installation - Install the pavement markers in the groove as shown and according to 00855.40(c).

Measurement

00855.80 Measurement - The quantities of pavement markers and recessed pavement markers will be measured on the unit basis, for each type of marker.

Payment

00855.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Mono-Directional White Type I Markers	Each
(b)	Mono-Directional White Type IAR Markers	Each
(c)	Bi-Directional Yellow Type I Markers	Each
(d)	Bi-Directional Yellow Type IAR Markers	Each
(e)	White Type II Markers	Each
(f)	Yellow Type II Markers	Each
(g)	Mono-Directional White Type IAR Markers, Recessed	Each
(h)	Bi-Directional Yellow Type IAR Markers, Recessed	Each
(i)	Bi-Directional Blue Type 1AR Markers	Each
(j)	Bi-Directional Blue Type 1AR Markers, Recessed	Each

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work.

No separate or additional payment will be made for constructing Pavement grooves, Pavement preparation, adhesive, or clean-up.

Section 00856 - Surface Mounted Tubular Markers

Description

00856.00 Scope - This Work consists of furnishing and installing permanent surface mounted tubular markers as shown or directed.

Materials

00856.10 Materials - Furnish surface mounted tubular markers from the QPL.

Construction

00856.40 General - Install surface mounted tubular markers straight and true to line at the spacings shown. In addition to bolting the base of the surface mounted tubular marker to the surface, bond the surface mounted tubular marker to the surface using an adhesive according to the manufacturer's recommendations.

Measurement

00856.80 Measurement - The quantities of permanent surface mounted tubular markers will be measured on the unit basis.

Payment

00856.90 Payment - The accepted quantities of permanent surface mounted tubular markers will be paid for at the Contract unit price, per each, for the item "Permanent Surface Mounted Tubular Markers".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00857 - Rumble Strips

Description

00857.00 Scope - This Work consists of milling rumble strips by constructing indentations in asphalt concrete surfaces as shown or directed.

Equipment

00857.20 Equipment:

(a) Longitudinal Rumble Strips - Construct continuous or gap pattern longitudinal Shoulder, edge line, and centerline rumble strips as shown using a rotary type cutting head with a maximum outside diameter of 24 inches. Provide a cutting head length that matches the rumble strip width as shown. Arrange the cutting head cutting tips in a pattern that provides a relatively smooth cut with approximately 1/16 inch between peaks and valleys. Attach the cutting heads to the power unit in a manner that allows the tool to self-align with the Slopes of the Pavement and Shoulder and any irregularities in the Pavement and Shoulder surfaces. The cutting Equipment shall be capable of cutting rumble strips of the required width in a single pass while moving in the same direction as the flow of traffic.

(b) Transverse Rumble Strips - Form transverse rumble strips using a rotary type cutting head 5 1/2 inches long. Arrange the cutting head cutting tips in a pattern that provides a relatively smooth cut (approximately 1/16 inch between peaks and valleys). Attach the cutting heads to the power unit in a manner that allows the tool to self-align with the Slope of the travel lane and any irregularities in the travel lane surface. The cutting Equipment shall be capable of cutting rumble strips perpendicular to the travel lane.

Construction

00857.40 Construction - Where rumble strips will be constructed at the same locations where permanent pavement markings will be installed, construct rumble strips within 3 weeks after temporary pavement markings have been placed for the final roadway configuration, but before installing permanent pavement markings.

After constructing the rumble strips, clean the Pavement by sweeping to remove dust and other foreign matter. Dispose of all materials according to 00290.20.

Measurement

00857.80 Measurement - The quantities of longitudinal rumble strips will be measured on the length basis, at least to the nearest 0.01 mile. Measurement will be made along each rumble strip run, regardless of location or width of strip with no deductions made for gaps in gap pattern rumble strips. Breaks in the rumble strips at intersections, interchange ramps, or other locations shown will not be measured for payment.

The quantities of transverse rumble strips will be measured on the unit basis, by actual count of rumble strip clusters.

Payment

00857.90 Payment - The accepted quantities of rumble strips will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Continuous Rumble Strips	Mile
(b)	Gap Pattern Rumble Strips	Mile
(c)	Transverse Rumble Strips	Each
(d)	Continuous Sinusoidal Rumble Strips	Mile
(e)	Gap Pattern Sinusoidal Rumble Strips	Mile

Payment will be payment in full for furnishing all Materials, Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00860 - Longitudinal Pavement Markings - Paint

Description

00860.00 Scope - In addition to the requirements of Section 00850, install painted longitudinal pavement markings according the following Specifications.

Construction

00860.45 Installation - Apply painted longitudinal pavement markings as follows:

- Apply two separate applications of painted longitudinal pavement markings. Retrace the second application directly over the first application, within 1/16 inch as follows:
  - Apply the second application after 2 hours but within 48 hours of the first application.
  - For yellow colored markings that delineate two-way traffic, apply the second application in the opposite direction of the first application. For yellow colored markings on one-way Roadways, apply the second application in the same direction of the first application. For white colored markings, apply the second application in the same direction of the first application.
- Apply each painted marking application at a thickness of 15 mils wet, equivalent to 17 gallons per mile for a 4 inch wide solid stripe.
- Apply reflective elements for each application at a minimum rate of 5 pounds per gallon of paint. Embed, by means of paint wicking, a minimum of 80 percent of the reflective elements in the paint to a minimum depth of 50 percent of their diameter.

Minimum initial retroreflectivity shall be the following:

- White - 250 mcd/m^2/lx
- Yellow - 200 mcd/m^2/lx

Measurement

00860.80 Measurement - The quantities of painted longitudinal pavement markings will be measured on the length basis. Painted longitudinal pavement markings will be based on a nominal line width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis. Measurement will be the actual stripe. Gaps between skip stripes will not be measured.

Payment

00860.90 Payment - The accepted quantities of painted longitudinal pavement markings will be paid for at the Contract unit price, per foot, for the item "Longitudinal Pavement Markings - Paint".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00865 - Longitudinal Pavement Markings - Durable

Description

00865.00 Scope - In addition to the requirements of Section 00850, install durable longitudinal pavement markings according to the following Specifications.

Labor

00865.30 Manufacturer's Representative - Provide a manufacturer's representative according to 00850.30.

00865.31 Manufacturer-Certified Installers - Provide certified installer's according to 00850.31.

Construction

00865.40 General - Before installing, and in the presence of the Engineer, conduct a performance test by applying a 150 foot test section on roofing felt. Do not place permanent material without the Engineer's approval of the performance test. Additional performance tests may be required. Conduct performance tests at no additional cost to the Agency.

00865.45 Installation - Place durable markings only when the manufacturer's representative determines that the Pavement is ready for the pavement marking material.

Apply reflective elements at a rate to obtain the following minimum initial retroreflectivity readings:

- White - 250 mcd/m^2/lx
- Yellow - 200 mcd/m^2/lx

Apply marking materials by one or more of the following methods:

- **Method A: Extruded Markings** - Apply markings with an extrusion or ribbon type process and according to the following:
  - For grooved markings, grind the slot depth as shown. Apply the specified marking material centered in the slot as shown. The top of the marking shall be flat or slightly convex.
  - For profiled markings, place lines and bumps straight and square.

- **Method B: Spray Markings** - Apply two separate applications of spray markings with each application being one half the total specified thickness. Retrace the second application directly over the first application within 1/16 inch. For white colored markings, apply the second application in the same direction of the first application. For yellow colored markings that delineate two-way traffic, apply the second application in the opposite direction of the first application. For yellow colored markings on one-way Roadways, apply the second application in the same direction of the first application.

  Thermoplastic spray markings may be installed in one application at the total specified thickness if approved by the Engineer and after a successful performance test according to 00865.40. Apply spray markings in two applications if installing yellow colored markings over rumble strips.

- **Method C: Pavement Marking Tape** - Do not place tape continuously on longitudinal Pavement joints. Apply pavement marking tape as follows:

  - **Rolled-In Installation** - Apply the tape to the fresh asphalt concrete surface prior to the final rolling of the mat. Roll the tape into the fresh surface during the finishing of the mat.

- **Grooved Installation** - Grind slot depth to 130 to 150 mils with a smooth, uniform, and flat bottom. Apply tape into slot.

- **Method D: Wet Weather Markings** - Apply markings with an extrusion, ribbon, or spray process and according to the following:

  - For grooved markings, grind the slot depth as shown. Apply the specified marking material centered in the slot as shown. The top of the marking shall be flat or slightly convex.
  - For profiled markings, apply markings with an extrusion or ribbon process. Place lines and bumps straight and square.

- **Method AB: Non-Profiled Extruded or Sprayed Markings** - Install Method A surface, non-profiled markings or Method B markings.

00865.75 Manufacturer Warranty - Furnish a manufacturer warranty that unconditionally warrants to the Agency the product(s) and installation under this Section against failure, according to this Subsection and 00170.85(c)(1). Use Agency-supplied warranty forms, available from the Engineer.

"Unconditionally warrant" means that the warranty covers all failures, regardless of the source or cause of the failure, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of materials.

The Agency inspection of any portion of the Work during the Contract and during the product installation, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the obligations under this warranty.

(a) Warranty Period - The warranty period shall be 3 years for surface mounted thermoplastic, and 4 years all other methods and materials in this Section.

(b) Failure - For purposes of this warranty, failure is defined as one or more of the following:

- **Loss of Retroreflectivity** - Markings fail to maintain a minimum retroreflectivity of 150 mcd/m^2/lx for white and 125 mcd/m^2/lx for yellow.
- **Insufficient Color Stability (Yellow)** - Yellow markings fail to meet ASTM D6628.
- **Insufficient Color Stability (White)** - White markings fail to meet ASTM D6628.
- **Loss of Adhesion** - Any 300-foot segment of marking shows 5 percent or greater loss of line due to non-adhesion. This constitutes a failure of that segment.

(c) Remedy - Upon notification by the Engineer of a failure, provide the following remedy at no additional cost to the Agency:

- Repair or replace, at the discretion of the Engineer all failed pavement markings within 6 months of the Agency's request to do so.
- Use materials and procedures meeting the Specifications.
- Match repairs to adjoining Work.
- Coordinate timing of repair Work with the Engineer.

(d) Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure causes or may cause a hazard, the failure may be temporarily corrected by Agency or other forces at no additional cost to the Agency. Replace temporary repairs with permanent repairs at no additional cost to the Agency and according to the Specifications and within the time specified in 00865.75(c).

Measurement

00865.80 Measurement - The quantity of durable longitudinal pavement markings will be measured on the length basis. Durable longitudinal pavement markings will be based on a nominal line width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis. Measurement will be the actual stripe. Gaps between skip stripes will not be measured.

Payment

00865.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
	Method A (Extruded)	
(a)	Methyl Methacrylate, Extruded, ____, ____	Foot
(b)	Thermoplastic, Extruded, ____, ____	Foot
	Method B (Sprayed)	
(c)	Methyl Methacrylate, Sprayed, Surface, Non-Profiled	Foot
(d)	Thermoplastic, Sprayed, Surface, Non-Profiled	Foot
	Method C (Pavement Marking Tape)	
(e)	Pavement Marking Tape, ____, ____	Foot
(f)	Pavement Marking Tape, ____, ____, Wet Weather	Foot
	Method D (Wet Weather Markings)	
(g)	Methyl Methacrylate, Wet Weather, ____, ____	Foot
(h)	Thermoplastic, Wet Weather, ____, ____	Foot
	Method AB (Non-Profiled Extruded or Sprayed)	
(i)	Methyl Methacrylate, Extruded or Sprayed, Surface, Non-Profiled	Foot
(j)	Thermoplastic, Extruded or Sprayed, Surface, Non-Profiled	Foot

In items (a) and (b), the word "Surface" or "Grooved" will be inserted in the first blank and the word "Profiled" or "Non-Profiled" will be inserted in the second blank.

In items (e) and (f), "Rolled-In" or "Grooved" will be inserted in the first blank and "Patterned" or "Non-Patterned" will be inserted in the second blank.

In items (g) and (h), the word "Surface" or "Grooved" will be inserted in the first blank and the word "Profiled" or "Non-Profiled" will be inserted in the second blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Payment for Work done under this Section will be limited to 75 percent of the amount due until the Agency has received the signed warranty.

Section 00866 - Longitudinal Pavement Markings - High Performance

Description

00866.00 Scope - In addition to the requirements of Section 00850, install high performance longitudinal pavement markings according to the following Specifications.

Labor

00866.30 Manufacturer's Representative - Provide a manufacturer's representative according to 00850.30.

00866.31 Manufacturer-Certified Installers - Provide certified installer's according to 00850.31.

Construction

00866.40 General - Before installing, and in the presence of the Engineer, conduct a performance test by applying a 150 foot test section on roofing felt. Do not place permanent material without the Engineer's approval of the performance test. Additional performance tests may be required. Conduct performance tests at no additional cost to the Agency.

00866.45 Installation - Place markings only when the manufacturer's representative determines that the Pavement is ready for the pavement marking material.

Do not place the pavement markings on longitudinal Pavement joints.

Apply reflective elements at a rate to obtain the following minimum initial reflectivity readings:

- White - 250 mcd/m^2/lx
- Yellow - 200 mcd/m^2/lx

Apply marking material by one or more of the following methods:

- **Method 1: Extruded Markings** - Apply markings with an extrusion or ribbon type process.
- **Method 2: Sprayed Markings** - If more than one application is required to obtain the specified thickness, retrace additional applications directly over previous applications within 1/16 inch.
- **Method 1-2: Extruded or Sprayed Markings** - Install Method 1 markings or Method 2 markings.

For grooved markings, grind the slot depth as shown. Apply the specified marking material centered in the slot as shown. The top of the marking shall be flat or slightly convex.

00866.75 Manufacturer Warranty - Furnish a manufacturer warranty that unconditionally warrants to the Agency the product(s) and installation under this Section against failure, according to this Subsection and 00170.85(c)(1). Use Agency-supplied warranty forms, available from the Engineer.

"Unconditionally warrant" means that the warranty covers all failures, regardless of the source or cause of the failure, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of materials.

The Agency inspection of any portion of the Work during the Contract and during the product installation, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the obligations under this warranty.

(a) Warranty Period - The warranty period shall be for 1 year.

(b) Failure - For purposes of this warranty, failure is defined as one or more of the following:

- **Retroreflectivity** - Markings fail to maintain a minimum retroreflectivity of 150 mcd/m^2/lx for white and 125 mcd/m^2/lx for yellow.
- **Insufficient Color Stability (Yellow)** - Yellow markings fail to meet ASTM D6628.
- **Insufficient Color Stability (White)** - White markings fail to meet ASTM D6628.
- **Adhesion** - Any 300-foot segment of marking shows 5 percent or greater loss of line due to non-adhesion. This constitutes a failure of that segment.

(c) Remedy - Upon notification by the Engineer of a failure, provide the following remedy at no additional cost to the Agency:

- Repair or replace, at the discretion of the Engineer all failed pavement markings within 6 months of the Agency's request to do so.
- Use materials and procedures meeting the Specifications.
- Match repairs to adjoining Work.
- Coordinate timing of repair Work with the Engineer.

(d) Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure causes or may cause a hazard, the failure may be temporarily corrected by Agency or other forces at no additional cost to the Agency. Replace temporary repairs with permanent repairs at no additional cost to the Agency and according to the Specifications and within the time specified in 00866.75(c).

Measurement

00866.80 Measurement - The quantities of high performance pavement markings will be measured on the length basis. High performance pavement markings will be based on a nominal line width of 4 inches. If the width of the line is other than 4 inches, measurement will be adjusted by converting to an equivalent length of nominal 4 inch line on a proportionate area basis. Measurement will be the actual stripe. Gaps between skip stripes will not be measured.

Payment

00866.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
Method 1 (Extruded)	
(a) Plural Component, Extruded, ____	Foot
(b) Plural Component, Extruded, Wet Weather, ____	Foot
(c) Hi-Build Paint, Extruded, ____	Foot
(d) Hi-Build Paint, Extruded, Wet Weather, ____	Foot
Method 2 (Sprayed)	
(e) Plural Component, Sprayed, ____	Foot
(f) Plural Component, Sprayed, Wet Weather, ____	Foot
(g) Hi-Build Paint, Sprayed, ____	Foot
(h) Hi-Build Paint, Sprayed, Wet Weather, ____	Foot
Method 1-2 (Extruded or Sprayed)	
(i) Plural Component, Extruded or Sprayed, ____	Foot
(j) Plural Component, Extruded or Sprayed, Wet Weather, ____	Foot
(k) Hi-Build Paint, Extruded or Sprayed, ____	Foot
(l) Hi-Build Paint, Extruded or Sprayed, Wet Weather, ____	Foot

The word “Surface” or “Grooved” will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Payment for Work under this Section will be limited to 75 percent of the amount due until the Agency has received the signed Warranty.

Section 00867 - Transverse Pavement Markings - Legends and Bars

Description

00867.00 Scope - In addition to the requirements of Section 00850, install pavement markings for legends and bars according to the following Specifications.

Labor

00867.30 Manufacturer's Representative - Provide a manufacturer's representative according to 00850.30.

00867.31 Manufacturer-Certified Installers - Provide certified installer's according to 00850.31.

Construction

00867.45 Installation - Place permanent markings only when the manufacturer's representative determines that the Pavement is ready for the pavement marking material.

Transverse joints will be allowed with no overlap or gap allowed at the joint.

Minimum initial retroreflectivity shall conform to the following:

- White - 250 mcd/m^2/lx
- Yellow - 200 mcd/m^2/lx

Apply one or more of the following marking material types:

- **Type A: Liquid, Hot-Laid Thermoplastic Material** - For pavement bars, apply the thermoplastic material to the Pavement by a spray or extrusion method, to the full width shown, in a single application. For pavement legends, apply the thermoplastic material to the Pavement by a spray method, to the full width shown, in a single application. Pavement markings shall be 90 mils to 120 mils in thickness, exclusive of projecting surface-applied reflective elements, with a continuous and uniform cross sectional configuration, and with the upper surface slightly arched.

  Separately apply reflective elements to the material as it is placed at a sufficient rate to obtain an initial reflectivity reading of 250 mcd/m^2/lx. Locate the dispenser behind the pavement marking extrusion die and uniformly distribute the reflective elements over the entire width of the thermoplastic material.

- **Type B: Preformed, Fused Thermoplastic Film** - Install preformed, fused thermoplastic film as shown.

- **Type B-HS: Preformed, Fused Thermoplastic Film High Skid** - Install preformed, fused thermoplastic film high skid, that has intermixed reflective elements with factory installed crushed glass or Aggregate on the surface for all staggered continental crosswalks, bicycle lane stencils, bicycle railroad crossings, lane reduction arrows, and other transverse pavement markings as shown. Install the preformed, fused thermoplastic film high skid to achieve a minimum initial skid resistance greater than or equal to 50 British Pendulum Number (BPN) when tested according to ASTM E303.

- **Type AB**: Install Type A, Type B or Type B-HS as the Contractor elects.

- **Type C: Cold-Applied Plastic Film (Tape)** - On asphalt, apply the tape on the fresh asphalt concrete surface prior to final rolling of the mat. Roll the tape into the fresh surface during the finish rolling of the mat. On concrete, install tape with primer as recommended by the manufacturer.

  Apply Type C - HS, cold applied plastic film that has intermixed reflective elements with factory installed crushed glass or Aggregate on the surface. On asphalt, apply the tape on the fresh asphalt concrete surface prior to final rolling of the mat. Roll the tape into the fresh surface during the finish rolling of the mat. On concrete, install tape with primer as recommended by the manufacturer.

- **Type D: Methyl Methacrylate** - Apply the methyl methacrylate material to the Pavement by a gravity and extrusion method, to the full width shown, in a single application. Pavement markings shall be 90 mils to 120 mils in thickness, exclusive of projecting surface-applied reflective elements, with a continuous and uniform cross-sectional configuration, and with the upper surface slightly arched. Provide intermixed reflective elements.

Separately apply reflective elements to the material as it is placed at a sufficient rate to obtain an initial reflectivity reading of 250 mcd/m^2/lx. Locate the dispenser behind the pavement marking extrusion die and uniformly distribute the reflective elements over the entire width of the methyl methacrylate material.

00867.75 Manufacturer Warranty - Furnish a manufacturer warranty that unconditionally warrants to the Agency the product(s) and installation under this Section against failure, according to this Subsection and 00170.85(c)(1). Use Agency-supplied warranty forms, available from the Engineer.

"Unconditionally warrant" means that the warranty covers all failures, regardless of the source or cause of the failure, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of materials.

The Agency inspection of any portion of the Work during the Contract and during the product installation, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the obligations under this warranty.

(a) Warranty Period - The warranty shall be for 18 months.

(b) Failure - For purposes of this warranty, failure is defined as one or more of the following:

- **Loss of Retroreflectivity** - Markings fail to maintain a retroreflectivity of 100 mcd/m^2/lx.
- **Insufficient Color Stability** - White markings fail to meet the requirements of ASTM D6628.
- **Loss of Adhesion** - Markings show 5 percent or greater loss of marking due to non-adhesion.
- **Skid Resistance** - Type B-HS materials fail to maintain an average skid resistance greater than or equal to 45 British Pendulum Number (BPN) when tested in an equal number of test locations in both wheel path and non-wheel path locations according to ASTM E303.

(c) Remedy - Upon notification by the Engineer of a failure, provide the following remedy at no additional cost to the Agency:

- Repair or replace, at the discretion of the Engineer all failed pavement markings within 6 months of the Agency's request to do so.
- Use materials and procedures meeting the Specifications.

- Match repairs to adjoining Work.
- Coordinate timing of repair Work with the Engineer.

(d) Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure causes or may cause a hazard, the failure may be temporarily corrected by Agency or other forces at no additional cost to the Agency. Replace temporary repairs with permanent repairs at no additional cost to the Agency and according to the Specifications and within the time specified in 00867.75(c).

Measurement

00867.80 Measurement - The quantities of pavement legends will be measured on the unit basis, by actual count.

The quantities of pavement bars will be measured on the area basis, for each stop bar and crosswalk bar.

Payment

00867.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Pavement Legend, Type ____: Arrows	Each
(b)	Pavement Legend, Type ____: "ONLY"	Each
(c)	Pavement Legend, Type ____: "SCHOOL"	Each
(d)	Pavement Legend, Type ____: "SCHOOL" Large	Each
(e)	Pavement Legend, Type ____: "CROSSING" Large	Each
(f)	Pavement Legend, Type ____: "X-ING"	Each
(g)	Pavement Legend, Type ____: "BUS"	Each
(h)	Pavement Legend, Type ____: Railroad Crossing	Each
(i)	Pavement Legend, Type ____: Railroad Crossing, Narrow	Each
(j)	Pavement Legend, Type B-HS: Railroad Crossing, Bike	Each
(k)	Pavement Legend, Type ____: HOV Diamond	Each
(l)	Pavement Legend, Type ____: Cattle Guard	Each
(m)	Pavement Legend, Type B-HS: Bicycle Lane Stencil	Each
(n)	Pavement Legend, Type ____: Disabled Parking	Each
(o)	Pavement Legend, Type ____: On-Street Parking	Each
(p)	Pavement Legend, Type ____: Yield Line Triangle	Each
(q)	Pavement Legend, Type ____: ____	Each
(r)	Pavement Bar, Type ____	Square Foot
(s)	Pavement Legend, Type ____: Bicycle Yield Line Triangle	Each

In items (a) through (s), the type of pavement marking Materials will be inserted in the first blank.

In item (q), the name of the legend will be inserted in the second blank.

Item (a) includes single or multiple headed arrows as required.

Items (h) and (i) include the R x R symbol, two 24 inch wide white pavement bars placed directly above and directly below the R x R symbol, and one 24 inch wide white stop bar placed prior to the tracks.

Item (j) includes a R x R Symbol and one 12 inch wide white pavement bar placed above the R x R symbol.

Item (m) includes the bike lane stencil and arrow.

Item (n) includes the wheelchair stencil only. The 4 inch wide white lines used to mark the disabled parking space and access aisle will be paid for according to 00860.90.

Item (o) includes the cross style marking or the end marking.

Item (p) includes one 24 by 36 inch triangle used to form the yield line.

Item (r) includes all transverse pavement markings that are defined as a "BAR", including, but not limited to, stop bars, crosswalk bars, chevron bars, transverse median bars, and transverse shoulder bars.

Item (s) includes one 12 by 18 inch triangle used to form the bicycle yield line.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Payment for Work under this Section will be limited to 75 percent of the amount due until the Agency has received the signed warranty.

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PART 00900 - PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS

Section 00905 - Removal and Reinstallation of Existing Signs

Description

00905.00 Scope - This Work consists of one or both of the following:

- Removing existing signs, specific service signs, and tourist-oriented directional signs (TODS) as shown or directed.
- Removing and moving existing signs, specific service signs, and tourist-oriented directional signs (TODS) from their existing locations and reinstalling them at new locations as shown or directed.

Construction

00905.40 General - Do not remove signs from existing supports until new supports are in place, ready to receive the signs. Install the signs on the new supports immediately after removing from existing supports. Provide temporary supports as required. Provide permanent supports according to Sections 00910, 00920, and 00930 as required.

Protect specific service signs (business logos) and TODS from damage, whether the signs are to remain in place or are placed on temporary supports, until reinstalled on permanent supports. Repair or replace damaged signs at no additional cost to the Agency. Liquidated damages will be assessed against the Contractor in the amount of $200 per Day for each sign out of service for more than 5 Calendar Days.

Install rigid, temporary vertical ties to the back of all extruded aluminum panel signs to prevent buckling of the sign panels and/or their legends during removal, moving and reinstallation of the signs. Repair any damage inflicted to the signs or their legends.

Remove to 1 foot below the ground line those installations with concrete or steel footings set in the ground unless indicated otherwise. Fill the resultant hole and finish the surface to correspond with the surrounding area. Do not remove the existing appurtenances until ordered. Dispose of all existing appurtenances removed and not used in reinstallation, according to 00290.20.

Measurement

00905.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00905.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) Remove Existing Signs	Lump Sum
(b) Remove and Reinstall Existing Signs	Lump Sum

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00910 - Wood Sign Posts

Description

00910.00 Scope - This Work consists of furnishing and installing preservative treated wood sign posts at the locations shown or as directed.

Materials

00910.10 Materials - Furnish Douglas fir wood posts meeting the following requirements:

Posts 02110.40
Preservative Treatment of Posts 02190

Construction

00910.40 Post Holes - Excavate post holes to the lines and grades established and to the depth shown or to a depth necessary to achieve the required mounting height, whichever is greater. If necessary, obtain the required depth by blasting. Do not set the post until the location, lines and grades of the holes have been approved. Align the post to a vertical position in the hole and backfill the hole. Backfill with selected general backfill meeting the requirements of 00330.13. Place in layers not greater than 6 inches. Solidly ram and tamp the layers into the excavated area around the post. Dampen during placement if too dry to compact properly. On completion of the Work, replace and finish the surface around the post to match the surrounding surface.

Measurement

00910.80 Measurement - The quantities of wood sign posts will be measured on the volume basis in units of foot board measure (FBM). Post volume will be determined by multiplying the nominal post size by the commercially available length shown on the Standard Drawings. For calculation purposes, post length will be determined by rounding the installed length to the nearest higher commercial length.

The estimated wood post lengths will be indicated on the Plans. Final lengths of wood posts will be determined or verified by the Engineer prior to fabrication.

Payment

00910.90 Payment - The accepted quantities of wood sign posts will be paid for at the Contract unit price, per foot board measure (FBM), for the item "Wood Sign Posts".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for route marker frames, wind bracing, or special sign brackets.

Section 00920 - Sign Support Footings

Description

00920.00 Scope - This Work consists of constructing major and minor sign support footings of the dimensions and design shown and at the locations shown or directed.

Materials

00920.10 Materials - Furnish Materials for constructing sign support footings meeting the following requirements:

Anchor Bolts.....02560.30
Backfill, unless otherwise directed.....00510.10 or 00510.11
Commercial Grade Concrete.....00440
Reinforcement.....02510

Construction

00920.40 Excavation and Backfill - Excavate and backfill footings according to Section 00510.

Finish the surface of backfill to match the existing surface. Where required, reinstall curbs and pavement markings.

00920.41 Concrete - Construct concrete sign foundations according to Section 00440 and the applicable portions of 00540.48(a).

Pour concrete spread footings and concrete shaft footings against undisturbed material or backfill with selected granular backfill material according to 00510.11. Compact to 95 percent maximum density according to 00330.43 or as shown.

During concrete placement, accurately and securely hold in place all anchor bolts or post stubs until the concrete has set.

Remove forms and place subsequent loading according to Table 00540-1.

00920.42 Reinforcement - Fabricate and place steel reinforcement according to Section 00530.

00920.43 Conduit - Fabricate and install conduit according to Sections 00960, 00970, and 00990.

Measurement

00920.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Estimated quantities of concrete for minor sign supports and estimated quantities of excavation, backfill, concrete, reinforcement, and miscellaneous metal for major sign supports will be listed in the Special Provisions. Miscellaneous metal includes anchor rods and associated hardware, templates, and anchor plates.

Payment

00920.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract lump sum amount for the item "Sign Support Footings".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Section 00921 - Major Sign Support Drilled Shafts

Description

00921.00 Scope - This Work consists of excavating and constructing drilled, cast-in-place, reinforced concrete shafts and footings for sign supports according to the Specifications and the Plans.

00921.01 Definitions:

Drilled Shafts - Reinforced concrete sections, cast-in-place against in situ Soil, Rock, or a casing.

Temporary Casing - Casing installed to facilitate drilled shaft construction only and removed during or after concrete placement.

00921.02 Subsurface Investigation - The Soils and Geological Exploration Logs are available for review through the Engineer's office. The data shown for each test boring or test pit applies only to that particular boring or test pit. Subsurface conditions may vary between borings or test pits. Core samples and laboratory test results, if obtained and performed for the Project, are available for review by contacting the Engineer.

The Foundation Data shown in the Plans is a compilation of pertinent information including, but not limited to, the Soils and Geological Exploration Logs.

Materials

00921.10 Materials - Furnish Materials meeting the following requirements:

(a) Reinforcement - Use reinforcement complying with Section 02510.

(b) Concrete - Use Class 4000 drilled shaft concrete according to Section 02001, except as modified in this Section. Water may be added to the concrete mix at the Project Site only if allowed by the approved mix design. Use Commercial Grade Concrete and anchor bolts according to 00920.10 for drilled shaft cap.

00921.13 Steel Casing - Furnish temporary casing meeting the requirements of ASTM A252 or ASTM A36. Use casing of sufficient strength to resist handling, transportation and installation stresses and the external stresses of the subsurface materials. Ensure that the casing is clean and watertight prior to placement in the drilled shaft excavation.

00921.14 Drilling Slurry - Furnish drilling slurry meeting one of the following requirements:

(a) Mineral Slurry - Use mineral slurry meeting the following requirements:

Property	Test	Requirement
Density	Mud Density API * 13B-1, Section 1	64 - 75 lb./cu. ft.
Viscosity	Marsh Funnel and Cup API * 13B-1, Section 2.2	26 - 50 sec./qt.
pH	Glass Electrode, pH Meter, or pH Paper	8 - 11
Sand Content	Sand API * 13B-1, Section 5	4.0 % max.

* American Petroleum Institute

Maintain slurry temperature at 40 °F or more during testing.

(b) Synthetic Slurries - Select synthetic slurries from the QPL. Use synthetic slurries according to the manufacturer's recommendations and the Contractor's quality control plan. The sand content of synthetic slurry shall be less than 2.0 percent (API 13B-1, Section 5) prior to final cleaning and immediately prior to concrete placement.

(c) Water Slurry - Water may be used as slurry when casing is used for the entire length of the drilled shaft. Use of water slurry without full-length casing will only be allowed with the Engineer's approval. Use water slurry meeting the following requirements:

Property	Test	Requirement (Maximum)
Density	Mud Density API * 13B-1, Section 1	70 lb./cu. ft.
Sand Content	Sand API * 13B-1, Section 5	2.0 %

* American Petroleum Institute

Do not use blended slurries.

00921.15 Crosshole Sonic Log Access Tubes - Furnish steel crosshole sonic log (CSL) access tubes meeting the following requirements:

- Steel access tubes shall be at least 1 1/2 inch inside diameter Schedule 40 pipe conforming to ASTM A53, Grade A or B, Type E, F, or S.
- Use access tubes having a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of the source and receiver probes used for the testing. Ensure that access tubes are watertight, free from corrosion with clean internal and external faces to ensure good bonding between the drilled shaft concrete and the access tubes. Fit the access tubes with watertight caps on the top and bottom.
- Access tube acceptance will be based on manufacturer's certification that the furnished material meets the requirements of this specification.

00921.18 Crosshole Sonic Log Cement Grout - Furnish non-epoxy grout or tendon grout from the QPL or furnish a pumpable CSL cement grout consisting of neat cement and water that has a water-cement ratio between 0.38 and 0.45. The portland cement for the pumpable CSL cement grout shall meet the requirements of Section 02010.

00921.19 Quality Control - Maintain and be responsible for quality control of the drilled shaft Work throughout the construction operation. The Engineer will inspect all drilling operations and verify the suitability of all drilled shaft construction procedures. Provide lights, mirrors, weighted tape, weighted probe, personnel, and all assistance required for the Engineer to perform inspection during drilled shaft construction.

Labor

00921.30 Personnel Qualifications - Perform the drilled shaft construction Work using a company and personnel experienced in drilled shaft construction work. Submit a list to the Engineer for approval identifying the on-site supervisors and drill rig operators assigned to the Project and the companies experience relevant to the Project. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, shaft size, depth and any special construction techniques required. Also provide the experience qualifications of the company performing the CSL testing. Before the

preconstruction conference, provide the following information to verify the firm's experience and the qualifications of personnel scheduled to perform the drilled shaft construction and CSL testing:

- Submit a project reference list of at least three separate foundation projects, successfully completed in the last 5 years, with drilled shafts of diameters and depths equal to or larger than those shown in the Plans and in ground conditions similar to those indicated. Include a brief description of each project and the owner's contact person's name and current phone number for each project listed.
- On-site supervisors shall have at least 2 years' experience in supervising construction of drilled shaft foundations of similar diameter and depth and scope to those shown in the Plans and in similar geotechnical conditions to those described in the geotechnical report. Experience shall include the direct supervisory responsibility for the on-site construction operations.
- Drill operators shall have at least 1 year experience in the construction of drilled shaft foundations.
- Perform CSL testing using an independent testing organization retained by the Contractor and approved by the Agency. Furnish personnel experienced in operating the CSL testing Equipment. Submit the CSL testing firm qualifications according to 00921.40(a). The CSL testing firm shall have successfully performed CSL testing on a minimum of five projects during the last 3 years. CSL testing personnel shall be trained in the operation of the CSL Equipment and have at least 1 year of experience in operating CSL testing equipment on a minimum of 10 shafts.

The Engineer will respond within 21 Calendar Days after receipt of the submittal. Do not begin Work on any drilled shafts until the qualifications have been approved. The Engineer may suspend the drilled shaft construction if the Contractor substitutes unapproved personnel during construction. Submit requests for substitution of either on-site supervisors, drill operators, or CSL testing personnel to the Engineer, who will have 7 Calendar Days to respond to each request. Additional costs resulting from the suspension of Work due to the changing of personnel is the Contractor's responsibility, and no adjustment in Contract Time resulting from the suspension of Work will be allowed.

Construction

00921.40 Submittals - Provide the following submittals to the Agency for review and approval:

(a) Drilled Shaft Installation Plan - At least 21 Calendar Days before beginning shaft construction, submit the following:

- The sequence of drilled shaft construction as it relates to the overall construction plan.
- A review of Equipment suitability based on the Contractor's understanding of the site subsurface conditions. Include a project history of the drilling Equipment that demonstrates the successful use of the Equipment for drilled shafts of equal or greater size in similar subsurface conditions.
- Details of shaft excavation methods, including proposed drilling methods and a disposal plan for excavated material. Include details of methods used to perform final cleaning of the excavation. Include a disposal plan for any water or contaminated concrete expelled from the top of the shaft if applicable.
- Details of the proposed methods for ensuring drilled shaft stability during excavation and concrete placement.
- Details for the use of drilling slurry including mix design, slurry head requirements, mixing methods, maintaining, and disposing of the slurry if applicable. Include a discussion of the suitability of the proposed drilling slurry in relation to the anticipated subsurface conditions.

- A plan for quality control of all drilling slurries, if their use is proposed. In the quality control plan, include property requirements, required tests and test methods to ensure the slurry performs as intended. Submit to the Engineer the name and current phone number of synthetic slurry manufacturer's representatives who will provide technical assistance during construction. Provide the names of the Contractor's personnel assigned to the Project and trained by the synthetic slurry manufacturer in the proper use of synthetics slurries.
- Unstamped reinforcing steel shop drawings and details of reinforcement placement, including bracing, splicing, centering, lifting methods, and the method for supporting the reinforcement according to 00150.35. Include details on the type, number, and placement of spacers and other devices for ensuring the reinforcing cage position is maintained during construction. Include details for attaching the CSL test access tubes to the reinforcing cage if applicable.
- Evidence that the proposed materials and concrete mix design conform to all applicable Specifications.
- Documentation that assures that the concrete mix design will maintain the required slump retention properties specified in Section 02001.
- If the concrete mix design allows the addition of water at the Project Site, documentation that specifies the amount of water that may be added and allowable methods for adding the water.
- Details of concrete placement, including proposed operational procedures for pumping and tremie methods. Include details for grout placement in the crosshole sonic logging test access tubes after testing is completed if applicable.
- Detailed procedures for temporary casing installation and removal. Include casing diameters, dimensions, and depths and the methods and Equipment for casing installation and removal.
- CSL testing company performing the CSL testing Work, including documentation demonstrating that the company, and company personnel, meets the required qualifications.
- Confinement methods required to contain drilling fluids, spoils, waste concrete and other products from contacting sensitive environmental areas according to Section 00290 and all applicable regulatory permits.
- Methods for protecting existing Structures according to 00170.82.

The Engineer will approve or reject the drilled shaft installation plan within 21 Calendar Days after receipt of all submissions. Provide any additional information and submit a revised plan, if requested, for review and approval. All procedural approvals given by the Engineer will be subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete the Work. Submit requests for modification of adopted procedures to the Engineer. Allow 21 Calendar Days for approval of modifications. Do not begin drilled shaft construction Work until all drilled shaft submittals have been approved.

(b) Drilled Shaft Repair Plans - For any shaft determined to be unacceptable, submit a repair plan to the Engineer for approval. Furnish all materials and Work, including engineering analysis and design, needed to correct unacceptable drilled shafts, at no additional cost to the Agency. Do not begin repair operations before remedial procedures or designs are approved. Any modifications to the dimensions or material of the drilled shafts shown on the Plans that are proposed in the repair plan will require stamped calculations and Working Drawings according to 00150.35.

(c) Drilled Shaft Inspection Reports - Provide the Engineer with a completed Drilled Shaft Inspection Report for each drilled shaft, detailing the actual location, alignment, elevations, dimensions, and quantities of the shafts.

Submit the report within 21 Calendar Days after the completion and acceptance of each shaft. A "Drilled Shaft Inspection Report" form is available from the Engineer.

(d) Concrete Placement Logs and Volume Curves - Measure and record all concrete placed into drilled shafts using standard ODOT forms designated for this purpose or other forms approved by the Engineer. Provide the Engineer with a completed Drilled Shaft Concrete Placement Log and Concrete Volume Curve Form for each drilled shaft within 24 hours after completion of shaft concrete placement.

00921.41 Drill Shaft Coordination Meeting - Hold a drilled shaft coordination meeting at least 7 Calendar Days before beginning any shaft construction Work at the site to discuss construction procedures, schedules, staging, personnel, Equipment to be used, and other elements of the approved shaft installation plan as specified in 00921.40. If synthetic slurry is used to construct the shafts, the frequency of scheduled site visits to the Project Site by the synthetic slurry manufacturer's representative will be discussed. Those attending the meeting include:

- **Representing the Contractor** - The superintendent, on-site supervisors, and all supervisors in charge of excavating the shaft, placing the casing, mixing and installing slurry as applicable, placing the steel reinforcing bars, and placing the concrete. If synthetic slurry is used to construct the shafts, the slurry manufacturer's representative and a Contractor's employee trained in the use of the synthetic slurry shall also attend.

- **Representing the Contracting Agency** - The Project Engineer, key inspection personnel, and designers of record or their appointed representatives.

If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved shaft installation plan, hold an additional meeting before any additional shaft construction operations are performed.

00921.42 Construction Tolerances - Excavate drilled shafts as accurately as possible at the locations shown and within the specified tolerances listed below. Determine the drilled shaft dimensions and alignment with approved methods. The following construction tolerances apply to drilled shafts unless otherwise stated:

- **Horizontal Position (At the Plan Elevation of the Top of Shaft)** - 3 inch horizontal tolerance from the location shown.

- **Top Elevation of Shaft Concrete** - Plus 3 minus 0 inches from the plan top of shaft elevation.

- **Vertical Alignment in Soil** - May not vary from the plan alignment by more than 1.5 percent of the shaft length.

- **Vertical Alignment in Rock** - May not vary from the plan alignment by more than 2 percent of the shaft length.

- **Top of Steel Reinforcement** - Plus 3 minus 0 inches from the plan top of steel reinforcement elevation. Maintain 3 inch of cover.

Frequently check the plumbness, alignment, and dimensions of the shaft during construction. Correct all out-of-tolerance shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and Work necessary to complete corrections for out-of-tolerance drilled shafts will be at the Contractor's expense, and no extension of the Project completion date will be granted. Materials and Work necessary to complete corrections for out-of-tolerance drilled shafts resulting from the removal of unexpected drilled shaft obstructions will be paid for according to 00195.20.

00921.43 Drilled Shaft Excavation - Perform drilled shaft excavation according to the following:

(a) General - Excavate drilled shafts to the dimensions and elevations shown or as directed. Provide and maintain stabilized drilled shaft sidewalls and bottoms for the full depth of the excavation, using approved materials, Equipment and methods. If caving or other unstable conditions occur during any construction procedure, stop further construction, notify the Engineer, and stabilize the shaft excavation by approved methods and submit a revised installation plan which addresses the problem and prevents further instability. Do not continue with shaft construction until any damage which occurred has been repaired according to the Specifications and until receiving the Engineer's approval of the revised shaft installation plan.

If the Engineer has reason to believe that the drilled shaft excavation techniques or workmanship have been deficient, so that the integrity of any excavation is in question, Work on that drilled shaft may be stopped. Drilled shaft excavation will not be allowed to resume until the deficient excavation techniques or workmanship have been changed to the Engineer's satisfaction.

Dispose of materials removed from the shaft excavations according to 00290.20.

Do not leave partially completed shaft excavations open overnight unless they are cased full depth or otherwise stabilized with approved methods. If approved by the Engineer, a partially excavated shaft may be left open overnight, provided that the excavation:

- Is stabilized at the bottom, sides and surface to prevent Soil caving or swelling or a reduction of Soil strength, and
- Is covered at the surface to protect the public.

Extend the drilled shaft excavation if the Engineer determines that the subsurface materials encountered are not capable of providing the required bearing resistance or differ from those anticipated in the design of the drilled shafts.

(b) Protection of Existing Structures - Control shaft construction operations to prevent damage to existing Structures and utilities. Preventive measures include, but are not limited to, selecting construction methods and procedures that will prevent caving of the shaft excavation and monitoring and controlling the vibrations from construction activities such as the driving and vibrating of casing or sheeting, drilling of the shaft, or from blasting, if blasting is allowed. Repair all damage caused to existing Structures, utilities or other facilities, resulting from drilled shaft construction activities, at no additional cost to the Agency.

(c) Temporary Casing - Provide temporary casing according to the approved installation plan and of sufficient quantities to meet the needs of the anticipated construction method.

(d) Unexpected Drilled Shaft Obstructions - Remove any natural or manmade object encountered that was not revealed by the Agency's site investigation, and that would cause a significant decrease in the rate of advancement if removed using the techniques and Equipment used successfully to excavate the shaft. The Engineer will be the sole judge of the significance of any reduced rate of shaft advancement and the classification of any unexpected obstructions. Removal of unexpected obstructions from the shaft excavation will be paid according to 00195.20.

(e) Lost Tools - Promptly remove drilling tools lost in the excavation. Lost tools will not be considered unexpected obstructions and shall be removed without additional compensation. Drilling tools lost during the course of removing unexpected drilled shaft obstructions will be paid according to 00195.20.

(f) Drilling Slurry Installation - If synthetic drilling slurry is selected, provide a manufacturer's representative to provide technical assistance at the site prior to use of the slurry, who shall remain

at the site during construction and completion of a minimum of one drilled shaft to adjust the slurry mix for the specific site subsurface conditions. After the manufacturer's representative is no longer at the site, provide the approved personnel trained in the use of the synthetic slurry for the remainder of the shaft slurry operations to supervise the proper slurry mix design and quality control procedures.

All in-hole drilling slurry shall meet the required slurry Specifications during excavation and prior to concrete placement. Clean, recirculate, de-sand or replace the slurry to maintain the required slurry properties.

Unless otherwise approved, maintain the level of slurry in the excavation at not less than 5 feet above the groundwater level for mineral slurries or 10 feet above the groundwater level for synthetic or water slurries. Maintain the slurry level a sufficient distance above all unstable zones to prevent bottom heave, caving or sloughing.

Maintain the required slurry properties and levels at all times during shaft construction, including work stoppages, unless other approved stabilization methods are applied.

Feed slurry continuously into the shaft excavation as drilling progresses so that a stable excavation is maintained. Use a self-priming pump to reclaim the slurry. Keep a standby pump available during the drilling operation.

(g) Drilling Slurry Inspection and Testing - Mix and thoroughly hydrate all drilling slurries in an appropriate storage facility. Collect sample sets from the storage facility and perform tests to ensure the slurry conforms to the specified material properties before introduction into the drilled shaft excavation. A sample set shall be composed of samples taken at mid-depth and within 24 inches of the bottom of the storage facility.

Sample and test all slurry in the presence of the Engineer, unless otherwise directed. The sample sets of slurry within the excavation shall consist of samples taken at mid-depth of the excavation and within 24 inches of the bottom of the excavation. Collect and test sample sets during the drilling operation as necessary to ensure the specified properties of the slurry are maintained. Clean, recirculate, de-sand, or replace the slurry as necessary to maintain the specified slurry properties. Final cleaning of the excavation and placement of concrete will not be allowed until the test results indicate the slurry properties are as specified.

Perform a minimum of two sets of slurry tests per 8-hour work shift, the first test being done at the beginning of the shift. Field conditions may require more frequent testing to ensure acceptable slurry properties.

Make copies of all slurry test results available to the Engineer on request.

(h) Clean Out - Use appropriate means, such as a cleanout bucket, pump or air lift, to clean the bottom of the drilled shaft excavations. No more than 1 inch of loose or disturbed material will be allowed at the bottom of the excavation.

Notify the Engineer of completion of each drilled shaft excavation to permit inspection before proceeding with construction. Measure final shaft depths with a suitable weighted tape or other approved method after final cleaning to determine that the shaft bottom meets the requirements in the Contract. Do not proceed with shaft construction until the bottom cleanliness requirements have been met and the bottom (shaft tip) elevation is approved.

00921.45 Reinforcing Steel - Furnish and place reinforcing steel as shown and according to the following:

(a) Placement - Do not place reinforcing steel in the shaft excavation until the Engineer has approved the final elevation of the bottom of the shaft.

In each shaft, place reinforcing steel to the top elevation shown. Support the reinforcing cage to prevent distortion or settlement during concrete placement. Support the reinforcing cage such that the supporting mechanism does not obstruct the center of the shaft and allows concrete placement vertically down the center of the shaft. If concrete placement does not immediately follow cage placement, remove the reinforcing cage from the excavation and rectify the integrity of the excavation prior to reinstallation of the cage.

(b) Bracing - Rigidly brace the reinforcing cage to retain its shape for lifting. Lift the cage in a manner that does not cause permanent racking or distortion. Show bracing and any extra reinforcing steel required for fabrication of the cage on the submitted shop drawings. Remove cross bracing during cage placement unless otherwise approved.

(c) Splicing - Splice all drilled shaft reinforcement using approved mechanical splicer's unless otherwise shown or approved.

(d) Concrete Cover - Maintain the required concrete cover shown by placing concentric spacer bars or other approved devices around the reinforcing cage. Place spacing devices on minimum 10 foot vertical spacings the full length of the shaft. At each 10 foot level, place spacers on a minimum 30 inch circumferential spacing with at least three spaces per level. Do not use wood spacers or concrete dobies. Provide details of the proposed centering method on the shop drawings submitted according to 00921.40.

00921.46 Crosshole Sonic Log Test Access Tubes - Furnish and install access tubes for CSL testing as shown. Attach CSL access tubes securely to the interior of the reinforcement cage as near to parallel as possible in each drilled shaft and in the pattern shown. Extend the access tubes from the bottom of the reinforcement cage to at least 24 inches above the top of the shaft. Joints required to achieve full-length access tubes shall be watertight. Do not damage the access tubes during reinforcement cage installation and concrete placement. Fill the tubes with potable water, according to 02020.10(b), as soon as possible, but no more than 1 hour after concrete placement and reinstall the top watertight caps. Check water level and top off as needed.

Replace all access tubes that the test probe cannot pass through to the full depth of the shaft at no additional cost to the Agency. Replace all damaged access tubes with 1.5 to 2.0 inch diameter holes cored through the concrete for the entire length of the shaft. Unless otherwise directed, locate replacement core holes approximately 6 inches inside the reinforcement. Do not damage the shaft reinforcement during coring operations.

Fill the access tubes with grout only after all CSL testing has been completed and the shaft has been accepted.

00921.47 Concrete - Furnish and place concrete according to the following:

(a) Concrete Placement - Place concrete immediately after completion of the shaft excavation and with the approval of the Engineer. Prior to concrete placement, ensure the shaft clean-out requirements are met according to 00921.43(h) and the properties of the slurry, if used, conform to the Specifications. Shaft concrete may be placed without mechanical vibration in those areas of the drilled shaft that are not formed or are below the ground line or the water surface.

Place concrete continuously until concrete at the top of the shaft is free of water, Soil, and debris, and uncontaminated concrete extends to the plan top-of-shaft elevation. Dispose of all contaminated concrete expelled from the top of the shaft in an approved manner. Remove waste concrete from the site. If a delay in concrete placement occurs because of a delay in concrete delivery or other factors, reduce the placement rate to maintain a flow of fresh concrete into the shaft excavation.

Allow a maximum of 60 minutes between concrete placements and use no concrete older than 90 minutes from batch time. Use procedures for concrete placement which ensure that the concrete within the shaft becomes a monolithic, homogeneous unit.

Place concrete using hoses or pipes having watertight joints. For concrete placement by gravity tremie, use hose or pipe having an inside diameter of at least 8 inches. For placement by concrete pump, use hose with inside diameter of at least 4 inches. Provide an alternate delivery system that can be used in case of failure of the primary delivery system. Place concrete only against the bottom of the drilled shaft or into fresh concrete.

If caving occurs during concrete placement, the shaft may be rejected.

(b) Dry Shaft Concrete Placement - Concrete may be placed by free-fall if all of the following conditions are met:

- No more than 3 inches of water is present in the bottom of the excavation at the beginning of the pour.
- Groundwater seepage into the excavation is at a rate of no more than 12 inches per hour.
- Shaft diameter is greater than or equal to 3 feet.

Under free-fall placement, deposit concrete through the center of the reinforcement cage by a method which prevents segregation of Aggregates and splashing of concrete on the reinforcement cage. Place concrete so that the free-fall is vertical down the center of the shaft without hitting the sides, the steel reinforcing bars or steel cage bracing.

(c) Wet Shaft Concrete Placement - If the drilled shaft excavation does not meet the requirements for dry concrete placement, stabilize water inflow and place the concrete under water or slurry with a tremie pipe or pump hose according to 00540.48(e). Place concrete continuously from the bottom of the shaft to the top-of-shaft elevation shown. Use a plug in the tremie pipe or pump hose to force water or slurry ahead of the advancing flow of fresh concrete. Dispose of all displaced water, slurry, or waste concrete according to 00290.20. When groundwater, the drilling water or slurry in the shaft excavation is to be removed by pumping during concrete placement, have a standby pump available.

Place concrete in a continuous operation so that the concrete always flows upward within the shaft. Withdraw the delivery hose or pipe slowly as the elevation of the fresh concrete rises in the shaft. Keep the discharge end of the pipe or hose at least 5 feet below the surface of the concrete after the concrete has reached a depth of 5 feet. Maintain sufficient concrete inside the hose or pipe to prevent drilling fluid from entering. During concrete placement, provide and maintain markings on the tremie pipe or pump hose, or a sounding device or other appropriate method to determine the relative elevations of the fresh concrete surface and the bottom end of the pipe or hose. Raise the bottom end of the pipe or hose only when the pipe or hose has a sufficient head of fresh concrete to prevent the formation of a void at the bottom.

(d) Concrete Curing and Cleaning - Allow the exposed top of concrete to cure a minimum of 7 Calendar Days by covering with wet burlap overlain with plastic sheets or by keeping top of concrete under water. Keep the burlap wet during the concrete cure.

Prior to placing any fresh concrete on top of a completed shaft, clean the upper surface of the concrete by removing all scum, laitance, loose gravel, and sediment and chip off any high spots on the upper surface that would prevent the steel reinforcing bar cage from being properly placed in the position shown on the Plans. Remove all loose material and poor quality concrete at the top of the shaft down to sound concrete prior to performing any required CSL testing.

(e) Casing Removal - Remove all temporary casing during or after completion of concrete placement. Do not start temporary casing removal until the level of fresh concrete within the casing has reached a depth of at least 10 feet or the level necessary to adequately counteract the external hydrostatic pressure head. As the temporary casing is withdrawn, maintain a minimum 5 feet head of concrete above the bottom of the casing. A slight downward movement of the casing while exerting downward pressure, or hammering or vibrating the casing will be allowed to facilitate extraction. Extract the casing so that concrete is cast directly against the surrounding in-situ material. Check the elevation of the top of the reinforcing cage before and after temporary casing extraction for conformance with the construction tolerance criteria of 00921.42. Casing that cannot be extracted during, or immediately after, the concrete placement operation may be cause for rejection of the shaft.

(f) Drilled Shaft Cap - Install drilled shaft cap according to 00920.40 and 00920.41.

00921.48 Drilled Shaft Testing and Acceptance - Acceptance of drilled shafts will be based on the Engineer's review of the results of CSL, or other, integrity testing if conducted, field inspection reports and visual observations during drilled shaft construction. The Engineer has final authority on the approval of drilled shafts. For shafts that are integrity tested, the Engineer will determine final acceptance of each tested shaft, based on the integrity test results and inspection reports and will provide a response to the Contractor within 5 Calendar Days after receiving the CSL test report.

(a) Crosshole Sonic Log Testing - Provide crosshole sonic log testing Equipment and perform crosshole sonic log testing and analysis on the first drilled shaft completed at each foundation and subsequent shafts as specified or designated for testing by the Engineer. Provide CSL testing Equipment conforming to the requirements of ASTM D6760 and approved by the Engineer. Provide all necessary access and other support to the CSL testing firm necessary to do the CSL testing Work.

Perform one CSL test on each shaft designated for testing. A single CSL test consists of all ultrasonic profile combinations in a given shaft. Test completed drilled shaft foundations using Ultrasonic Crosshole Testing methods ((CSL) Testing) according to ASTM D6760. Inform the Engineer of scheduled CSL testing at least 3 Calendar Days prior to the testing. Perform all CSL testing using the Contractor's CSL technician in the presence of the Engineer.

Allow at least 3 Calendar Days of curing time before testing unless otherwise approved. Additional curing time beyond 3 Calendar Days may be required if the shaft concrete contains admixtures such as set retarding admixture or water reducing admixture. Additional CSL testing required due to the CSL testing being conducted on concrete that has not cured sufficiently is at no additional cost to the Agency. Additional curing time required due to concrete admixtures will not be grounds for additional compensation or time extensions.

(b) Contractor's Crosshole Sonic Log Test Reports - Provide a brief summary report of the data, with interpretation of the test results, to the Engineer at the completion of each test. Provide copies, either hardcopies or electronic files, of the raw test data as requested. Mark the test data files to identify, as a minimum, the Structure, bent and shaft number, the date of CSL testing, depths of testing and any other pertinent information.

Submit three copies of a final CSL Test Report for each shaft tested according to ASTM D6760. Provide electronic file copies of the raw CSL data measurements compatible with the Cross Hole Ultrasonic Monitor (CHUM) program, if requested. The report shall summarize the CSL testing performed, data analysis, and interpretation of CSL data with special attention made to the identification and location of any anomalies or possible defects. Provide interpretation of the CSL test data in terms of overall shaft integrity and acceptance. Submit all reports to the Engineer within 5 Calendar Days of the performance of the tests.

(c) Additional Testing and Investigation - Conduct additional testing or investigation necessary to identify the location, extent and condition of possible shaft defects if requested by the Engineer. Additional testing and investigation may include, but is not limited to, additional CSL testing, excavation Work or core drilling.

If requested by the Engineer, drill a core hole in any questionable quality shaft to explore the shaft condition. The number, location and depths of the core holes will be determined by the Engineer. Submit the method and Equipment used to drill and remove cores from the shaft to the Engineer for review and approval prior to drilling. Use a coring method that provides complete core recovery and minimizes abrasion and erosion of the core. If a defect is confirmed, as determined by the Engineer, all investigation costs associated with identifying the defect will be at no additional cost to the Agency and no extension of the Project completion date will be granted, regardless of whether the identified defect is repaired or not.

If no defect is identified in the investigation Work, and the CSL tubes were satisfactorily installed according to ASTM D6760 and accepted, the Agency will pay for all coring and excavation costs associated with the additional investigation and grant an appropriate time extension, if required, according to Section 00190 and Section 00195. If it is determined by the Engineer that the CSL tubes were not installed properly thus invalidating the CSL test results, all coring, excavation, and other investigation and evaluation costs will be at no additional cost to the Agency and no extension of the Project completion date will be granted.

Fill all core holes with grout only after the evaluation process is completed and the shaft is accepted and approved.

(d) Drilled Shaft Repair - Repair all defects and rejected shafts according to 00921.40(b). Perform additional CSL testing, or other investigation required, as directed by the Engineer, to confirm the quality of the completed shaft repair Work at no additional cost to the Agency with no time extension granted.

For temporary casing not extracted from the shaft excavation, submit a repair plan or a structural evaluation to the Engineer for approval according to 00921.40. If caving occurs during concrete placement submit a repair plan to the Engineer for approval.

00921.49 Scheduling and Restrictions - Unless otherwise approved, do not proceed with construction of subsequent shafts until the CSL testing has been completed on the first drilled shaft and the results have been approved and accepted, in writing by the Engineer. Approval to proceed with the construction of subsequent shafts, before receiving approval of the first shaft will be based on the Engineer's observations of the Contractor's workmanship during construction of the first shaft and the Engineer's review and assessment of the following:

- The Contractor's conformance with the approved shaft installation plan.
- The Contractor's daily reports and Inspector's daily logs of excavation, rebar, and concrete placement.
- The concrete placement logs and volume curves.

Written notification will be provided to the Contractor on whether or not to proceed with subsequent shaft construction within 24 hours after completion of the first shaft. If the Engineer determines the first shaft to be of questionable quality, discontinue all shaft construction until the CSL test results of the first shaft are received and reviewed and the shaft accepted, in writing, by the Engineer.

Denial of permission to proceed with subsequent shaft construction will not be cause for Contract Time extension.

Do not proceed with the third drilled shaft until the final CSL test results from the first drilled shaft has been received and reviewed and the shaft accepted, in writing, by the Engineer.

After the first drilled shaft on the Project has been accepted, make no significant changes in construction methods, Equipment, or materials used to construct subsequent shafts, unless otherwise approved.

Measurement

00921.80 Measurement - The quantities of Work performed under this Section will be measured on the length basis, by the vertical excavated length from the bottom of the shaft to the top of the sign support footing. If directed to construct drilled shafts below the elevations shown, the drilled shaft will be measured from the revised bottom of shaft.

The estimated quantities of materials for the sign support drilled shaft foundations will be listed in the Special Provisions.

Payment

00921.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per foot for the item "____ Inch Diameter Sign Support Drilled Shaft Foundation".

The diameter of the drilled shaft will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified. Work completed according to Section 00920 shall be incidental to this Section.

No separate or additional payment will be made for:

- furnishing drilling Equipment
- temporary casings
- drilled shaft excavation
- drilled shaft concrete
- drilled shaft reinforcement
- CSL Equipment mobilization
- CSL test access tubes
- CSL tests

Section 00930 - Metal Sign Supports

Description

00930.00 Scope - This Work consists of furnishing, fabricating, galvanizing, and erecting metal sign supports.

00930.01 Definitions and Terms:

Multi-Post Breakaway Sign Supports - The complete Structure is composed of post stubs, base plates, posts, hinges, sign support members, and fasteners, but does not include the sign support footings.

Triangular Base Breakaway Sign Supports, Pipe Breakaway Sign Supports, and Perforated Steel Square Tube Slip Base Sign Supports - The complete Structure is composed of post stub, base plates, metal post, sign support members, and fasteners, but does not include the sign support footings.

90 Degree Rotational Sign Supports - The complete Structure is composed of post stubs, base plates, posts, rotator connection, sign support members, and fastenings, but does not include the sign support footings.

Pipe Sign Supports and Perforated Steel Square Tube Anchor Sign Supports - The complete Structure is composed of metal post, sign support members and fasteners, but does not include the sign support footings.

Truss Sign Bridges, Monotube Sign Bridges, Butterfly Sign Structures and Monotube Cantilever Sign Structures - The complete Structure is composed of base plates, support columns, cantilever arms, trusses, horizontal beam, sign support arms, supporting brackets, fasteners, and maintenance walkways, but does not include the sign illumination Equipment and sign support footings.

Bridge Structure Mounts - The W-shapes or special detailed attachments used for mounting signs to Bridge Structures and maintenance walkways, and includes all necessary support brackets, arms, and fasteners, but does not include sign illumination Equipment.

Exit Number Sign Mounts - The S-shape, spacers, special mounting brackets, and fasteners, necessary to install the exit number signs.

Signal Pole Mounts - The complete support including horizontal and vertical arms, supporting brackets, and fasteners.

Adjustable Sign Mounts - The complete support is adjustable horizontally and vertically to facilitate signal pole mast arm and pole mounting of flat sign sheets. The bracket consists of cast aluminum and galvanized steel elements, stainless steel straps, and fasteners.

Vertical Sign Mounts on Existing Structures - The additional or replacement vertical members and fasteners necessary to install a new sign onto an existing major sign support.

Secondary Sign Mounts - This group includes tubes, S-shapes, channels, plates, and fasteners necessary to install secondary signs.

Major Sign Supports - This group includes Truss Sign Bridges, Monotube Sign Bridges, Butterfly Sign Structures, and Monotube Cantilever Sign Structures.

Minor Sign Supports - This group includes Multi-Post Breakaway Sign Supports, Triangular Base Breakaway Sign Supports, Pipe Breakaway Sign Supports, Perforates Steel Square Tube Slip Base Sign Supports, 90 Degree Rotational Sign Supports, Pipe Sign Supports, and Perforated Steel Square Tube Anchor Sign Supports.

Mast Arm Street Name Sign Mounts - This group includes the frame members, attachment channel or bracket, steel bands or cables, and fasteners necessary to install a street name sign on a signal mast arm.

00930.02 Working Drawings - Submit six copies of unstamped Working Drawings according to 00150.35 for all structural metal Work. Submit six copies of stamped designs, details, Plans, and calculations according to 00150.35 for all engineered details and drawings that are not prepared by the Agency but are required by the Contract Documents and Specifications for the Project prior to fabrication. Include the Field Verification of Post Lengths form for Major Sign Supports, available from the Engineer. Material ordered or Work done before the Engineer finishes and returns the documents will be at the Contractor's risk.

In addition to the Working Drawings, submit six copies of all available data including manufacturer's pamphlets and brochures, technical bulletins, Working Drawings and other technical information relative to products used on the Project. After installation, submit corrected Working Drawings that represent the material as installed and in operation. Include sufficient information to enable the Agency's maintenance forces to replace all or part of the commercially manufactured sign Structures, under routine or emergency maintenance, by direct reference to the information furnished by the Contractor.

Working drawings are not required for the following types of steel supports:

- Multi-Post Breakaway Sign Supports
- Triangular Base Breakaway Sign Supports
- Signal Pole Mounts
- Exit Number Sign Mounts
- Secondary Sign Supports
- Route Marker Frames

Working drawings for these supports will be provided by the Agency's Engineer of Record. Use the Field Verification of Post Lengths form, available from the Engineer, to provide the necessary site data to the Engineer of Record for use in producing Working Drawings. All Work done, or materials ordered, before receiving Working Drawings from the Engineer of Record will be at no additional cost to the Agency.

00930.09 Identifying Tags - Overhead and butterfly sign support Structures, except structure mounts, shall have stainless steel or brass identifying tags attached to all posts, arms, and truss sections. The tags shall be at least 1/16 inch thick. Tag lettering shall be at least 1/4 inch in height, and shall be stamped into the tag. Tags shall be attached with stainless steel pop rivets of at least 3/16 inch nominal body diameter. Do not locate pop rivet holes within 6 inches of welds. Post tag shall be located approximately 5 feet above the baseplate. Holes for pop rivets shall be drilled prior to hot-dip galvanizing. Remove excess hot-dip galvanizing from holes and repair according to ASTM A780.

Tags shall include the following information:

- Structure number
- Manufacturer

- Month and year of manufacture
- Highway number and mile point

Materials

00930.10 Materials - Furnish perforated steel square tube slip base sign supports and perforated steel square tube anchor sign supports from the QPL. Furnish other structural steel materials meeting the applicable portions of Section 02530, with weights and sizes as shown or specified.

Furnish galvanized bolts, nuts, hardened washers, and direct tension indicators meeting the requirements of Section 02560, except the rotational capacity test of 02560.60(a) does not need to be repeated at the Project Site for Minor Sign Supports.

Except for perforated steel square tube slip base sign supports and for perforated steel square tube anchor sign supports, galvanizing shall conform to the requirements of Section 02530. Galvanize perforated steel square tube slip base sign supports and perforated steel square tube anchor sign supports according to ASTM A653 G90, zinc coat corner seam weld after scarfing, apply a conversion coating, and apply a final clear polymer coating.

Labor

00930.30 Fabricators - Fabricators of metal sign supports shall have either a current AISC Simple Steel Bridge Structures (Sbr) certification or a current AISC Major Steel Bridges (Cbr) certification.

Construction

00930.40 Fabrication and Erection - Fabricate and erect according to the applicable portions of Section 00560, except where in conflict with the following:

(a) General - Erect breakaway sign posts, pipe sign posts and pipe support columns at a true vertical.

Where two or more posts are required to support a sign, orient and position both posts so that no twist or warp will be imparted to the sign panels.

(b) Assembly of Metal - Accurately assemble the parts as shown on the Plans and follow any match marks. Handle the material carefully so that no parts will be bent, broken or otherwise damaged. Clean bearing surfaces and surfaces to be in permanent contact before the members are assembled. Roughen faying surfaces of slip-critical structural connections utilizing high strength bolts by means of hand wire brushing after galvanizing. Power wire brushing is not allowed.

Faying surfaces of plates shall be flat to within a tolerance of 1/32 inch in 12 inches and a tolerance of 1/16 inch overall. Base plates with leveling nuts shall be flat to within a tolerance of 1/8 inch in 12 inches and a tolerance of 3/16 inch overall.

(c) Welding - Weld steel sign Structures according to AWS D1.1 with the following exceptions:

- AWS D1.1, Clause 3 prequalified welds for complete joint penetration (CJP) are not allowed.
- Qualify CJP welds according to AWS D1.1, Clause 4. Perform V-notch (CVN) testing at 70 °F meeting the requirements of the absorbed energy values of Table 4.14.

The fabricator shall inspect welds according to the details and requirements called out on the Contract Documents. This requirement will override all appropriate weld inspection requirements

called out in Section 5.15 WELDED CONNECTIONS in AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. Submit all Procedure Qualification Records, Welding Procedure Specifications, and testing procedures for Engineer's review prior to starting manufacturing. Submit certified copies of inspection reports to the Engineer for review.

If requested by the Engineer, additional weld inspection may be required upon arrival of the material at the Project Site. If defects are found by this additional inspection, the Contractor shall be responsible for the additional testing and repair costs. If no defects are found, the Engineer will be responsible for the additional inspection costs.

(d) Bolt Installation - Do not reuse galvanized high strength bolts. Other high strength bolts may be reused, if approved, but not more than once. Retightening previously tightened bolts that may have been loosened by the tightening of adjacent bolts will not be considered a reuse.

Provide all high strength bolts with hardened washers under the element (nut or bolt head) turned in tightening. If a high strength bolt is installed in an oversized or short slotted hole in an outer ply, use a hardened washer. If a high strength bolt is installed in a long slotted hole in an outer ply, use a plate washer or a continuous bar made of structural grade steel at least 5/16 inch thick with standard holes. Make the washer or bar sufficiently large to completely cover the slot after installation.

Protect fasteners from dirt and moisture at the Project Site. Do not remove the lubricant that is present in as-delivered condition. Clean and relubricate fasteners that accumulate dirt according to 02560.70.

(1) Bolt Installation for Slip Bases (Breakaway) - Furnish, at no additional cost to the Agency, a calibrated torque wrench of a capacity appropriate to the size of the high-strength bolts installed and tightened. Confirm the accuracy of the calibrated torque wrench through calibration by an approved testing agency at least once a year.

Remove any dirt and moisture from the lubricated fasteners, and recoat the lubricated fasteners with a fresh, second coat of lubricant immediately before tightening. Tighten the bolts, in the presence of the Engineer, to the minimum torque or tension shown to seat the bolts in the base plate slots. After all the bolts in the slip base are tightened, loosen each bolt and retighten to the prescribed torque or tension shown in the same order as the initial tightening.

(2) Bolt Installation for Slip-Critical Connections - Tighten high strength bolts by direct tension indicator method unless noted otherwise. The calibrated torque wrench method of final tightening is not acceptable. Use of direct tension indicators is not allowed with Type 3 high-strength bolts in AASHTO M 270, Grade 50W (ASTM A709, Grade 50W; ASTM A588), unpainted weathering steel connections.

a. Direct Tension Indicator Tightening - Install new and unused direct tension indicator washers at each bolt. Install so that the direct tension indicator protrusions are in contact with a hardened washer.

Bring the connection to a snug-tight condition. Snug-tight is defined as the condition when all plies of the connection are in firm contact and can be attained by applying the full effort of a worker on the end of a 12-inch long wrench to each bolt in the connection. Tighten all fasteners in the connection by progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic partial tightening.

After attaining a snug-tight condition, tighten all fasteners in the connection by progressing systematically from the most rigid part of the connection to the free edges until all of the spaces between the direct tension indicator protrusions refuse entry to a 0.005 inch feeler gauge.

b. Turn-of-Nut Tightening - During all turn-of-nut tightening, proceed systematically from the most rigid part of the connection to the free edges. Tighten all bolts until they are simultaneously snug tight and the connection is fully compacted. Snug tight is defined as the tightness that exists when all plies of the joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a worker using a 12 inch long wrench. Following this initial operation, further tighten all bolts in the connection by the amount of rotation specified in Table 00560-3 in Section 00560. During the tightening operation do not permit rotation of the part not turned by the wrench.

(e) Bolt Inspection:

(1) General - The Engineer will observe the installation and tightening of bolts to determine that the selected tightening procedure is properly used and that all bolts are tightened, and in the case of direct tension indicators that the correct indication of tension has been achieved. Bolts may reach tensions substantially above the value given in Table 00560-1, but this will not be cause for rejection. The installation will be rejected if the geometry does not satisfy the requirements of 02560.05.

(2) Direct Tension Indicator Method - Provide the Engineer full opportunity to witness installation of bolted connections. The Engineer will periodically observe the installation and tightening operations to ensure that proper procedures are being adhered to.

Upon completion of a bolted joint, the Engineer will determine that all bolts have been tightened. A minimum of 10 percent, but not less than two bolts in each joint, will be inspected. The joint will be accepted as properly tightened when all spaces between the direct tension indicator protrusions refuse entry to a 0.005 inch feeler gauge. If there are any spaces between the direct tension indicator protrusions that do not refuse entry to a 0.005 inch feeler gauge, re-inspect all bolts, retighten bolts in the joint as required, and resubmit the joint for inspection.

(3) Turn-of-Nut Method - When all turn-of-nut tightening activities have been witnessed and are acceptable by the Inspector, no additional bolt tightening inspection is required. If turn-of-nut tightening has been performed without being witnessed by the Inspector, use the following inspection procedure:

- In the presence of the Engineer, use an inspection wrench, which may be a calibrated torque wrench.
- Place three bolts of the same grade, diameter and condition as those under inspection individually in a calibration device capable of indicating bolt tension. Use a hardened washer under the part turned in tightening each bolt.
- Tighten each bolt specified in the paragraph above in the calibration device by any convenient means to an initial condition equal to 20 percent of the required tension, and then to a tension not less than 5 percent greater than specified for its size in Table 00560-1 in Section 00560. Tightening beyond the initial condition shall not produce greater nut rotation than 1.5 times that allowed in Table 00560-3 in Section 00560. Then apply the inspecting wrench to the tightened bolt and determine the torque necessary to turn the nut or head 5 degrees, approximately 1 inch at 12 inches radius, in the tightening direction. Take the average torque measured in the tests of three bolts as the job inspecting torque to be used in the manner specified in the next paragraph.

- Test bolts that have been tightened in the Structure and are represented by the sample prescribed above with the inspecting wrench. Apply the job inspecting torque to 10 percent of the bolts, but not less than two bolts selected at random. If no nut or bolt head is turned by this application of the job inspecting torque, the connection will be accepted as properly tightened. If any nut or bolt head is turned by the application of the job inspecting torque, test all bolts in the connections. Retighten all bolts whose nut or head is turned by the job inspecting torque, and re-inspect. Retighten all of the bolts in the connection and then resubmit the connection for the specified inspection.

(f) Tube Bending - For major sign supports, bend tube using induction heating methods in accordance with TPA-IBS-98 *Recommended Standards for Induction Bending of Pipe and Tube*.

00930.41 Adjustable Sign Mounts - The mount shall allow vertical adjustment for positioning the sign and shall rotate to plumb the sign. Use galvanized or stainless steel nuts, bolts and washers for fasteners.

Measurement

00930.80 Measurement - No measurement of quantities will be made for metal sign supports.

Estimated quantities of structural steel will be listed in the Special Provisions. If field verified post lengths increase or decrease by more than 25 percent of the length specified, adjustments to the Contract lump sum amount will be made according to 00190.10(h).

Payment

00930.90 Payment - The accepted quantities of metal sign supports will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
	Major Sign Supports	
(a)	Truss Sign Bridge	Lump Sum
(b)	Monotube Sign Bridge	Lump Sum
(c)	Butterfly Sign Structures	Lump Sum
(d)	Monotube Cantilever Sign Structures	Lump Sum
	Mounts	
(e)	Bridge Structure Mounts	Lump Sum
(f)	Exit Number Sign Mounts	Lump Sum
(g)	Signal Pole Mounts	Lump Sum
(h)	Adjustable Sign Mounts	Lump Sum
(i)	Vertical Sign Mounts on Existing Structures	Lump Sum
(j)	Secondary Sign Mounts	Lump Sum
	Minor Sign Supports	
(k)	Multi-Post Breakaway Sign Supports	Lump Sum
(l)	Triangular Base Breakaway Sign Supports	Lump Sum
(m)	Pipe Breakaway Sign Supports	Lump Sum
(n)	Perforated Steel Square Tube Slip Base Sign Supports	Lump Sum
(o)	90 Degree Rotational Sign Supports	Lump Sum
(p)	Pipe Sign Supports	Lump Sum
(q)	Perforated Steel Square Tube Anchor Sign Supports	Lump Sum

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for route marker frames, wind bracing, pole clamps, stainless steel clamps, mast arm street name sign mounts, or special sign brackets.

Section 00940 - Signs

Description

00940.00 Scope - This Work consists of furnishing, fabricating, and erecting traffic signs of the types shown.

00940.03 Drawings - Copies of Working Drawings for non-standard signs will be made available to the Contractor by the Engineer. Standard signs called for in the Contract Documents shall be constructed using drawings available in FHWA's *Standard Highway Signs* (FHWA English Version) or ODOT's *Sign Policy and Guidelines for the State Highway System*. The ODOT sign policy is available on the ODOT Traffic-Roadway Section website.

Materials

00940.10 Materials - Furnish Materials for signs meeting the requirements of Section 02910.

Use retroreflective, reflective, or nonreflective sign sheeting as shown.

Use sign sheeting colors conforming to the Federal Highway Administration *Color Specifications for Retroreflective Sign and Pavement Marking Materials*. In addition, specified color coordinates shall be subject to visual matching by the Engineer to determine that all panels in any one sign match.

Construction

00940.40 General - Finished signs shall conform to the designs shown or specified.

Furnish substrate Material as shown.

See Table 02910-1 in Section 02910 for sheet aluminum thicknesses for various sizes of signs.

Fabricate all components of each individual sign with sheeting from the same Supplier, to ensure that all components are compatible, and are warrantable by the manufacturer. Removable legend does not have to be fabricated with sheeting from the same Supplier as the background sheeting on the sign panels.

Construct standard signs as shown in the FHWA *Standard Highway Signs manual* or in ODOT's *Sign Policy and Guidelines for the State Highway System*.

00940.41 Aluminum Panel Sign Fabrication:

(a) General - Fabricate aluminum panel signs as shown or specified. Do not round corners of panels outside the border. Reinforced sheet aluminum signs will not be allowed. All aluminum used for sign panels shall be new material.

(b) Extruded Aluminum - Each panel of extruded aluminum panel signs shall be a continuous section. Apply the sign sheeting to the extrusion a sufficient distance around the edge to ensure that no aluminum surface is visible on the face of the sign.

(c) Sheeting - The sign sheeting applied to the extrusions shall be the background color of the sign.

(d) Legend - Signs consisting of only one extrusion may use permanent legend.

(e) Transparent Paste - Do not use transparent paste background on extruded aluminum signs.

00940.42 Sheet Aluminum Sign Fabrication:

(a) General - Cut the sheet aluminum sign to size and shape as shown or specified. The sign shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication.

Before application of retroreflective, reflective, or nonreflective sheeting, treat the entire surface of the sign with a conversion film according to the sheeting manufacturer's recommendations.

(b) Mounting Holes:

(1) On Posts - Signs having a vertical dimension of less than 48 inches and mounted on wood or metal posts shall have at least two mounting holes. Signs having a vertical dimension of 48 inches or greater shall have three mounting holes. Place the third mounting hole near the center of the sign. Locate mounting holes so the mounting hardware will not cover any portion of the legend unless otherwise shown.

(2) On Extruded Aluminum Signs - Provide a minimum of eight mounting holes for sheet aluminum signs mounted on extruded aluminum signs.

00940.43 Plywood Sign Fabrication - Perform all fabrication with saw blades that do not tear plywood grain. Cut all holes clean and uniform. Splicing will not be allowed unless specified. Locate mounting holes so that the mounting hardware will not cover any portion of the legend. Provide mounting holes for signs according to 00940.42(b).

After fabrication and before the application of retroreflective, reflective, or nonreflective sheeting, seal all edges with plywood sealer tinted to match the color of the panel overlay material. Where retroreflective, reflective, or nonreflective sheeting is to be applied, prepare the surface of the sign according to the sheeting manufacturer's recommendations.

00940.44 Retroreflective, Reflective, or Nonreflective Sheeting Application - Apply the sheeting according to the sheeting manufacturer's recommendations on extruded aluminum panel signs. Up to 25 percent of the extruded aluminum panel signs required in the Plans will be allowed one manufacturer's splice for each sign. One patch will be allowed for each 50 square feet of sign to a maximum of three patches for each sign. Patches shall be between 3/4 inch and 3 3/8 inches in diameter. No Contractor splices will be allowed.

On all other signs, manufacturer's splices will not be allowed except as noted on approved shop drawings, or when sign dimensions exceed the sheeting manufacturer's capabilities. Make these splices horizontal with the upper section of sheeting overlapping the lower by a minimum of 3/8 inch on encapsulated lens sheeting, and butt splice prismatic lens sheeting with no appreciable substrate visible. The use of overlaid transparent paste or electronic cuttable film will not be allowed on overlapped splices. No Contractor splices will be allowed.

00940.45 Legend Installation:

(a) General - The word "legend" means the entire message and border for a sign. A group of words, numbers and/or symbols constitute the "message" for a sign. Install the type of legend for each traffic sign as shown.

Spacing between letters and/or numbers shall conform to the FHWA *Standard Alphabets for Highway Signs manual*.

Spacing between words for Series "E" (modified) legend shall be 1.5 times the upper case letter height. Spacing between words for other fonts shall be as tabulated below unless otherwise shown:

Legend Series	Word Spacing
B	(0.531) H
C	(0.625) H
D	(0.836) H
E	(1.000) H

H = height of upper case letter

Spacing between symbols shall conform to FHWA *Standard Highway Signs* unless otherwise shown.

Space all lines equally between side borders unless otherwise shown. Space the legend vertically as shown. For diamond shaped signs, space between lines in the legend a minimum of one half the average letter height and space between the message and the borders equally so the message is centered on the sign.

(b) Attachment - Attach removable legend to aluminum panels using aluminum, domed head, 1/8 inch diameter, self-plugging blind rivets. Remove aluminum shavings from the sign face before attaching the legend. The entire sign will be rejected if any shavings are left beneath the legend. Drill 0.128 inch diameter holes in the removable legend and sign panel as shown on the *Mounting Details for Removable Legend* Standard Drawings.

Apply screened legend according to the sheeting manufacturer's recommendations. Apply cut-out legend according to 00940.44.

Attach 1 inch retroreflective removable border sections by placing two rivets 1/2 inch from the end of each border section with additional rivets spaced at a maximum of 6 inches apart, centered in the section. Corner border sections shall be attached with a minimum of five rivets, two rivets 1/2 inch from each end, and the remaining rivet centered in the middle of the section.

Attach 2 inch retroreflective removable border sections by placing two rivets 1/2 inch from the end of each border section with additional rivets spaced at a maximum of 6 inch apart, along the top and bottom edge of the section. Corner border sections shall be attached with a minimum of five rivets, two rivets 1/2 inch from each end, and the remaining rivet centered in the section.

00940.46 Inspection - The Engineer will inspect signs at the fabrication shop or at the Project Site. Inspection will be for conformance to the Plans and Specifications, and for conformance to nighttime visibility. The Contractor's expense for sign inspection will be according to 00165.91.

00940.47 Sign Erecting - Erect all signs at the locations staked and as shown or directed. Do not erect individual signs until the sign is complete with legend. Signs not mounted as shown or directed will not be accepted.

Erect the signs so the sign face is vertical, unless otherwise directed.

When signs are installed on supports 10 feet or less from the edge of guardrail, curb, or Shoulder, set them to reflect 3 degrees away from traffic. When signs are installed on supports more than 10 feet from the edge of guardrail, curb or Shoulder, set them to reflect 3 degrees toward traffic.

The closest edge of any column or overhead sign Structures shall be as shown.

Where signs are mounted to supports by bolting through the sign, a sheeting manufacturer approved lubricant may be used on the nylon and metal washers to prevent sign sheeting deformation. Replace damaged signs, or signs with sheet deformation, with new signs at no additional cost to the Agency.

If a sign installation is a replacement for an existing sign, install the new sign immediately after removal of the existing sign unless otherwise directed.

Measurement

00940.80 Measurement - The quantities of signs will be measured on the area basis, by multiplying the height by width, using the dimensions shown. No deductions will be made for irregular shapes cut from the rectangle.

Route markers and other signs fastened to the face of larger signs will be measured as separate signs.

Payment

00940.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Signs, Standard Sheeting, Extruded Aluminum	Square Foot
(b)	Signs, Standard Sheeting, Sheet Aluminum	Square Foot
(c)	Signs, Standard Sheeting, Plywood	Square Foot
(d)	Signs, Wide Angle Sheeting, Extruded Aluminum	Square Foot
(e)	Signs, Wide Angle Sheeting, Sheet Aluminum	Square Foot
(f)	Signs, Wide Angle Sheeting, Plywood	Square Foot

Items (a), (b), and (c) include payment for signs constructed with only ASTM Type III, ASTM Type IV, or non-reflective sheeting.

Items (d), (e), and (f) include payment for signs constructed with ASTM Type IX or ASTM Type XI sheeting.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Payment for Work done under this Section will be limited to 75 percent of the amount due until the Agency has received the signed warranties required by 02910.75.

No separate or additional payment will be made for coating backs of aluminum substrate signs.

Section 00941 - Sign Covers

Description

00941.00 Scope - This Work consists of covering sign faces as shown, specified, or directed.

Materials

00941.10 Materials - For permanent signs, furnish sign covers from the QPL or porous cloth covers pre-approved by the sign sheeting manufacturer. Do not use plywood.

For temporary signs comply with Section 00222.

Construction

00941.40 Fabrication - Fabricate sign covers in one piece, unless otherwise directed. Make them large enough to completely cover the sign, and capable of easy attachment to the sign without damaging the sign face.

00941.41 Installation - Lap covers over all sign edges and secure to the sign or support as recommended by the sign sheeting manufacturer.

00941.42 Alternate - The Contractor may elect one or more of the following as alternate methods subject to approval:

- Install signs in conjunction with the movement of the traffic flow.
- Remove demountable legend from signs and re-install legend as directed.
- Remove entire sign and store in a vertical position for future reinstallation.

Measurement

00941.80 Measurement - No measurement will be made for sign covers.

Payment

00941.90 Payment - No separate or additional payment will be made for sign covers or for the alternate methods listed in 00941.42. Payment will be included in payment made for the appropriate items under which this Work is required.

Section 00950 - Removal of Electrical Systems

Description

00950.00 Scope - This Work consists of removing existing electrical systems as shown or specified.

00950.02 Definitions:

Electrical Systems - Electrical systems will be described in the Special Provisions.

Construction

00950.40 General - Remove existing electrical systems in the order directed.

Keep existing electrical systems to be removed in operation until the new electrical systems are ready to be turned on or as directed. Keep authorized downtime to a minimum. Perform the changeover with a minimum disruption to traffic.

Remove existing materials, as specified or approved, which interfere with or which are incompatible with new construction before completion of the new construction. Notify the Engineer at least 4 Calendar Days in advance of removal.

00950.41 Removal and Abandonment - Remove from the right of way electrical systems as shown. Dispose of materials according to 00290.20. Abandon conduit by removing all wiring, elbows, and risers.

Remove the top of the foundation, anchor bolts, and conduits to a depth not less than 2 feet below the adjacent finished ground line. Backfill resulting holes with material equivalent to the surrounding material. Finish and blend the surface area to the adjacent surface area.

Repair all holes or damage to Existing Surfacing caused by removal of existing installations as directed at no additional cost to the Agency.

00950.42 Salvaging and Stockpiling Materials - Electrical systems to be salvaged and stockpiled will be described in the Special Provisions,

Measurement

00950.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

00950.90 Payment - Payment for Work performed under this Section will be made by either method "A" or method "B" as follows:

- **Method "A"** - Method "A" will be used when existing electrical systems are removed and replaced with new electrical systems. Under method "A" no separate payment will be made for removal of electrical systems.

  Payment for removal of existing electrical systems will be included in payment made for the appropriate new electrical system.

- **Method "B"** - Method "B" will be used when existing electrical systems are removed and are not replaced with new electrical systems. Under method "B" payment will be made at the Contract lump sum amount for the item "Removal of Electrical Systems".

  Payment will be payment in full for all furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for salvaging and stockpiling Materials.

Section 00960 - Common Provisions for Electrical Systems

Description

00960.00 Scope - This Work consists of furnishing and installing Materials for electrical systems and for modifying existing systems.

00960.01 Regulations, Standards, and Codes - All electrical Materials and workmanship shall conform to the following standards where applicable:

- American National Standards Institute (ANSI)
- International Municipal Signal Association (IMSA)
- Underwriter's Laboratories, Inc. (UL)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Electrical Code, Oregon Amended (NEC)
- Standards of the American Society for Testing and Materials (ASTM)
- Local laws

Use the code, order, or standard in effect on the date the Project is advertised unless otherwise shown.

Safe wiring labels normally required by the Department of Consumer and Business Services, Building Codes Division will not be required for traffic management systems listed on the Red Sheets (see 00160.00) as allowed by ORS 479.540 and OAR 918-261-0037. The Red Sheets may be viewed on ODOT's web site.

00960.02 Equipment List and Drawing Submittals - Within 30 Calendar Days after execution of the Contract, submittwo copies of the Blue Sheets (see 00160.00 and 00160.07) and two copies of the Green Sheets (see 00160.00 and 00160.07) according to 00150.37 for all materials the Contractor proposes to install. Blue Sheets and Green Sheets contain submittal instructions and will be made available to the Contractor by the Engineer.

Within 14 Calendar Days after receipt of submittals, the Engineer will review the submittals and designate them in writing as "approved", "approved as noted", or "returned for correction". Do not proceed with the Work before receiving written approval of the submittals from the Engineer.

00960.03 Permits - Provide the Engineer with copies of all required electrical permits prior to performing any work.

Materials

00960.10 Materials - Furnish Materials meeting the following requirements:

Commercial Grade Concrete	00440
Controlled Low Strength Materials	00442
Delineators	00840.10 and 00840.11
Metal Illumination and Traffic Signal Supports	00962
Selected General Backfill	00330.13
Selected Granular Backfill	00330.14
Reinforcement	02510

Furnish electrical Materials that have been approved through the Blue Sheet and Green Sheet submittal process in 00960.02.

Anchor rods shall conform to 02560.30 and to the types and sizes shown.

Use commercially available 30 pound nonperforated asphalt-saturated felt where shown.

Use commercially available No. 10 - 0 sand when sand blanket is required.

Use commercially available UL listed insulating vinyl plastic tape where shown.

Use commercially available UL listed silicon bronze (or copper alloy) split bolt where shown.

Use commercially available galvanized steel weatherproof compression fittings where shown.

Labor

00960.30 Licensed Electricians - According to the Oregon Administrative Rule 918-282-0120(1), every person engaged in the installation of electrical Equipment and wiring systems shall possess a valid Oregon Electrical Supervising or Journeyman's License, or be registered as an Electrical Apprentice. Every person who installs electrical systems on the Project shall submit a copy of his or her electrical license or apprentice registration to the Engineer prior to performing any Work.

Construction

00960.40 Excavation - Remove and replace sidewalks, curbs, paved surfaces, and other materials as needed. Replace and finish all surfaces to correspond with the existing surfaces. Restore all disturbed landscaping and underground systems to original condition.

Excavate trenches, foundations, and junction boxes to locations, Neat Lines, grades and Cross Sections as shown or as established or approved. Furnish, place, and remove any shoring required to prevent caving of walls.

Dispose of all excavated Materials according to 00290.20.

00960.41 Horizontal Directional Drilling - Drilling shall not "hump" or deform the Pavement and shall be guided. Keep drilling pits at least 2 feet from the edge of Pavement. Do not use water to the extent that the Pavement might be undermined or Subgrade softened. Sand bedding and marking tape are not required with this method.

If jointed conduit is used, verify the joints have not separated by pulling a mandrel through the conduit after installation.

00960.42 Conduit:

(a) Cleaning New Conduit - Before cable and wire installation, clean all new conduit with cylindrical mandrel of the proper size for that conduit and blow out with compressed air. Mechanical pulling methods may be used for conduit cleaning.

(b) Cleaning Existing Conduit - Before installation of new cable(s) or wire(s) in an existing conduit, temporarily remove all existing cable(s) and wire(s). Clean existing conduit with cylindrical mandrel of the proper size for that conduit and blow out with compressed air. Mechanical pulling methods may be used for conduit cleaning. Stop work and notify the Engineer immediately if there are any difficulties cleaning the existing conduit. Reinstall existing cable(s) and wire(s) in existing conduit unless otherwise shown.

00960.43 Foundations: Construct foundations for pedestals, posts, and cabinets according to Section 00440 and the applicable portions of 00540.48(a). Place concrete:

- Directly against the sides of the excavation in undisturbed or well-compacted material or place in forms.
- With a continuous pour.
- To the elevation shown or directed.
- With conduit ends and anchor rods held securely in proper vertical position, to proper height, using a manufacturer's recommended template until the concrete sets.

Maintain rebar clearances during concrete pour.

Make no adjustments of anchor rods after concrete has set.

Set forms square and true to line and grade. Construct forms of rigid materials that remain in position until removed.

Remove forms and place subsequent loading according to Table 00540-1.

Finish tops of foundations to Roadway, sidewalk or curb grade, or as directed.

Finish exposed concrete foundations to present a smooth, neat appearance. Fill all holes.

00960.45 Grounding and Bonding:

(a) General - Make all ground rods, metal conduit, metal poles, grounding wire, metallic junction boxes, metallic junction box covers, and cabinets mechanically and electrically secure to form a continuous, effectively grounded and bonded system.

(b) Grounding/Bonding Wire - Use a THWN No. 6 AWG stranded copper grounding/bonding wire in conduit or as shown. Use an un-insulated No. 4 AWG stranded copper grounding/bonding wire outside of conduit or as shown.

(c) Ground Rods - Ground each above ground metallic Structure with a separate ground rod.

(1) Located in Junction Box - Install ground rod in a junction box if shown. Drive ground rods into the ground with the top of the ground rod 2 inches to 3 inches above the bottom of the junction box to allow for an accessible clamp.

(2) Located in Foundation - Install ground rod in a foundation if shown, with the ground rod 2 inches to 3 inches above the top of the foundation to allow for an accessible clamp.

(d) Services and Cabinets - Bond the neutral conductor, the control cabinets, and the metal base to the grounding electrode system.

(e) Nonmetallic Conduit - In all nonmetallic conduit, run a ground/bond wire continuously between all poles, pedestals, posts, and cabinets. Bond wires are not required in conduit that only contains circuits that operate at less than 25 volts.

00960.46 Service Cabinet and Electrical Energy - Install service cabinet and associated equipment early on to allow the Utility to schedule its Work before project completion. Have the service cabinet inspected by the Utility providing power. Arrange for the Utility to make the electrical hookup.

Maintenance

00960.60 Maintenance, Operation and Power Costs - The Agency will continue normal maintenance and operations of the existing systems including the furnishing of electrical energy. Do not use for construction purposes electrical energy billed to the Agency or other agencies.

Finishing and Cleaning Up

00960.71 As-Built Plans - Upon completion of the installation, submit a red-lined copy of the original Plans noting all changes made. The information furnished shall include all modifications made and shall represent the material installed and in operation. It shall be sufficiently detailed to enable maintenance forces to replace or repair any part of the Project under routine or emergency maintenance by direct reference.

Section 00962 - Metal Illumination and Traffic Signal Supports

Description

00962.00 Scope - This Work consists of furnishing, fabricating, galvanizing, and installing materials for illumination and traffic signal supports and foundations. The location of illumination/signal material shown is approximate, with exact locations established in the field.

00962.01 Regulations, Standards, and Codes - All designs and workmanship shall conform to the following standards where applicable:

- AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*
- AWS D1.1

Wherever reference is made to any of the standards mentioned above, the reference means the code, order, or standard in effect on the date the Project is advertised unless otherwise shown or specified in the Specials Provisions.

Do not begin installations until all permits are obtained and copies are given to the Engineer.

00962.02 Calculations and Drawings - Within 30 Calendar Days after execution of the Contract, submit at least six copies of:

- Prequalified manufacturing shop drawings.
- Calculations and shop drawings for all standard poles that do not have prequalified manufacturing shop drawings.
- Calculations and shop drawings of all nonstandard poles that do not have prequalified manufacturing shop drawings.
- Calculations and installation drawing of all nonstandard pole foundations that do not have details shown.

All engineered details and drawings which are not prepared by the Agency, but are required in the Contract Documents, shall be submitted for review prior to fabrication. Designs, details, Plans, and calculations shall be stamped and submitted according to 00150.35. Include the Field Verification Forms for Signal and Illumination supports, available from the Engineer.

Upon completion of the installation, submit six copies of all changes made from the original Plans. The information furnished shall include all modifications made and shall represent the material installed and in operation. It shall be sufficiently detailed to enable maintenance forces to replace or repair any part of the Project under routine or emergency maintenance by direct reference.

00962.05 Design - Design all traffic signal and illumination poles according to the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

(a) Traffic Signal Mast Arm Supports - Design non-standard poles and foundations according to the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 4th Edition* with 2001, 2002, and 2003 interim revisions. Design factors include:

Basic Wind Speed (3 second gust).....As shown
Gust Factor (G).....1.14
Importance Factor (Ir).....1.0 (50 year recurrence interval)
Fatigue Category II

(b) Traffic Signal Strain Pole Supports - Design non-standard poles and foundations according to the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 4th Edition* with 2001, 2002, and 2003 interim revisions. Design factors include:

Basic Wind Speed (3 second gust).....As shown
Gust Factor (G).....1.14
Importance Factor (Ir).....1.0 (50 year recurrence interval)

Fatigue design is not required.

(c) Illumination Supports - Design non-standard luminaire slip base, fixed base, and high mast poles and foundations according to the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 1994*. Design factors include:

Basic wind speed (fastest mile per hour)..... 100 mph

Materials

00962.10 Materials - Furnish materials meeting the following requirements:

Anchor Rods 02560.30
Commercial Grade Concrete.....00440
High-Strength Fasteners 02560.20

Furnish steel pole materials meeting the requirements of 02530 modified as follows:

- Provide steel sheet for pole and arms meeting the requirements of ASTM A595, Grade A or B, ASTM A572, or approved equal.
- Provide all other steel sheet and plate meeting the requirements of ASTM A36 or ASTM A572, or approved equal.
- Supplementary Requirement S18 (ASTM A6), maximum tensile strength, is required.
- Galvanized base plates and small and hidden pieces do not require controlled silicon content.

Construction

00962.41 Excavation - Do all excavation, backfilling and resurfacing Work necessary to complete the Work. This includes removal and replacement of curbs, sidewalks, paved surfaces and other materials. On completion of the Work, replace and finish all surfaces to correspond with the existing surfaces.

Furnish, place, and remove any shoring required to prevent caving of walls.

When excavating in paved areas, cut with an approved pavement cutting saw to a depth of at least 2 inches along the neat boundaries of the area to be removed. Cut sharp and well-defined Pavement edges with no evidence of cracking, delaminating, or stressing.

Restore all disturbed landscaping and underground systems to original condition upon completion of the Work at no additional cost to the Agency. Use hand excavation if directed.

(a) Excavation for Poles Foundations - Make all excavations for pole foundations to the Neat Lines of the foundations. Hand excavation may be required. Place the concrete directly against the sides of the excavation in undisturbed or well-compacted material.

(b) Disposal of Materials - Dispose of all materials according to 00290.20.

00962.43 Foundations - Construct foundations according to Section 00440 and the applicable portions of 00540.48(a). Place concrete as follows:

- With a continuous pour.
- To the elevation shown or directed.
- With conduit ends and anchor rods held securely in proper vertical position and height with the manufacturer's recommended template until the concrete sets.

Make no adjustment of anchor rods after concrete has set. Any adjustment made may be cause for rejection of the foundation.

Maintain rebar clearances during concrete pour.

Set forms square and true to line and grade. Construct forms of rigid materials that remain in position until removed. Use a steel template to accurately locate the anchor rods and hold them plumb and in proper alignment. Out-of-position anchor rods and anchor rods installed more than 40V:1H out of plumb are cause for rejection of the foundation. Field bending of anchor rods and field modification of the base plate are not allowed.

Remove forms and place subsequent loading according to Table 00540-1.

Finish tops of foundations to Roadway, sidewalk or curb grade, or as directed.

Finish exposed concrete foundations to present a smooth, neat appearance. Fill all holes.

Where breakaway bases are specified, the post stub projection shall not exceed the limits shown.

Where obstructions prevent the construction of planned foundations, construct the foundations in the location directed. Any extra cost due to the site change will be paid according to 00195.20.

If it is determined that foundations will extend deeper than shown, the extra foundation depth will be paid according to 00195.20.

(a) Design of Illumination Pole Foundations - Design non-standard foundations according to the Rutledge method using a S1 allowable average Soils stress of 1,500 pounds per square foot unless site conditions do not meet poor Soil requirements as listed in the Rutledge method.

(b) Design of Non-Standard Foundations - Design non-standard foundations according to the Agency's *Traffic Structures Design Manual*

(c) Installation of Traffic Signal Pole Foundations - Construct drilled shafts according to Section 00963.

00962.46 Steel Illumination and Signal Poles - Metal poles include vertical posts, signal mast arm, luminaire arms, connection hardware, and anchor rods. Do not erect poles until the Engineer has made a visual inspection of pole welding.

Fabricate entrance openings in metal poles and arms, including handholes, before galvanizing, except as shown for mounting traffic signal material.

(a) Design - Design all metal poles with self-supporting upsweep arms similar to the details shown.

(b) Pole Height - Before poles are ordered, the Engineer will check the pole heights in the field and verify that the specified luminaire mounting heights above Pavement are provided. Provide upsweep bracket arms of lengths shown in the Metal Light Pole Table or shown on the Plans. Provide traffic signal poles of heights as shown or specified. Height of poles requiring slip plate bases is the length of shaft above the slip plate.

(c) Mast Arm - Install mast arms for traffic signals and signs according to details provided by the manufacturer. Use proper type and size of mounting appurtenances that correctly fit the pole furnished, or as shown. Provide self-supporting mast arms without tie rods or braces. Provide tapered mast arms that are either round, 8 sided, 12 sided, or 16 sided.

All mast arms shall allow wiring entrances directly into the pole from inside the mast arm.

(d) Luminaire Arm - The luminaire end of the arm shall be level when loaded to design weight. Use a bolted, flange type connection to join the upsweep arm to the pole. The connection shall be raintight and shall develop the strength of the arm. Provide the mast arm rise according to the Metal Light Pole Table, or as shown or specified.

Arms shall be self-supporting without tie rods, or braces. Measure upsweep rise from the point of attachment to the pole to the end tangent portion of the arm. Provide tapered arms that are either round, 8 sided, 12 sided, or 16 sided.

All arms shall allow for wiring entrances directly into the pole from inside the arm.

All pole bracket attachments for mounting upsweep arms shall have reamed, smooth ends.

The nominal mounting height (MH) shown in the Metal Light Pole Table or on the Plans is the distance between the Roadway at the edge of the Pavement and the luminaire. This height may vary plus or minus 1 foot.

(e) Deflection - The horizontal dead load deflection at the top of the poles shall not exceed 1 percent of the pole length (2 percent for strain poles).

(f) Deviation from Straightness - After the poles are delivered to the Project Site, and before they are erected on the foundations, the Contractor may be required to check any or all poles for deviation from straightness according to the following:

(1) Deviation in One Plane and One Direction Only - A straight line joining the surface of the pole at the base and the same surface of the pole at the top shall not be more than 1/2 inch from the surface of the pole for each 10 feet of length from the closest of these points. The opposite surface shall meet the same requirement.

(2) Deviation in Any Plane - A straight line connecting the midpoint of the pole at the base, with the midpoint at the top, shall not pass through the surface of the pole at any intermediate point.

Any pole not meeting these requirements will be rejected. If more than 25 percent of the poles fail to meet these requirements, sufficient cause exists to reject the entire shipment of poles for the Project.

(g) Welding - Weld steel illumination and signal poles according to AWS D1.1. The fabricator shall inspect welds according to details and requirements called out on the Contract Documents. This requirement will override all appropriate weld inspection requirements called out in Section 5.15 WELDING CONNECTIONS in AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. Submit all testing procedures for Engineer's review prior to starting inspection. Submit certified copies of inspection reports to the Engineer for review.

If requested by the Engineer, additional weld inspection may be required upon arrival of the material at the Project Site. If defects are found by this additional inspection, the Contractor shall be responsible for the additional testing and repair costs. If no defects are found, the Engineer will be responsible for the additional inspection costs.

(h) Welding Steel After Galvanizing - No field welding of galvanized steel will be allowed. The effected piece shall have the existing galvanizing removed from the heat effected area before welding. Perform the weld, remove the galvanizing totally from the entire piece, and hot-dip galvanize it. Submit the following data, stamped according to 00150.35, for review:

- Explanation for modification
- Name of shop performing the Work
- Welding procedure
- Description of the Work that will be performed
- Name of the shop performing the hot-dip galvanizing

(i) Identifying Tags - Attach a stainless steel identifying tag to all poles. Provide tags that are at least 1/16 inch thick. Tag lettering shall be at least 1/4 inch in height, and be stamped into the tag. Attach tags with stainless steel pop rivets of at least 3/16 inch nominal body diameter. Do not locate pop rivet holes within 6 inches of welds. Locate the pole tag approximately 24 inches below the top of the mast arm or messenger cable attachment point. Locate the tag on the side of the pole furthest from the intersection. Drill holes for pop rivets prior to hot-dip galvanizing. Remove excess hot-dip galvanizing from holes and repair according to ASTM A780.

Include the following information on the tags, if applicable:

- Manufacturer
- Month and year of manufacture
- Lum Arm Yield (ksi)
- Lum Arm thickness (inch)
- Mast Arm Yield (ksi)
- Mast Arm thickness (inch)
- Pole Yield (ksi)
- Pole thickness (inch)
- Base Plate Yield (ksi)
- Anchor Rod Yield (ksi)

(j) Erecting Metal Poles - Erect metal poles on concrete foundations and according to the recommendations of the pole manufacturer and as shown. Exercise reasonable care to prevent marking the finish and damaging poles.

Install all joint traffic signal and illumination poles so the distance from the Pavement to the light center is as shown or specified. Use the same tapered design for traffic signal and street light arms.

Bolt protrusion on slip base poles shall not interfere with the breakaway action of pole. File sharp edges smooth and repair according to ASTM A780.

(1) Repair Damaged Finish - Repair damaged galvanizing according to ASTM A780. Minor scratches less than 3 inches long by 3/16 inch wide or an area of 1/2 square inch can be repaired with the sprayed zinc method.

(2) Assembly of Supports and Bolt Tightening - Nuts shall have full thread engagement.

a. Anchor Rods for Signal Supports and Fixed Base Luminaire Supports - After foundation concrete strength and curing requirements are satisfied and after inspection of the foundation, pole installation may begin.

Lubricate anchor rods and nuts according to 02560.70. Estimate the required rake, if any, and set the lubricated leveling nuts accordingly, so that when pole installation is complete and all appurtenances are installed on the pole, the top of the pole is plumb with the base of the pole.

Lift the pole into position on the leveling nuts and washers. Make sure all leveling nuts and washers are in full contact with the base plate.

Install washers and lubricated top nuts, and bring to a snug tight condition. Snug tight is defined as the condition when all plies of the connection are in firm contact, and can be obtained by the full effort of a worker on the end of a 12 inch long wrench. Several passes may be required to obtain uniform snug tightness.

When all anchor rods are snug tight, proceed with installation of arms and other appurtenances, if not previously installed. When installation of arms and appurtenances is complete, and the pole is plumb as defined above, final anchor rod tightening may begin. If the pole is not plumb, adjust as required and repeat snug tightening as described above. Make sure all leveling nuts and washers are in full contact with the base plate. As a safety measure, provide crane support of the pole until anchor rods tightening is completed.

Mark the position of each turned element (nut or bolt head) with a felt tip pen or similar marker. Rotate each top nut past snug tight by the amount shown in "d." below. Several passes may be required to obtain uniform final tightness. "Cheater" bars or slugging wrenches are allowed if required for large diameter anchor rods.

b. Anchor rods for Slip Base (Break-away) Luminaire Supports - After foundation concrete strength and curing requirements are satisfied and after inspection of the foundation, pole installation may begin.

Furnish, at no additional cost to the Agency, a calibrated torque wrench of a capacity appropriate to the size and type of the bolts being tightened. Confirm the accuracy of the calibrated torque wrench through calibration by an approved independent testing agency at least one a year.

Lubricate anchor rods and nuts according to 02560.70. Estimate the required rake, if any, and set the lubricated leveling nuts accordingly, so that when pole installation is complete and all appurtenances are installed on the pole, the top of the pole is plumb with the base of the pole.

Install the anchor plate on the leveling nuts and washers. Make sure all leveling nuts and washers are in full contact with base plate.

Install washers and lubricated top nuts, and bring to a snug tight condition. Snug tight is defined as the condition when all plies of the connection are in firm contact, and can be obtained by the full effort of a worker on the end of a 12 inch long wrench. Several passes may be required to obtain uniform snug tightness.

When all anchor rods are snug tight, proceed with the "Slip Base Bolting Procedure" as shown. When the slip base bolting procedure is complete, final anchor rod tightening may begin. As a safety measure, provide crane support of the pole until anchor rod tightening is complete.

Mark the position of each turned element (nut or bolt head) with a felt tip pen or similar marker. Rotate the top nut of each anchor rod past snug tight by the amount in paragraph "d." below. Several passes may be required to obtain uniform final tightness. "Cheater" bars or slugging wrenches are allowed if required for large diameter anchor rods.

c. High-Strength Bolts in Mast Arm-to-Pole Connections and Luminaire Arm-to-Pole Connections - Lubricate high-strength bolts according to 02560.70. Provide all high-strength bolts with hardened flat washers under the element turned during tightening.

If arms or appurtenances are attached after pole erection, support them until bolts are snug tight.

Install high-strength 4-bolt connections to a snug tight condition. Snug tight is defined as the condition when all plies of the connection are in firm contact, and can be obtained by the full effort of a worker on the end of a 12 inch long wrench. Mark the position of each turned element (nut or bolt head) with a felt tip pen or similar marker. Rotate the top nut of each bolt past snug tight by the amount in 00962.46(j)(2)(d). Several passes may be required to obtain uniform snug tightness.

Install high-strength 8-bolt connections according to 00930.40(d).

d. Final Tightening - Required final tightening of anchor rods and high-strength bolts are shown in the following Table:

Connection Type	Rotation Past Snug Tight
ASTM A307 Anchor Rods	30° (1/12 turn)
ASTM A449 Anchor Rods	60° (1/6 turn)
ASTM F1554 Gr. 55 Anchor Rods	60° (1/6 turn)
ASTM F3125, Grade A325	60° (1/6 turn)

(3) Bolt Inspection - The Engineer will observe the installation and tightening operations to ensure that proper procedures are followed. All inspections will be visual and no testing will be conducted.

The installation will be rejected if the geometry does not satisfy the requirements of 02560.05.

(k) Plate Flatness - Faying surfaces of plates shall be flat to within a tolerance of 1/32 inch in 12 inches and a tolerance of 1/16 inch overall. Base plates with leveling nuts shall be flat to within a tolerance of 1/8 inch in 12 inches and a tolerance of 3/16 inch overall.

00962.48 Coating - Prepare and coat supports as shown or specified according to all applicable portions of Section 00593 or Section 00594 as the Contractor elects with color as specified or shown. Provide paint for field application, repair damaged coatings, and paint hardware after installation. Do not paint:

- Slip plate or arm connected surfaces.
- Slip base bolting hardware.
- Anchor rods, anchor rod washers, and anchor rod nuts.

00962.50 Grounding and Bonding - For fixed base poles, provide a 1/2 inch, Type 308, 309, or 310 stainless steel stud on the inside of the shaft. Locate the stud directly opposite and level with the handhole in the pole. Attach grounding electrode conductors and bonding conductors to the stud with a grounding wire clamp, "acorn style".

For slip base poles, do not allow the grounding wire to intrude into the slip plane. Instead, run a bond wire from the grounding electrode to a 1/2 inch, Type 308, 309, or 310 threaded stainless steel stud welded to the bottom base slip plate.

Section 00963 - Signal Support Drilled Shafts

Description

00963.00 Scope - This Work consists of excavating and constructing drilled, cast-in-place, reinforced concrete shafts for signal supports according to the Specifications.

00963.01 Definitions:

Drilled Shafts - Reinforced concrete sections, cast-in-place against in situ Soil, Rock or a casing.

Temporary Casing - Casing installed to facilitate drilled shaft construction only and removed during or after concrete placement.

00963.02 Subsurface Investigation - The Soils and Geological Exploration Logs are available for review through the Engineer's office. The data shown for each test boring or test pit applies only to that particular boring or test pit. Subsurface conditions may vary between borings or test pits. Core samples and laboratory test results, if obtained and performed for the Project, are available for review by contacting the Engineer.

Materials

00963.10 Materials - Furnish Materials meeting the following requirements:

Reinforcement.....02510

Furnish Commercial Grade Concrete meeting the requirements of Section 00440 except provide the mixture with a slump of 8 inches ± 1 1/2 inches.

00963.13 Steel Casing - Furnish temporary casing meeting the requirements of ASTM A252 or ASTM A36. Test each heat of steel at 40 °F with a minimum absorbed energy requirement of 15 foot pounds. Use casing of sufficient strength to resist handling, transportation and installation stresses and the external stresses of the subsurface materials. Ensure that the casing is clean and watertight prior to placement in the drilled shaft excavation. Use casing with an outside diameter not less than the specified drilled shaft diameter.

00963.19 Quality Control - Provide quality control according to 00512.19.

Labor

00963.30 Personnel Qualifications - Perform the drilled shaft construction Work using a company and personnel experienced in drilled shaft construction work. Submit a list to the Engineer for approval identifying the on-site supervisors and drill rig operators assigned to the Project and the companies experience relevant to the Project. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, shaft size, depth, and all special construction techniques required. Before the preconstruction conference, provide the following information to verify the firm's experience and the qualifications of personnel scheduled to perform the drilled shaft construction:

- Submit a project reference list of at least three separate foundation projects, successfully completed in the last 5 years, with drilled shafts of diameters and depths equal to or larger than those shown in the Plans and in ground conditions similar to those indicated. Include a brief description of each project and the owner's contact person's name and current phone number for each project listed.
- On-site supervisors shall have at least 2 years' experience in supervising construction of drilled shaft foundations of similar diameter and depth and scope to those shown in the Plans and in

similar geotechnical conditions to those described in the geotechnical report. Experience shall include the direct supervisory responsibility for the on-site construction operations.

- Drill operators shall have at least 1 year experience in the construction of drilled shaft foundations.

The Engineer will respond within 21 Calendar Days after receipt of the submittal. Do not begin Work on any drilled shafts until the qualifications have been approved. The Engineer may suspend the drilled shaft construction if the Contractor substitutes unapproved personnel during construction. Submit requests for substitution of either on-site supervisors or drill operators to the Engineer, who will have 7 Calendar Days to respond to each request. Additional costs resulting from the suspension of Work due to the changing of personnel will be the Contractor's responsibility, and no adjustment in Contract Time resulting from the suspension of Work will be allowed.

Construction

00963.40 Submittals - Provide the following submittals to the Agency for review and approval:

(a) Drilled Shaft Installation Plan - At least 21 Calendar Days before beginning shaft construction, submit the following:

- The sequence of drilled shaft construction as it relates to the overall construction plan.
- A review of Equipment suitability based on the Contractor's understanding of the site subsurface conditions. Include a project history of the drilling Equipment that demonstrates the successful use of the Equipment for drilled shafts of equal or greater size in similar subsurface conditions.
- Details of shaft excavation methods, including proposed drilling methods and a disposal plan for excavated material. Include details of methods used to perform final cleaning of the excavation. Include details of the methods and materials used to fill or eliminate all voids between the plan shaft diameter and excavated shaft diameter, or between the casing and surrounding Soil, if permanent casing is specified. Include a disposal plan for any water or contaminated concrete expelled from the top of the shaft if applicable.
- Details of the proposed methods for ensuring drilled shaft stability during excavation and concrete placement.
- Unstamped reinforcing steel shop drawings and details of reinforcement placement, including bracing, centering and lifting methods and the method for supporting the reinforcement on the bottom of the shaft excavation. Include details on the type, number and placement of spacers and other devices for ensuring the reinforcing cage position is maintained during construction.
- Evidence that the proposed materials conform to all applicable Specifications.
- Details of concrete placement, including proposed operational procedures for pumping and tremie methods.
- Detailed procedures for temporary casing installation and removal. Include casing diameters, dimensions, and depths and the methods and Equipment for casing installation and removal.
- Confinement methods required to contain drilling fluids, spoils, waste concrete and other products from contacting sensitive environmental areas according to Section 00290 and all applicable regulatory permits.
- Methods for protecting existing Structures according to 00170.82.

The Engineer will approve or reject the drilled shaft installation plan within 21 Calendar Days after receipt of all submissions. Provide any additional information and submit a revised plan, if requested, for review and approval. All procedural approvals given by the Engineer will be subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete

the Work. Submit requests for modification of adopted procedures to the Engineer. Allow 21 Calendar Days for approval of modifications. Do not begin drilled shaft construction Work until all drilled shaft submittals have been approved.

(b) Drilled Shaft Repair Plans - For any shaft determined to be unacceptable, submit a repair plan to the Engineer for approval. Furnish all materials and Work, including engineering analysis and design, needed to correct unacceptable drilled shafts, at no additional cost to the Agency. Do not begin repair operations before remedial procedures or designs are approved. Any modifications to the dimensions or materials of the drilled shafts shown on the Plans that are proposed in the repair plan will require stamped calculations and Working Drawings according to 00150.35.

00963.41 Drilled Shaft Coordination Meeting - Hold a drilled shaft coordination meeting at least 7 Calendar Days before beginning any shaft construction Work at the site to discuss construction procedures, schedules, staging, personnel, Equipment to be used, and other elements of the approved shaft installation plan as specified in 00963.40. Those attending the meeting include:

- **Representing the Contractor** - The superintendent, on-site supervisors, and all supervisors in charge of excavating the shaft, placing the temporary casing, placing the steel reinforcing bars, and placing the concrete.

- **Representing the Contracting Agency** - The Project Engineer, key inspection personnel, and designers of record or their appointed representatives.

If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved shaft installation plan, an additional meeting shall be held before any additional shaft construction operations are performed.

00963.42 Construction Tolerances - Excavate drilled shafts as accurately as possible at the locations shown. Determine the drilled shaft dimensions and alignment with approved methods.

Frequently check the plumbness alignment and dimensions of the shaft during construction. Correct all out-of-tolerance shaft excavations and completed shafts to the satisfaction of the Engineer. Correct out-of-tolerance drilled shafts at no additional cost to the Agency, and no extension of the Project completion date will be granted. Materials and Work necessary to complete corrections for out-of-tolerance drilled shafts resulting from the removal of unexpected drilled shaft obstructions will be paid for according to 00195.20.

00963.43 Drilled Shaft Excavation - Perform drilled shaft excavation according to the following:

(a) General - Excavate drilled shafts to the dimensions and elevations shown or as directed. Provide and maintain stabilized drilled shaft sidewalls for the full depth of the excavation, using approved materials, Equipment and methods. If caving or other unstable conditions occur during any construction procedure, stop further construction, notify the Engineer, and stabilize the shaft excavation by approved methods and submit a revised installation plan which addresses the problem and prevents further instability. Do not continue with shaft construction until any damage which occurred has been repaired according to the Specifications and until receiving the Engineer's approval of the revised shaft installation plan.

If the Engineer has reason to believe that the drilled shaft excavation techniques or workmanship have been deficient, so that the integrity of any excavation is in question, Work on that drilled shaft may be stopped. Drilled shaft excavation will not be allowed to resume until the deficient excavation techniques or workmanship have been changed to the Engineer's satisfaction.

Dispose of materials removed from the shaft excavations according to 00290.20.

Do not leave partially completed shaft excavations open overnight unless they are cased full depth or otherwise stabilized with approved methods. If approved by the Engineer, a partially excavated shaft may be left open overnight, provided that the excavation:

- Is stabilized at the bottom, sides and surface to prevent Soil caving or swelling or a reduction of Soil strength, and
- Is covered at the surface to protect the public.

Extend the drilled shaft excavation if the Engineer determines that the subsurface materials encountered are not capable of providing the required bearing resistance or differ from those anticipated in the design of the drilled shafts.

(b) Protection of Existing Structures - Protect existing Structures according to 00512.43(b).

(c) Temporary Casing - Provide temporary casing according to the approved installation plan and of sufficient quantities to meet the needs of the anticipated construction method.

(d) Unexpected Drilled Shaft Obstructions - Remove unexpected drilled shaft obstructions according to 00512.43(d).

(e) Lost Tools - Promptly remove drilling tools lost in the excavation. Lost tools will not be considered unexpected obstructions and shall be removed without additional compensation. Drilling tools lost during the course of removing unexpected drilled shaft obstructions will be paid according to 00195.20.

(f) Clean Out - Clean out drilled shafts according to 00512.43(h).

00963.45 Reinforcing Steel - Furnish and place reinforcing steel as shown and according to the following:

(a) Placement - Do not place reinforcing steel in the shaft excavation until the Engineer has approved the final elevation of the bottom of the shaft.

In each shaft, place reinforcing steel extending from 3 inches above the bottom of the shaft excavation to the elevation shown. The reinforcing cage may be supported on the bottom of the shaft excavation if approved. Support the reinforcing cage to prevent distortion or settlement during concrete placement. If concrete placement does not immediately follow cage placement, remove the reinforcing cage from the excavation and rectify the integrity of the excavation prior to reinstallation of the cage.

(b) Bracing - Rigidly brace the reinforcing cage to retain its shape for lifting. Lift the cage in a manner that does not cause permanent racking or distortion. Show bracing and any extra reinforcing steel required for fabrication of the cage on the submitted shop drawings. Remove cross bracing during cage placement, unless otherwise approved.

(c) Concrete Cover - Maintain the required concrete cover shown on the Plans by placing concentric spacer bars or other approved devices around the reinforcing cage. Provide details of the proposed centering method on the shop drawings submitted according to 00963.40.

00963.47 Concrete - Furnish and place concrete according to the following:

(a) Concrete Placement - Place concrete immediately after completion of the shaft excavation and with the approval of the Engineer. Immediately prior to concrete placement ensure the shaft clean out requirements are met according to 00963.43(f).

Place concrete according to 00540.48(a) and continuously until concrete at the top of the shaft is free of water, Soil, and debris, and uncontaminated concrete extends to the plan top-of-shaft elevation. Dispose of all contaminated concrete expelled from the top of the shaft in an approved manner. Remove waste concrete from the site. If a delay in concrete placement occur because of a delay in concrete delivery or other factors reduce the placement rate to maintain a flow of fresh concrete into the shaft excavation.

Allow a maximum of 60 minutes between concrete placements and use no concrete older than 90 minutes from batch time. Use procedures for concrete placement which ensure that the concrete within the shaft becomes a monolithic, homogeneous unit.

Place concrete using hoses or pipes having watertight joints. For concrete placement by gravity tremie, use hose or pipe having an inside diameter not less than 8 inches. For placement by concrete pump, use hose with inside diameter not less than 4 inches. Provide an alternate delivery system that can be used in case of failure of the primary delivery system. Place concrete only against the bottom of the drilled shaft or into fresh concrete.

If caving occurs during concrete placement, the shaft may be rejected.

(b) Wet Shaft Concrete Placement - Perform wet shaft concrete placement according to 00512.47(c).

(c) Concrete Curing and Cleaning - Allow the exposed top of concrete to cure a minimum of 7 days by covering with wet burlap overlain with plastic sheets or by keeping top of concrete under water. Keep the burlap wet during the concrete cure.

Prior to placing any fresh concrete on top of a completed shaft, clean the upper surface of the concrete by removing all scum, laitance, loose gravel and sediment and chip off any high spots on the upper surface that would prevent the steel reinforcing bar cage from being properly placed in the position shown on the Plans.

(d) Casing Removal - Remove all temporary casing during or after completion of concrete placement. Do not start temporary casing removal until the level of fresh concrete within the casing has reached a depth of 10 feet or the level necessary to adequately counteract the external hydrostatic pressure head. As the temporary casing is withdrawn, maintain a minimum 5 feet head of concrete above the bottom of the casing. A slight downward movement of the casing while exerting downward pressure, or hammering or vibrating the casing will be allowed to facilitate extraction. Extract the casing so that concrete is cast directly against the surrounding in-situ material. Check the elevation of the top of the reinforcing cage before and after temporary casing extraction for conformance with the construction tolerance criteria of 00963.42. Casing that cannot be extracted during or immediately after the concrete placement operation may be cause for rejection of the shaft.

00963.48 Drilled Shaft Testing and Acceptance - Acceptance of drilled shafts will be based on the Engineer's review of the field inspection reports and visual observations during drilled shaft construction. The Engineer has final authority on the approval of drilled shafts.

00963.49 Scheduling and Restrictions - Do not proceed with additional shafts until the first drilled shaft has been approved. After the first drilled shaft on the Project has been accepted, make no significant change in construction methods, Equipment or materials used in the construction of subsequent shafts, unless approved by the Engineer.

For 24 hours after completion of concrete placement in a newly-constructed shaft, including withdrawal of casing if applicable, do not, within 15 feet of the shaft:

- Excavate adjacent shafts
- Construct footings
- Apply Equipment wheel loads
- Introduce vibrations with a velocity greater than 1/4 inch per second

Measurement

00963.80 Measurement - The quantities of signal support drilled shafts will be measured on the length basis, by the vertical excavated length from the bottom of the shaft to the ground surface. If directed to construct drilled shafts below the elevations shown, the drilled shaft will be measured from the revised bottom of shaft.

Payment

00963.90 Payment - The accepted quantities of signal support drilled shafts will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) 36 Inch Diameter Signal Support Drilled Shaft	Foot
(b) 42 Inch Diameter Signal Support Drilled Shaft	Foot

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- excavating the shafts and disposing of the excavated material
- furnishing, placing, splicing and removing temporary shaft casing and forms
- concrete and all reinforcement
- anchor rods, anchor plates, nuts, and washers

Section 00970 - Highway Illumination

Description

00970.00 Scope - In addition to requirements of Section 00960, Section 00962, and Section 02926, install highway illumination according to the following Specifications.

00970.02 Equipment List and Drawings - Submit four copies of isocandela diagrams indicating the vertical light distribution, vertical control limits and the lateral light distribution classifications for each type of luminaire submitted for approval.

Upon request, submit one copy of luminous intensity distribution data in IES format using electronic mail for each type of luminaire submitted with the following:

- **Vertical angles** - Provide data in increments of 5 degrees or less for the vertical angles of 0 to 90 degrees, inclusive.

- **Horizontal angles** - Use a maximum of 10 degree increments for all horizontal angles.

Complete description data is required.

00970.03 Luminaire Submittal - Provide a sample luminaire for inspection and photometric testing if required. Sample luminaires may be considered as part of the shipment furnished for installation.

Construction

00970.41 Metal Light Pole or Tower Table - The metal light pole or high mast tower table for the Project is shown on the highway illumination Plans.

00970.42 Cable and Wire - Use type XHHW stranded copper wire in all current-carrying conductors in raceways.

Support the conductors at the top of the pole using a flexible metal cable support grip to prevent insulation damage at the upsweep arm opening. When splicing cable into a new or existing circuit at a pole base (minimum wire length: 18 inches outside handhole), install a watertight, in-line fuse holder in the pole base for each current-carrying wire going up the pole. This fuse holder shall be constructed so the wire to the ballast can be disconnected without cutting or disconnecting wiring at the ballast. Insulate terminal ends of the in-line fuse holder using either heat shrink tubing or electrical insulating rubber tape over-wrapped with electrical vinyl plastic tape as specified.

Use No. 12 AWG Type XHHW wire from the control cabinet to the photoelectric relay.

Use 3 conductor No. 10 AWG Type TC cable from the pole base to luminaire ballast. Use 2 conductors for luminaire ballast connection and 1 conductor for circuit grounding at the luminaire. Extend and securely connect electrical circuit grounding for each circuit connected to the luminaire end.

For double arm illumination pole, two sets of wires shall be installed separately from the pole base to each luminaire end. Do not splice wires inside the illumination pole except at the pole base.

Wires from the ballast to the lamp holders shall conform to the manufacturer's recommendations.

Color coding of illumination circuits is required for three phase systems only. Ensure color coding of each phase conductor remains consistent throughout the entire electrical system.

00970.43 Photocontrol Electronic Relay - Install the photocontrol electronic relay on either the control cabinet or on the metal pole as shown.

Use 1 1/4 inch welded hub in top of cabinet to install photocontrol electronic relay with minimum 24 inch long galvanized metal conduit and twistlock plug. When photocontrol relay is attached on the side of the cabinet, use LB type conduit outlet body, 1 1/4 inch galvanized metal conduit riser, and galvanized channel support for the riser. Riser conduit shall be minimum 2 feet above the top of the control cabinet. Secure field installed relay and conduit extensions against vandalism and ensure they are rain tight.

When photocontrol relay is installed on metal pole, use welded hub outlet located 180 degree from luminaire arm, threaded close nipple and 1 1/4 inch LB type conduit outlet body. Locate the hub 30 feet above base plate or as shown.

Mount the relay away from adjacent luminaires, and orient the light sensitive relay's window to the northern sky. Mark the date of installation on the bottom of the photocontrol electronic relay.

00970.44 HID Luminaires - Level luminaires on the upsweep arms in both the transverse and the longitudinal direction, as recommended by the manufacturer.

On roadway grades greater than 4 percent, orient luminaires on the upsweep arm so that the light beams strike the Pavement equidistant from the luminaire.

(a) Mounting Height - Mount luminaires at heights shown. Measure the nominal mounting height from the top of the nearest edge of Pavement to be lighted to the center of the luminaire.

(b) Lamp Marking - Mark the month and year the lamp is installed on the lamp base dating system with a sharp instrument.

(c) Lamp Size and Identification Decals:

(1) Identification Decals for High-Intensity Discharge Lamps - Indicate the lamp size and type with a NEMA-approved decal on each luminaire as specified below. Apply decals on clean and prepared surfaces. Use decals that provide a durable, legible surface for the life of the luminaire, and:

- Are at least 3 inches square.
- Are made of noncorrosive, pressure sensitive material.
- Have a colored background with black numbers as shown in Table 00970-1.

For pole-mounted luminaires, install the decals on the bottom side of the luminaire or on the arm adjacent to the luminaire, whichever is more visible, as directed.

For wall-mounted luminaires, install the decals vertically on the luminaire housing or adjacent to the luminaire on the wall, as directed.

For pendant-mounted luminaires, install the decals horizontally on the ballast housing or externally at the top portion of the reflector if a remote ballast installation.

(2) Lamp Size and Identification Decal Code - Use the lamp size and color codes that conform to the following:

Tables 00970-1 A and 1 B - Lamp Decal Code
High Intensity Discharge Lamps

TABLE 00970-1 A

Lamp Wattage	Identifying Number
50	5
70	7
100	10
150	15
175	17
200	20
250	25
310	31
400	40
750	75
1000	x1

TABLE 00970-1 B

Lamp Type	Background Color
Phosphor-Coated Mercury	White
High Pressure Sodium	Gold - Yellow
Clear Metal Halide [1]	Red
Phosphor-Coated Metal Halide [1]	Green
Induction Lamp	Orange

[1] In addition, metal halide lamp targets shall include a 1/2 inch wide by 3 inch long strip of pressure sensitive, flat top, wide angle reflective tape to show lamp burning position requirements. Apply tape 1/2 inch from the lamp size target as follows:

Lamp Burning Position	Target Color
Any position	None
Base up to horizontal	None
Base down to horizontal	Gold
Position-oriented-mogul socket (POM)	Red

00970.45 LED Luminaires - Install LED luminaires as shown or as specified.

00970.46 Pole Identification - Identify luminaire poles with a numbered label corresponding to the pole numbers on the highway illumination Plans. Labels shall:

- Be made of noncorrosive, pressure-sensitive material suitable for outdoor use and resistant to fading and abrasion.
- Have blue or black numbers with a high-contrast colored background.
- Have 1/4 inch block numbers at least 2 inches high.

Install labels on poles so they are visible from a passing vehicle.

00970.50 Grounding and Bonding - In addition to the requirements of 00960.45 and 00962.50, ground and bond metal illumination poles and high mast towers according to the following:

Install 1-inch nonmetallic conduit from the pole base to the concrete and polymer concrete junction box at each pole. Install a ground rod in each junction box and install No. 6 AWG copper ground wire from the ground stud in the pole base to the ground rod in the junction box. The ground rod may be installed in the same junction box that provides illumination circuitry to the pole, if a separate and independent conduit is installed for the ground wire. Bond all metal conduit and metal junction box covers, if used, together to the ground rod.

On the inside of high mast tower shafts, weld a 1/2 inch Type 308, 309, or 310 threaded stainless steel stud for a grounding lug. Locate the grounding lug 90 degrees from and level with the bottom of the handhole.

Maintenance

00970.60 Maintaining Existing and Temporary Illumination Systems - Protect existing illumination systems and approved temporary replacements. Shutdown of a system may be allowed for alterations or final removal, as approved. Lighting system shutdowns shall not interfere with the regular lighting schedule. Notify the Engineer before performing any Work on existing systems.

Determine the exact location of existing conduit runs and pull boxes before using Equipment that may damage such facilities or interfere with any system.

Where Roadways are to remain open to traffic and existing lighting systems are to be modified, keep the existing systems in operation until the final connection to the modified circuit is made. The modified circuit is to be complete and operating by nightfall of the same Day the existing system is disconnected.

Finishing and Testing

00970.70 Field Test - Operate the completed lighting system or subsystem continuously for 7 consecutive days and an additional 7 days normal burn afterwards. When the lighting performance is satisfactory, the Contractor may be relieved of maintenance responsibility according to 00170.80(b).

Before completing the Work, conduct the following tests on all lighting circuits in the presence of the Engineer.

- A Megger test on each circuit between the conductor and ground with all switchboards, panelboards, fuse holders, switches, receptacles and overcurrent devices in place. Record all readings. Furnish the Engineer with one copy of the test results identifying observed readings with their respective circuits.
- Test the insulation resistance between conductor and ground. Resistance shall be as follows on circuits with total single conduction length of:
  - 2,500 feet and over - at least 6 MΩ
  - Less than 2,500 feet - at least 8 MΩ

Measurement

00970.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

The estimated quantities of lighting poles and arms are listed on the Project Plans. If individual pole lengths or individual arm lengths increase or decrease by more than 3 feet from the estimated quantities shown, adjustments to the Contract lump sum amount for the item "Lighting Poles and Arms" will be made according to 00190.10(h). Adjustments will be made only for the increased or decreased individual pole lengths or individual arm lengths greater than 3 feet.

Payment

00970.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Pole Foundations	Lump Sum
(b)	Lighting Poles and Arms	Lump Sum
(c)	Luminaires, Lamps, and Ballasts	Lump Sum
(d)	Switching, Conduit, and Wiring.	Lump Sum
(e)	Refurbishing and Reinstalling Existing Illumination Systems	Lump Sum

Item (a) includes all concrete foundations for lighting poles.

Item (b) includes all poles and arms for lighting poles.

Item (d) includes all switches, conduit, cabinets, wiring, delineators, junction boxes, and other items required to construct the lighting system as specified.

Item (e) includes all refurbishing, reinstalling, and other Work as specified and not included in the removal of existing illumination.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for labeling the luminaires or poles.

If shown or specified as part of the Work for concrete Bridges or retaining walls, all conduit, junction boxes, cabinets, and other items permanently attached to or encased within concrete Bridges and retaining walls, as well as pole foundations incorporated into a Bridge or wall, will be included in payment made for the appropriate Bridge and wall items.

00970.92 Electrical Energy Costs - All electrical energy costs for the lighting systems or subsystems will be paid for by the Agency.

Section 00990 - Traffic Signals

Description

00990.00 Scope - In addition to requirements of Section 00960 and Section 00962, install traffic signals according to the following Specifications.

Materials

00990.11 Electrical Materials - Submit all electrical materials the Contractor proposes to install according to 00960.02.

00990.12 Traffic Signal Control Devices - The traffic signal controllers and related Equipment shall conform to requirements of the current edition of the ODOT *Standard Specification for Microcomputer Signal Controller* and errata.

The most current published version of the ODOT *Standard Specification for Microcomputer Signal Controller*, including all published errata, on ODOT's Traffic Standards website (see 00110.05(e)) at the time of Advertisement is the version in effect for the Project.

Labor

00990.30 Video/Radar Detector Manufacturer's Representative - Provide the services of a manufacturer's representative on-site within 1 week in advance of the anticipated signal completion date to set up devices with Agency electrical crew present.

Construction

00990.42 Controller Cabinet Terminations:

(a) General - Terminate all field wiring to the terminal blocks physically attached to the controller cabinet.

00990.43 Traffic Control Signs - Furnish and install the type of sign and mount as shown. Signs shall conform to the applicable portions of Section 00940.

00990.44 Illumination on Traffic Signal Poles - Install illumination and associated appurtenances on traffic signal poles as shown and according to applicable portions of Section 00970.

Temporary

00990.50 Signal Covers - Cover mounted vehicle signals and pedestrian signals at all times until the signal installation is ready for continuous operation.

00990.51 Pushbutton Covers - Cover mounted pushbuttons at all times until the pushbuttons are operational.

Maintenance

00990.60 Cabinet Protection - Keep interiors of all cabinets clean and free of dust, dirt, moisture, and other foreign matter.

Finishing and Testing

00990.70 Testing and Turn-on - This Work includes the testing traffic signal control Equipment, testing traffic signal installations, and turning on completed traffic signal installations.

(a) Delivery of Control Equipment - Provide all traffic control signal Equipment for the Project according to the cabinet print(s), including all associated manuals, diagrams, and other documents. The cabinet print(s) will be made available to the Contractor by the Engineer. Deliver all traffic signal control Equipment, including wiring diagrams and operation manuals, in one shipment. Partial shipments will not be accepted and will be returned to the Contractor at no additional cost to the Agency. Include the following information with the Equipment shipments:

- Contractor
- Location
- For controller cabinets, TSSU ID number
- Contract number
- Completed Green Sheets

Deliver the traffic signal control Equipment and information for testing to:

Oregon Department of Transportation
Traffic Systems Services Unit
2445 Liberty St. NE
Salem, Oregon 97303-6738

(b) Control Equipment Testing - The following traffic signal control Equipment will be tested by the Agency for conformance with the Contract Documents before being installed:

- Controller unit
- Controller cabinet
- Power supplies
- Input devices
- Output devices
- Conflict monitors
- Flasher units
- Relays
- Preemption devices
- Auxiliary Equipment in the cabinet
- Other Equipment required for the operation of the installation

Control Equipment will be tested at no cost to the Contractor.

The control Equipment will be tested in three categories: physical, functional, and environmental as specified in the *Standard Specification for Microcomputer Signal Controller*. ODOT will require at least 6 weeks for completion and evaluation of the testing.

(c) Control Equipment Failure - A traffic signal control Equipment failure is any occurrence that results in nonspecified operation of the Equipment.

The Contractor will be notified of all control Equipment failures, and shall make on-site repairs within 5 days of receiving the notification.

Following repair of the control Equipment, the testing will be resumed at the beginning of the test category in which the failure occurred.

(d) Control Equipment Rejection - The traffic signal control Equipment will be rejected under either of the following conditions:

(1) Twice Fail - The control Equipment fails twice in the same testing category.

(2) Failure to Repair - The Contractor fails to repair the control Equipment within 5 days of receiving notification of the failure.

Pick up rejected traffic signal control Equipment within 10 days of receiving the rejection notice, or it will be returned, at Contractor's cost, to the Contractor.

Replace rejected control Equipment with Equipment having a different serial number.

Rejected control Equipment will not be accepted for testing or installation on any subsequent traffic signal project within the State of Oregon.

(e) Control Equipment Acceptance - Traffic signal control Equipment that successfully passes the testing procedure will be certified by the Agency as acceptable for installation. Acceptability for installation does not guarantee final acceptance of the completed installation.

The successful completion of the testing does not relieve the Contractor of the responsibility to furnish a complete working signal installation at the time the Equipment is placed in operation.

The Contractor will be notified when the testing has been completed. Pick up the controller cabinet at the test facility.

(f) Control Equipment Installation - Be responsible for pick-up, delivery and installation of the controller cabinet.

The Agency will be responsible for delivery and installation of the other control Equipment, such as controller units, input devices, switch packs, monitor units, miscellaneous plug-in devices and auxiliary devices not physically wired to the controller cabinet.

Other control Equipment that the Agency is to install will be stored at the test facility until the signal installation is ready to be turned on.

The Agency will be responsible for providing signal timing software and timing parameters.

(g) Field Testing - Field testing of traffic signal installations will be performed by Agency electrical crews. Notify the Engineer 1 week in advance of the anticipated signal completion date. The Engineer will notify the Agency's Traffic Systems Services Unit and the Agency's electrical crew of the anticipated completion date. Field testing will be performed within 1 week following the date of completion. The Engineer will notify the Contractor of the test results.

Information on Agency testing procedures is available from the Engineer.

(h) Traffic Signal Turn-on - The Engineer will establish the date and time the installation is to be turned on. The Agency will turn on the signal within 1 week after completion of corrections identified during field testing.

Be present at the Project Site.

After traffic signals are turned on and operating as designed, the agency ultimately responsible for maintenance will assume operation and maintenance of the signal. Turn-on does not constitute final approval. The Contractor is still obligated to finish any incomplete portion of the installation and correct problems with workmanship or replace material that does not meet Specifications. After turn-on, damage to the traffic signal installation caused by conditions beyond the Contractor's control will be the responsibility of the maintaining agency.

Measurement

00990.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Signs shown on the traffic signal poles, mast arms, or span wires that are shown on the sign and post data table will be measured according to 00930.80 and 00940.80.

Payment

00990.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Traffic Signal Installation, ____	Lump Sum
(b)	Traffic Signal Modification, ____	Lump Sum
(c)	Detector Installation, ____	Lump Sum
(d)	Ramp Meter Signal Installation, ____	Lump Sum
(e)	Interconnect System	Lump Sum
(f)	Flashing Beacon Installation, ____	Lump Sum
(g)	Automatic Traffic Recorder Installation, ____	Lump Sum

In items (a), (b), (c) (d), (f), and (g), the intersection location will be inserted in the blank.

Item (a) includes furnishing and installing all items of the traffic signal system and the detection system.

Item (b) includes furnishing and replacing or installing items for an existing traffic signal installation.

Item (c) includes furnishing and installing a complete traffic detection system for an existing installation, including required controller Equipment.

Item (d) includes furnishing all items of the ramp meter signal system.

Item (e) includes furnishing all the interconnect system.

Item (f) includes furnishing and installing all items of the flashing beacon system.

Item (g) includes furnishing and installing all items of the automatic traffic recorder system.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Mast arm pole and strain pole foundations will be paid for according to 00963.90.

No separate or additional payment will be made for:

- Replacement of disturbed earthwork, Base, and Surfacing
- Illumination and associated appurtenances shown on traffic signal poles
- Steel Reinforcement

Signs shown on traffic signal poles, mast arms, or span wires that are shown on the sign and post data table will be paid for according to 00930.90 and 00940.90.

PART 01000 - RIGHT OF WAY DEVELOPMENT AND CONTROL

Section 01030 - Seeding

Description

01030.00 Scope - This Work consists of seeding and associated tasks to develop plant growth for erosion control, environmental mitigation, and Roadside development.

01030.02 Definitions:

Certified Seed - A grass or legume seed named variety that has been reviewed and accepted into the Oregon Certified Seed program. Currently certified seed is individually sold in bags with a blue-colored Oregon Certification Tag, thus the name commonly used for such seed is "blue tag stock".

Establishment Period - A period when planting Work has been performed and initially accepted, and there is a Contract requirement to care for the planted areas in some way until the period ends.

Native Plant (existing) - A variety of plant species occurring in its natural habitat without direct or indirect human actions.

Noxious Weed - All weed designated by the Oregon State Weed Board as injurious to public health, agriculture, recreation, wildlife, or all public or private property. The Oregon Department of Agriculture (ODA) will be the authority in determination of noxious weed species.

Pure Live Seed (PLS) - The amount of living seed in the total quantity of seed when non-viable seed or non-seed material is excluded.

Riparian - Related to the bank, shore, or water-influenced areas of a watercourse or water body.

Sensitive Areas - Defined areas such as Wetlands, natural water and riparian resources, special environmental zones, or where certain activities are restricted such as the use of chemicals.

Specified Weeds - All noxious weeds as defined above, and all plant species identified in the Special Provisions or on the Plans as a species to be removed.

Waters of the State - See ORS 468B.005 for "Waters of the State" definition.

Weed - A plant that is undesirable where it is growing.

Weed Free - For these Specifications, "Weed Free" is defined as the following maximum amount of living weeds per square yard:

- Zero "Type A" or "Type T" Noxious Weeds
- One "Type B" Noxious Weed
- One of each non-noxious weed listed in the Special Provisions

The ODA Noxious Weed Policy and Classification System lists Type "A", "B", and "T" Noxious Weeds.

Weed Management Area (WMA) - A defined project area with specified weeds to remove, including areas where weeds begin growing because of Project-associated ground disturbance. A WMA may be the entire Project Site or any portion, including material source and disposal sites as shown.

Materials

01030.11 Topsoil - Furnish Topsoil meeting the requirements of 01040.14.

01030.12 Soil Conditioners, Amendments, and Bio-Amendments - Furnish Soil modifiers meeting the requirements of 01040.15, 01040.16, and 01040.17.

01030.13 Seed - Furnish seed meeting the following requirements:

(a) Label - Deliver all seed in standard, sealed containers. Label each container with the following:

- The kind and variety of each seed of 3 percent or more in a mixture, by weight. Be sure that seed mix labels include the words "mixture" or "mixed seed" when the seed is a mixture
- The country or state where the seed is grown
- The lot number or other lot identification
- The total percentage, by weight, of other crop seed
- The total percentage, by weight, of weed seed
- The total percentage, by weight, of inert matter
- Statement of "No Noxious (weed) Found"
- For each named seed:
  - Percentage of germination
  - Percentage of hard (non-living) seed, if more than 1 percent
- Percent of PLS for each kind of seed
- Percent and kind of other crop
- Month and year of seed test
- Net weight of contents
- Name and address of seed labeler or seller
- Origin for each seed (state or foreign country)
- If seed inoculant is used, the claimed date that inoculant effectiveness ends
- For treated seeds (if any):
  - Statement that the seeds have been treated
  - Name of all chemical used in the treatment
  - Description process used in the treatment
  - Warning statement for all residual chemicals used
- Net weight of each container
- For seeds listed as native, date and location of collection of source (first generation) seed
- For native seeds specified to be collected for direct use on a project, label containers with the date and location of collection sites for each seed species

Alternate label requirements may be identified in the Special Provisions for certain native plant seeds.

(b) Quality - Furnish seed meeting the following requirements:

- The seed and labeling complies with Oregon Seed Law and Federal Seed Act.

- The seed has been tested within 18 months of the planting date.
- The seed is not sprouted, moldy, or showing evidence of having been wet or otherwise damaged.
- The seed is labeled as "Oregon Certified Seed" or the equivalent from another state when identified in the Special Provisions. Information about certified seed is available from County Extension Offices, Oregon State University, and the Oregon Department of Agriculture.

(c) Pure Live Seed - Obtain the amount of seed to apply by using the purity and germination percentages from the label on actual bags of seed to be used on the Project.

To calculate the amount of seed to be applied:

- Obtain the PLS factor - Multiply the seed label germination percentage times the seed label purity percentage.
- Divide the specified PLS rate by the PLS factor.

Example: A PLS seeding rate of 10 pounds per acre is specified. The seed label shows a purity of 80 percent and germination is 90 percent. After converting percentages to decimals, 0.80 x 0.90 equals a factor of 0.72. The specified PLS rate, 10 pounds per acre, divided by the factor of 0.72 equals 13.88. In order to meet a PLS seeding rate of 10 pounds per acre, about 14 pounds of seed needs to be applied per acre. For a seed mix, make this calculation for every seed to obtain the total amount to be applied.

(d) Inspection - Each lot of seed is subject to inspection upon delivery to the Project. Seed that is not labeled or that does not conform to the Specifications will be rejected and shall be replaced at no additional cost to the Agency.

(e) Mixes - Furnish seed mixes that meet the labeling, quality and inspection requirements stated above. Submit all other proposed seed or seed mixes for consideration and receive written approval before seeding Work begins. Replace rejected seed before planting.

(f) Types of Seed Mixes - Seed mixes, quantities, standards, seeding rates, and other information will be included in the Special Provisions for each type of seed mix.

The following are the functional categories of seed mixes that may be included on projects (a category may have multiple functions on a Project Site):

- **Temporary Seeding** - To provide short-term control of Soil erosion until permanent seeding is performed or all potential for erosion is removed.

- **Permanent Seeding** - The final seeding, or only seeding performed for erosion control.

- **Lawn Seeding** - Seeding for areas where finished turf appearance is desired.

- **Wildflower Seeding** - Seeding to develop growth of wildflowers. The seed mix will typically contain grass or other plant seed to provide erosion control.

- **Plant Seeding** - Seeding which typically includes more than just grass species, such as seeds of woody or herbaceous plants.

- **Water Quality Seeding** - For use in water quality facilities such as swales or settling basins.

- **Wetland Seeding** - To vegetate existing or constructed Wetlands with native plant species.

- **Native Plant Seeding** - Seeding to restore native vegetation.

(g) Availability - Provide a list of seed sources for all specified seeds within 60 Calendar Days after execution of the Contract. Verify that all specified seed has been located and will be available for use on the Project.

01030.14 Fertilizer - Furnish standard, commercial grade fertilizer meeting the following requirements:

(a) General - Deliver fertilizers in separate or mixture containers that have the percentage of total nitrogen, available phosphoric acid, and water-soluble potash (NPK) in the amounts specified. Label each container with a quality compliance certificate that includes the container weight, the percentage of each ingredient, and the source of each component in the mixture. Ensure that each container is labeled with a quality compliance certificate that meets the applicable requirements of Section 00165.

Furnish fertilizer according to State and federal regulations. Fertilizer is subject to testing by the State Department of Agriculture.

(b) Type of Fertilizer - Provide the following fertilizer:

(1) West of the Cascades - Furnish 22-16-8 inorganic fertilizer analyzing 22 percent nitrogen, 16 percent phosphoric acid, 8 percent soluble potash, and including a minimum of 2 percent sulfur. Furnish fertilizer containing not less than 50 percent available water-insoluble, controlled-release nitrogen derived from one of the following sources:

- Urea formaldehyde (Nitroform)
- Isobutylidene Diurea (IBDU)
- Polymer coated urea (no sulfur)

(2) East of the Cascades - Furnish 22-10-5 inorganic fertilizer analyzing 22 percent nitrogen, 10 percent phosphoric acid, 5 percent soluble potash, and including a minimum of 10 percent sulfur. Furnish fertilizer containing not less than 50 percent available water-insoluble, controlled-release nitrogen derived from one of the three sources stated for West of the Cascades above.

(3) Statewide, Near Water - For application within 50 feet of open water, furnish 22-2-11 low-phosphorus fertilizer analyzing 22 percent nitrogen, 2 percent phosphorus, and 11 percent potassium which releases slowly over an eight to nine month period. Furnish fertilizer containing a minimum of 60 percent available water-insoluble, controlled-release nitrogen derived from one of the three sources stated for west of the Cascades above. Furnish phosphorus and potassium that is coated to allow a minimum of 95 percent controlled-release.

01030.15 Mulch - Furnish mulch Materials free of all weed or plant seeds and containing no substances detrimental to plant life. The kind of mulch materials acceptable for use will be shown on the Plans, listed in the Special Provisions, or will be as approved. Furnish mulch meeting the following requirements:

(a) Hydromulch from Cellulose, Wood, or Straw Fiber - Cellulose fiber produced from virgin wood, straw, or paper fiber product from the QPL. Furnish wood or straw mulch processed so the fibers remain uniformly suspended under agitation in water and the fibers have moisture-absorption and percolation properties. Ship hydromulch in packages of uniform weight, $\pm$ 5 percent, and labeled with the manufacturer's name and air-dry weight. Include enough green dye tracer so applied mulch is easily visible.

(b) Straw - Straw mulch for non-hydroseeding applications from bentgrass, bluegrass, fescue or ryegrass singly or in combination. Cereal grain straw from barley, oat or wheat may be allowed upon approval of the Agency. Provide straw that is not moldy, caked, decayed or of otherwise low quality. Submit certification from the Supplier that the straw is free of noxious weed seeds or plant parts. Acceptable documentation is any one of the following:

- The straw source is an "Oregon Certified Seed" field.
- The straw is certified by a recognized program accepted by the Oregon Department of Agriculture as being weed free.
- Seed lab test results of seed harvested from the straw meet minimum Oregon Certified Seed quality for weed seed content.

(c) Compost - Commercially manufactured medium compost material meeting the requirements of Section 03020, unless otherwise approved.

01030.16 Tackifier - Furnish a commercial quality tackifier containing no agent toxic to plant life. Furnish tackifier of either a liquid stabilizing emulsion or a dry powder tackifier meeting the following requirements:

(a) Liquid Stabilizer Emulsion - Tackifier with a base material of liquid, polyvinyl acetate polymers, using emulsion resins and containing not less than 55 percent total solids by weight. Furnish tackifier containing no polyacrylates or polyvinyl acrylics. The emulsion shall, when diluted with water and upon drying, allow exchange of air and moisture to the seeds and have an effective life of 1 year or more.

(b) Dry Powder Tackifier - Tackifier base consisting of one or more active hydrocolloids from natural plant sources, which hydrates in water and blends with other slurry materials, and upon application and drying tacks the slurry particles to the Soil surface, and exhibits no growth or germination inhibiting factors. Provide stabilizing emulsion in a dry powder form that may be re-emulsifiable, and consisting of a processed organic adhesive derivative of one of the following:

- Gumbinder derived from guar (Cyamopsis tetragonoloba)
- Gumbinder derived from plantain (Plantago insularis)

01030.17 Pesticides - Submit proposed pesticides and receive approval before using. Submit a copy of the manufacturer's federal registered label and, if requested, a Material Safety Data Sheet. The Agency reserves the right to restrict chemicals from being used on sensitive areas.

Labor

01030.30 General:

(a) Weed Control Coordinator - Submit certification at the preconstruction conference that the weed control coordinator meets the following minimum requirements:

- Demonstrates ability to identify noxious and other weed species commonly seen in Oregon. Some examples of potentially acceptable credentials are at least 1 year conducting weed surveys in Oregon or Washington State or a degree in botany or horticulture from an accredited institution.
- Has successful weed control experience, with similar duties to those stated under typical duties below, on at least three construction or vegetation management projects. Two examples of acceptable certification are an Oregon Pesticide Consultant License or Oregon Landscape Contractor's License held in the individual's name.

The weed control coordinator duties include:

- Identify Specified Weeds.
- Prepare and update the Weed Control Work Plan (WCWP).
- Coordinate Contractor's weed removal Work and records.
- Resolve weed control issues as the Contractor's representative.
- Determine when Specified Weed content exists in disposable materials and ensures the materials are disposed of at an approved off-site facility.

(b) Pesticide Applicator - Submit certification before application of pesticide Work begins, that when chemical weed control is used, that each applicator possesses an Oregon Commercial Pesticide Applicator's License held in the individual's name. Submit a certification each time a new applicator begins application Work on the Project.

Construction

01030.40 General - Notify the Agency not less than 24 hours in advance of seeding operations. Do not begin seeding until prepared slopes in an area have been approved for seeding. Do not perform seeding during windy weather or when the ground is frozen, excessively wet, or otherwise not tillable.

Do not disturb or damage existing desirable vegetation to be left in place. Do not disturb areas previously seeded and mulched, with the exception of disturbances caused by stage construction. If previously seeded areas are disturbed, rework and reseed as directed, at no additional cost to the Agency.

Remove all non-approved plants resulting from the seed mixes provided for the Project at no additional cost to the Agency, including erosion protection required during reseeding.

01030.41 Area Preparation - Refer to 01040.48 for area preparation for the following kinds of seeding:

- Temporary Seeding - Method E
- Permanent Seeding - Method D
- Wildflower Seeding - Method B
- Plant Seeding - Method B
- Water Quality Seeding - Method B
- Wetland Seeding - Method B
- Lawn Seeding - Method C
- Native Plant Seeding - Method B

01030.42 Weed Control - When the Contract Schedule of Items includes an item for "Weed Control", remove and prevent regrowth of Specified Weeds, weed plant parts, and weed seeds from areas within the Project limits.

Do not harm or disturb existing native or ornamental vegetation, unless directed to do so. Do not compact Soil with heavy Equipment in areas where Soil will not be disturbed for roadway or other construction.

If a pesticide has been approved for use, apply according to federal and State laws, including conditions and requirements of the federal registered pesticide label.

(a) Weed Control Work Plan - Depending on Project conditions such as location, sensitive environments, permit requirements, jurisdictional regulations, or other items, there may be limits on the use of chemicals or other weed control methods. Before submitting the initial WCWP, determine if there are restrictions or all potential for restrictions on weed control methods on Project Sites. At the preconstruction conference, submit a WCWP with the following:

- Name and contact information for the approved weed control coordinator.
- WMA's with existing Specified Weeds mapped on Project Plan sheets where possible.
- Botanical and common name of each species of weed to be removed.
- The proposed methods of weed removal and continuing control for each weed species listed.
- Schedule of weed control measures.
- Request to use wheeled or tracked construction Equipment in sensitive areas.

If changes of the WCWP are necessary, resubmit a revised WCWP for approval before proceeding.

(b) Weed Control Inspections - Inspect the Project for new growth of specified weeds at least monthly and apply weed control measures as appropriate. This requirement may be waived by the Engineer during the period that weeds are fully dormant. To ensure satisfactory weed removal, the last WMA inspection will occur at least 30 days after growing season has begun or as directed.

At a minimum, schedule weed control inspection with the Agency at the following times:

- After approval of WCWP and prior to beginning weed control within a WMA.
- Monthly.
- Upon request by the Agency to discuss non-compliant weed control Work.
- After completing weed control at material sources and disposal sites.

(c) Remove and Control of Weeds - Remove and control weeds according to the following:

(1) All Areas:

- At least 3 Calendar Days prior to beginning weed control activities, walk through each WMA with the Engineer and confirm the identity, location, type, and approximate number of Specified Weeds. Verify that control methods in the WCWP are acceptable as planned for each WMA before proceeding with weed control activities.
- Remove Specified Weeds and receive approval prior to beginning construction or Equipment mobilization in that area. As much as practicable, ensure that weed seeds or reproducing plant parts such as vines, runners, or rhizomes do not remain or become disbursed during control activities.
- As soon as practicable, place weeds and related materials in an approved container and transport to an approved offsite disposal facility according to applicable laws and regulations. During transport, ensure that materials are fully enclosed at all times to prevent escape.
- Keep a record of all weed material loads transported off the Project and submit documentation from the approved disposal facilities that a corresponding number of weed material loads were disposed of at that facility.
- Keep WMA's Weed Free including weeds not initially present in the walk through.

(2) Sensitive Areas:

- Unless otherwise approved in writing, use only hand or light mechanical weed control methods within 50 feet of Sensitive Areas. Hand methods include the use of hand tools. Light mechanical methods include the use of hand carried, motorized machinery.
- Inside Sensitive Areas, obtain approval before using wheeled or tracked construction Equipment. Requests will be approved only when all vegetation in the area will be cleared, such as under new Roadways or slopes.
- The Engineer will be the authority in the determination of Sensitive Areas.

(d) Weed Control Corrective Work - If corrective Work for areas identified as deficient by the Engineer is not completed within a 15 Calendar Day period, the Engineer may suspend the Work according to 00180.70. If the Contractor's weed control Work is determined to be unsatisfactory, the Agency reserves the right to do the Work at the Contractor's expense.

01030.43 Temporary and Permanent Seeding:

(a) Temporary Seeding - Temporarily seed disturbed Soils and slopes that are not at finished grade and which will be exposed for 2 months or longer before being disturbed again. Provide fertilizer, mulch, water, and other amendments necessary to ensure establishment. Ensure that temporary seeding Work achieves the coverage of live plants required by 01030.60 by the end of the next permanent seeding date stated in 01030.43(b). If this coverage is not achieved, or if the Agency determines that it is not effective in stabilizing the Soil from erosion, stabilize the area with other temporary stabilization methods as described in 00280.42 at no additional cost to the Agency.

(b) Permanent Seeding - Perform this seeding during the permanent seeding dates shown below. If Work done within the seeding dates does not provide coverage according to 01030.60, re-seed according to 01030.48 and as directed. The dates for permanent, wildflower, plant, water quality, Wetland, lawn, and native plant seeding are as follows:

- **West of the Cascades** - March 1 through May 15 and September 1 through October 31. If new lawn areas are regularly watered, they can be seeded from March 1 through November 15.

- **East of the Cascades** - October 1 through February 1. If new lawn areas are regularly watered, they can be seeded from March 1 through October 31.

- **Wetland (Statewide)** - September 1 through October 31 and March 1 through April 30.

Permanent seeding outside of these dates requires written authorization from the Agency. Approval to seed outside these dates will only be given when physical completion of Project Work is imminent and environmental conditions are conducive to satisfactory growth. For permanent seeding done outside the seeding dates, ensure that the coverage of live plants required by 01030.60 is achieved no later than 3 weeks into the next permanent seeding period. If this coverage is not achieved, re-seed and re-fertilize areas of insufficient coverage according to the permanent seeding requirements, at no additional cost to the Agency.

01030.44 Fertilizer:

(a) Inorganic - Apply 22-16-8 or 22-10-5 inorganic fertilizer at the rate of 400 pounds per acre.

(b) Low-Phosphorous - Apply 22-2-11 polymer coated urea low-phosphorus fertilizer at the rate of 200 pounds per acre.

01030.45 Soil Testing - Test Soil according to 01040.13.

01030.46 Topsoil and Wetland Topsoil - Construct Topsoil areas according to 01040.43 and 01040.44, as appropriate.

01030.47 Soil Amendments and Bio-Amendments - Incorporate Soil amendments and bio-amendments into the seeding operation according to 01040.45 and 01040.46, as appropriate.

01030.48 Application - The following application methods are acceptable for both temporary and permanent seeding:

(a) Hydroseeding, Fertilizing, Hydromulching, and Tacking - Apply seed, fertilizer, mulch, and tackifier as follows:

Use hydraulic Equipment that continuously mixes and agitates the slurry and applies the mixture uniformly through a pressure-spray system providing a continuous, non-fluctuating delivery. Ensure the Equipment and application method provides a uniform distribution of the slurry. Place seed, fertilizer, mulch, and tackifier in the hydroseeder tank no more than 30 minutes prior to application.

(1) Hydroseeding Operation - Perform hydroseeding according to the following:

a. One-Step Operation - Apply materials in one step only for the following situations:

- When seeding in conjunction with erosion control matting. Apply seed, fertilizer, and tracer before installing matting.
- When treating small areas according to 01030.48(e). Double the amount of seed to compensate for seed suspended above Soil by the mulch.

b. Two-Step Operation - Except for the one-step method situations in 01030.48(a)(1)(a), use the two-step method for all hydroseeding operations:

1. Step 1 - Apply seed, fertilizer, and tracer. The seed and fertilizer may be applied separately or together. If hydromulch is used as a tracer, apply it at a rate of 500 pounds per acre.

2. Step 2 - Apply mulch and tackifier. Hydromulch, if used as a tracer in Step 1, will be included as part of the specified hydromulch rate specified in 01030.48(a)(3).

(2) Seed - Thoroughly mix seeds when more than one kind is to be used.

(3) Mulch - Apply hydromulch at the following rates based on dry fiber weight:

a. Slopes Flatter Than 1V:2H - Apply cellulose fiber that includes a tackifier at a rate of 2,000 pounds per acre.

b. Slopes 1V:2H or Steeper - Apply cellulose fiber that includes a tackifier at a rate of 3,000 pounds per acre.

(4) Tackifier for Cellulose Fiber Applications - Use one of the following:

a. Liquid Stabilizer Emulsion - Dilute the emulsion with water at a rate of one part emulsion to 30 parts water. Apply the diluted mixture at the rate of 865 gallons per acre unless the manufacturer recommends a greater rate of application.

b. Dry Powder Tackifier - Apply at the following rates unless the manufacturer recommends a greater rate of application:

1. Slopes Flatter Than 1V:2H - 60 pounds per acre mixed with hydromulch fibers at the rate specified.

2. Slopes of 1V:2H or Steeper - 100 pounds per acre mixed with hydromulch fibers at the rate specified.

(b) Seeding, Fertilizing, Dry Mulching, and Tacking - Apply seed and fertilizer separately or together as the first step. Apply dry mulch as the second step. Tackify the mulch as the third step.

(1) Seed and Fertilizer - Apply seed and fertilizer at the specified rates. When fertilizer and seed are to be applied in dry condition, except when compost material is used, apply them separately. When applied from separate compartments, the application may be done in one operation by one of the following methods:

a. Blower - Blower Equipment using air pressure and an adjustable spout that uniformly applies dry fertilizer and dry seed in separate and successive applications at constant measured rates.

b. Helicopter - Helicopter equipped with hoppers and adjustable disseminating mechanisms that separately and successively apply fertilizer and seed in uniform and prescribed quantities.

c. Mechanical Spreaders - Hand or machine operated mechanical spreaders that uniformly apply dry fertilizer and dry seed separately and successively in the prescribed quantities.

d. Hydroseeding - Uniformly apply at the rate specified. Add 500 pounds per acre of hydromulch fiber to the seed and fertilizer mixture to visibly aid uniform application at no additional cost to the Agency.

(2) Dry Mulch:

a. Straw Mulch - Evenly apply straw mulch within 24 hours after seeding and fertilizing. In areas not accessible to heavy Equipment or hose, apply straw mulch by hand or other approved method.

Place straw mulch approximately 2 inches deep, in loose condition, which requires approximately 2 1/2 tons per acre of dry mulch, depending on moisture content. Do not use straw mulch on Slopes of 1V:1.5H or steeper.

b. Compost Material Mulch - Evenly apply compost material mulch with a pneumatic blower or other Equipment that propels the material directly at the Soil surface and achieves direct contact with the Soil. Apply compost at a uniform depth of 2 inches. Apply at least 3 feet over the top of the slope or overlap the material into existing vegetation.

When seed is required, apply it by one of the following methods:

1. Two-Step Pneumatic Application:

- **Step 1** - Apply compost to a uniform depth of 2 inches with a pneumatic blower or other Equipment that propels the material directly at the Soil surface and achieves direct contact with the Soil.

- **Step 2** - Uniformly mix seed with additional compost material and apply the combined seed and compost material over the first layer to a depth of 1/4 inch with a pneumatic blower or other similar methods.

2. Two-Step Pneumatic and Hydroseeding Application:

- **Step 1** - Apply compost to a uniform depth of 2 inches with a pneumatic blower or other Equipment that propels the material directly at the Soil surface and achieves direct contact with the Soil.

- **Step 2** - Hydroseed over the first layer according to 01030.48(a) except do not use fertilizer unless shown.

(3) Tacking - Anchor straw mulch using one of the following methods:

a. Dry Powder Tackifier - Unless the manufacturer recommends a greater rate, apply dry powder tackifier at the rate of 80 pounds per acre mixed with 800 pounds per acre of hydromulch.

b. Mechanical Crimping - Mechanically incorporate the straw into the top 2 inches of the Soil forming a uniform surface cover effective at preventing erosion by one of the following:

1. Crimping Disc - A heavy disk with flat scalloped discs approximately 1/4 inch thick, having dull edges and spaced no more than 9 inches apart.

2. Sheep's-Foot Roller - Modified sheep's foot roller equipped with straight studs, made of approximately 3/4 inch steel plate, placed approximately 8 inches apart and staggered. Ensure that the studs are not less than 6 inches long or more than 6 inches wide, and are rounded to prevent withdrawing the straw from the Soil. Use a roller with enough weight to incorporate the straw sufficiently into the Soil providing a uniform surface cover.

(c) Drill Seeder - Apply seed and fertilizer with a grass seed drill that works fertilizer into the Soil and places seed under about a 1/4 inch Soil cover.

(d) Seeding Over Mulched Areas - If an area has been previously mulched for erosion control or temporary seed and mulch is present on the Soil surface, double the amount of each seed type used. Apply seed and fertilizer hydraulically and add a green dye to the mixture to visibly aid uniform application. Upon approval, fertilizer and seed may only be applied after mulching if one of the following conditions apply:

- Mulch is punched into the Soil by mechanized means.
- It is necessary to hold down mulch with netting or like material.
- The Slope is 1V:1.5H or steeper and a slurry mixture would tend to run down the slope.
- Mulch is removed prior to seeding.

(e) Optional Temporary or Permanent Seeding - Upon approval, the following may be used to stabilized disturbed areas that are 1,500 square feet or less and totaling no more than 0.5 acre:

(1) Seed - Seed the disturbed area with the seed mix at the rate of 2 pounds per 1,000 square feet. Seed may be spread by mechanical spreader according to 01030.48(b)(1)(c).

(2) Cover - Cover seeded areas with one of the following:

- Straw mulch at a rate of 100 pounds per 1,000 square feet. Spread the mulch uniformly and apply commercial tackifier or netting to hold in place.
- Bark mulch spread uniformly at an approximate depth of 1/2 inch. Use well-decomposed mulch for seed mulching.
- Suitable open-weave, biodegradable erosion control matting installed according to manufacturer's instructions.
- Hydromulch applied in one step according to 01030.48(a).

(3) Fertilizer - Fertilize according to 01030.44.

01030.49 Work Quality:

(a) Drift - Prevent drift and displacement of seed and fertilizer regardless of Equipment and methods used. Use protective covering on Structures and objects where coverage and stains would be objectionable and when tacking agents are used with mulch. Protect vehicles and people from drifting spray. If Equipment and methods of application result in wasting material, make corrections to prevent waste.

(b) Displacement - Prevent seed, fertilizer, and mulch from falling or drifting onto areas occupied by Rock Base, Rock Shoulders, plant beds, or other areas where grass is detrimental. Remove material that falls on plants, Roadways, gravel Shoulders, Structures, and other surfaces where material is not specified.

(c) Damage - Prevent damage to prepared areas and to completed fertilizer, seed, and mulch Work. Replace all material that becomes displaced before acceptance of the Work.

Maintenance

01030.60 General - Ensure that each seeded area has a uniform, healthy and weed-free stand of grass or other seeded plants growing at the end of the Establishment Period. The minimum living plant coverage standards for acceptance of seeding in a planted area are as follows:

- **Temporary Seeding:**
  - **West of the Cascades** - 70 percent coverage of ground surface.
  - **East of the Cascades** - 30 percent coverage of ground surface.
- **Permanent Seeding:**
  - **West of the Cascades** - 90 percent coverage of ground surface.
  - **East of the Cascades** - 30 percent coverage of ground surface.
- **Wildflower and Wetland Seeding** - 70 percent coverage of ground surface.
- **Water Quality and Lawn Seeding** - 100 percent of ground surface.
- **Woody or Other Plant Seeding** - See Special Provisions for minimum living plant coverage.
- **Native Plant Seeding** - See Special Provisions for minimum living plant coverage.

01030.61 Establishment Period - The seeding Establishment Period is as follows:

(a) Erosion Control Seeding - For temporary and permanent seeding done solely for erosion control, the Establishment Period begins upon acceptance of the initial seeding Work and ends

upon satisfactory plant growth and coverage of the seeded areas according to 01030.43 and 01030.60.

(b) All Other Seeding - Establishment Periods for wildflower, plant, water quality, lawn, Wetland, native plant, and permanent seeding begins upon acceptance of the initial seeding Work and ends as follows:

- The seeding Establishment Period will end 45 days after the beginning of the Establishment Period, if the area was seeded during the seeding season and all establishment responsibilities have been met.
- If the original seeding construction is completed and accepted outside the permanent seeding dates, the Establishment Period will end 45 Calendar Days after all necessary reseeding is completed and accepted during the following seeding season.

01030.62 Establishment Work:

(a) Erosion Control Seeding - Select and provide establishment Work for erosion control seeding from 01030.62(b) necessary to provide performance described in 01030.60.

(b) All Other Seeding - Ensure the establishment of wildflower, lawn, plant, water quality, Wetland, native plant, and permanent seeding by the following:

(1) Protection - Protect seeded areas from trespass and other hazards of damage. Use protective fences and signs at no additional cost to the Agency. Obtain approval of protective methods used.

(2) Fertilizing and Watering - Apply fertilizer according to 01030.44. Apply water according to good horticultural practice under the prevailing conditions, as required to promote a healthy stand of plants. Obtain water at no additional cost to the Agency.

(3) Weed Control - Remove Specified Weeds prior to plants going to seed and keep WMA's and seeded areas "Weed Free" throughout the Establishment Period.

(4) Mowing - Mowing is required for lawn seeding and water quality seeding. Do the first mowing of grass when Soil is firm enough to prevent rutting and grass is about 3 inches tall. After mowing, leave grass that is approximately 2 inches tall. At each subsequent mowing, leave about 1 1/2 inches of growth. After the second mowing, grass clippings may be left in place upon written approval. The approval may be granted if:

- Mowing is done with a mulching blade.
- There are no weed seeds in the mulch.
- Mulch is not detrimental to the growth of grass.

(5) Repair and Restore - Repair and restore Soil grades and re-seed damaged, settled, or unproductive areas to the specified conditions of this Section at no additional cost to the Agency.

Finishing and Cleaning Up

01030.70 Cleanup - Remove weeds, trash, debris, stones, and other extraneous matter from seeded areas as directed and dispose of according to 00290.20.

01030.71 Waste Disposal - Dispose of materials according to 00290.20.

Measurement

01030.80 Measurement - The quantities of seeding and associated Work performed under this Section will be measured according to the following:

- **Unit Basis** - Unit basis items will be measured by actual count.
- **Area Basis** - Area basis items will be measured on the ground surface.

Payment

01030.90 Payment - The accepted quantities of seeding and associated Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Weed Control	Acre
(b)	Seeding Mobilization	Each
(c)	Temporary Seeding, ____	Acre
(d)	Permanent Seeding, ____	Acre
(e)	Wetland Seeding, ____	Acre
(f)	Water Quality Seeding, ____	Acre
(g)	Plant Seeding, ____	Acre
(h)	Native Plant Seeding, ____	Acre
(i)	Wildflower Seeding, ____	Acre
(k)	Lawn Seeding	Acre or Square Yard
(l)	Fertilizing	Acre
(m)	Mulching	Acre

Item (a) includes all Work associated with the WCWP.

Item (b) includes all labor and transportation of Materials and Equipment, each time the Contractor mobilizes as required for all hydraulically or airborne applied seeding, fertilizing, and mulching.

In items (c) through (i), the type of seed mix, such as Mix No. 1, if applicable, will be inserted in the blank.

Items (c) through (k) include preparing the seed bed, Soil preparation, seeding, fertilizing, mulching, applying tacking agent, and all establishment Work.

When temporary seeding, applied according to 01030.43(a), is later accepted as permanent seeding according to 01030.43(b), payment will be made only one time under the permanent seeding Pay Item. No separate payment will be made for the initial seeding.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- mobilization for application by blowers, mechanical spreaders, or hand spreading
- inspections or maintenance
- seeding mobilization if it is not included in the Contract Schedule of Items

Partial payments for permanent seeding, regardless of type, will be made as follows:

- At completion of seeding ……..……..…70%
- At completion of seeding Establishment Period….……30%

Section 01040 - Planting

Description

01040.00 Scope - This Work consists of planting and associated Work as shown or directed.

01040.02 Definitions:

Arborist - A specialist in the care and maintenance of trees.

Certified Arborist - An Arborist certified by the International Society of Arboriculture (ISA).

Consulting Arborist - An Arborist registered with the American Society of Consulting Arborists (ASCA).

Caliper - The diameter of a tree measured at a point 6 inches above the ground. If the measurement is over 4 inches, a new measurement is taken at a point 12 inches above the ground.

Dripline - The area directly under the branch and leaf canopy of trees and large shrubs. This area typically contains the most important of a plant's roots and is sometimes used as an approximate guide to estimate a root protection zone.

Licensed Nursery - Commercial nursery licensed by the Oregon Department of Agriculture to operate as a grower, dealer or agent, or to transport or store nursery stock grown or held for sale.

Native Plant (existing) - See 01030.02 for native plant definition.

Noxious Weed - See 01030.02 for noxious weed definition.

Ornamental Plant - A desirable plant species that is not native, or a plant propagated in such a way that it does not carry genetic characteristics of the species that are native to the area where it is planted.

Plant Establishment Period - A period of time, that is part of the planting Work, that ensures satisfactory growth and establishment of plants.

Permanent Wilting Point - The level of Soil wetness at which point a plant wilts and can no longer recover its sustainable turgidity when placed in a saturated atmosphere for 12 hours.

Root Protection Zone - A generally circular area around an existing plant to be protected from disturbance or compaction by the use of temporary fencing or other means. The zone as actually staked may exceed the current root area to allow for future growth of the plant. Root Protection Zones will be shown on the Plans or staked before construction activities begin.

Weed - See 01030.02 for weed definition.

01040.03 General - Ensure that Work meets the following requirements:

(a) Existing Vegetation - Do not disturb existing desirable vegetation that is to remain or is designated for protection, unless approved by the Agency prior to construction.

(b) Pesticide Applicators License and Chemical Registration - Furnish evidence to the Agency that each applicator is licensed for the specific class of chemical being applied. Also, furnish evidence that any chemical is registered for the proposed use by the Oregon Department of Agriculture according to ORS Chapters 452, 561, 570, and 634.

(c) Weather Conditions - Planting Work will not be allowed during the following conditions, unless otherwise approved:

- **Cold Weather** - When air or ground temperatures are expected to be below 32 °F.
- **Hot Weather** - When air or ground temperatures are expected to be above 88 °F.
- **Wet Weather** - When the ground reaches saturation, except as approved when planting wetland plants.
- **Windy Weather** - When wind velocity exceeds 25 mph.

(d) Work Performed During Unacceptable Conditions - If any Work occurs during unacceptable weather conditions, the Contractor may be required to provide the following services at no additional cost to the Agency:

(1) Expert Consultation - Consultation with a certified Arborist (for trees) or other expert as approved (for other plants) to determine what plant care measures are required to maintain the plants installed during the unacceptable weather conditions in a healthy and vigorous condition.

(2) Replacement - Replacement of all Work performed during unacceptable weather conditions.

(3) Watering and Maintenance - Watering and maintenance of all plant materials installed during the unacceptable weather conditions and responsibility for all extra costs incurred.

01040.04 Coordination - Coordinate the following elements with the Agency prior to construction:

(a) Planting Work Plan - Within 90 Calendar Days of Award of the Contract, submit a planting Work plan (PWP) for approval. Include or describe the proposed methods for the following:

- Work progress schedule according to 00180.41
- Material submittals according to 01040.10
- Contract Growing Plan according to 01040.19(g)
- Topsoil and/or Wetland Topsoil approvals according to 01040.14
- Plant installation and establishment
- Weed Control Work Plan (WCWP) according to 01030.42(a)
- Emergency contact person, including the name, telephone and pager numbers, and voice mail and/or email address information

The following are included as part of the PWP, but are required only before the related planting Work begins:

- Soil Fertility Test and Soil Amendment Report according to 01040.13.
- Soil Testing and Soil Bio-amendment Report according to 01040.13.

Proceed according to the approved PWP once written approval is received from the Agency. If any part of the PWP become unworkable at any time during construction, notify the Agency, then submit a revised plan. Do not proceed with the planting Work until approved by the Agency.

(b) Notice for Inspections - Notify the Agency a minimum of 24 hours prior to each required inspection.

(c) Site Conditions - Ensure that the area is properly prepared prior to the start of the planting operation.

(d) Utility Locate - Coordinate all existing Utility locations according to Section 00150.

(e) Utility Use - Provide required water and electricity for planting and plant establishment at no additional cost to the Agency unless an approved Agency source is available.

(f) Verification - Verify actual ground dimensions prior to construction. Notify the Agency of any discrepancies before beginning Work.

Materials

01040.10 General - Submit a list of Project materials for approval according to 01040.04(a) before arranging for procurement of any materials. For materials not approved, submit a list of alternate materials for approval. Materials installed without approval will be subject to removal and replacement with acceptable material at no additional cost to the Agency.

Substitute materials may be allowed if proof of equivalent quality, suitable product specifications, manufacturer's literature and other detailed information is furnished to the Agency according to 00140.70.

01040.12 Product Delivery, Storage, and Handling - Deliver manufactured products in original, unopened containers, each bearing the manufacturer's guaranteed analysis, name, trade name, and conformance with governing regulations and laws. Protect products against damage or dehydration. Remove unacceptable products as soon as possible from the Project site. If required or requested, provide any manufacturer's literature to the Agency.

01040.13 Soil Testing - Furnish the following kinds of Soil testing and reports:

(a) Soil Fertility Test and Soil Amendment Report - Prior to planting, furnish a Soil fertility analysis of existing Soils performed by a certified testing lab. Prior to planting, adjust Soil amendment and fertilizer applications as recommended by the Soil amendment report and as approved by the Agency.

(1) Sampling - Take five samples per acre of each Soil type. Mix the five samples into one test sample for each Soil type. Furnish Soil fertility test results that provide information on available nutrient content and fertility status of the Soil. Conduct sampling procedures according to the Oregon State University Extension Service handout EC 628, *How to Take a Soil Sample… and Why*.

(2) Testing - The test may be performed by any qualified soils testing laboratory. A list of qualified soils testing laboratories is available from the Oregon State University Extension Service. Include testing for levels of acidity (pH), salinity, nitrates, ammonium, phosphates, potassium, calcium, and magnesium, and any other tests necessary to determine appropriate fertilization and amendment needs for the type of plants being planted.

(3) Soil Amendment Report - Provide a report from the testing laboratory summarizing sampling locations and procedures with printed results, and which makes recommendations for fertilizers and Soil amendments to effectively develop productive Soil.

(b) Testing and Soil Bio-Amendment Report - Have Soils tested prior to planting by an approved Soil ecology lab. Provide information on Soil foodweb structure and function, and include total and active bacterial biomass, total and active fungal biomass, protozoan numbers, nematodes, microarthropods, and mycorrhizal colonization. Adjust the kind and amount of Soil conditioners,

Soil amendments, Soil bio-amendments, and fertilizers (if any) as recommended by the Soil bio-amendment report, and as approved by the Agency prior to construction.

(1) Sampling - Take five samples per acre of each Soil type. Mix the five samples into one test sample for each Soil type. Conduct sampling according to the standard procedures for Soil organism assessment as recommended by the Soil ecology lab.

(2) Testing - Perform the following Soil ecology tests and furnish Soil meeting these minimum Soil organism biomass requirements:

Test	Minimum Requirements
Percent active bacterial and fungal biomass	between 5% and 25% activity
Total bacterial biomass	6×10^8 per gram of dry Soil
Total fungal biomass	100 μg for grasslands 200 μg for shrubs or perennials 300 μg for forested areas
Protozoa	5000 per gram of Soil
Beneficial nematodes	20 per gram of Soil (No root-feeding nematodes)

Determine if anaerobic or compacted conditions are present, based on the assessment of total bacterial biomass, percent bacterial activity, and protozoan biomass.

If the Soil contains biomass numbers lower than these levels, apply amendments and inoculates according to the Soil ecology lab recommendations in the Soil bio-amendment report in 01040.13(b)(3).

(3) Soil Bio-Amendment Report - Provide a report summarizing sampling locations and procedures. Include the Soil ecology lab report of the Soil organism assessment and the recommendations for:

- Inoculation of missing organisms groups to the Soil.
- Amendment with food resources for organism groups with too low of a biomass.
- Reduction of undesirable groups, or groups with the biomass too high for the optimal growth of the desired plants.
- Any adjustments to the bio-amendments required for the types of plants being planted.

01040.14 Topsoil - Furnish Topsoil containing no substance detrimental to the growth of plants and that is free of plants designated by the Oregon Department of Agriculture as Type "A" or Type "B" weeds. Unsuitable Topsoil, or Topsoil placed by the Contractor without approval in areas to be planted, may be required to be replaced at no additional cost to the Agency.

Twenty days before furnishing any type of Topsoil, do the following:

- Give the Agency notice of intent to use the source.
- Provide access to the source for Agency inspection.
- Provide one 20 pound representative Soil sample of each Topsoil type for testing of particle size range and organic matter by the Agency, unless otherwise specified.
- Obtain approval of the source before excavation of Topsoil begins.

(a) Selected Topsoil - Furnish native Topsoil from the required excavations meeting the requirements of 00330.10 or from other Agency-Controlled Lands. The general limits of Topsoil

materials will be indicated on the Plans. The Agency will make the final determination of the areas where the most suitable materials exist. Furnish Topsoil that is the fertile part of a Soil profile commonly referred to as the "A" horizon, typically ranging in depth from 3 inches to 12 inches. Do not take material for Topsoil from a depth greater than 12 inches below existing ground, unless approved.

Select only sources that are well-drained and, before stripping, have a healthy crop of vegetative growth. Remove and dispose of all heavy grass or other vegetation before taking materials from the source.

(b) Imported Topsoil - Furnish imported Topsoil from non-Agency controlled lands that, when tested according to AASHTO T 88, meet the following limits:

Standard Sieve Analysis

Particle Size Range	Percent Retained (by Weight)
Larger than 2"	0
2" - 3/4"	0 - 5
3/4" - No. 4	0 - 20
No. 4 or less	0 - 100

Of the fraction passing the No. 4 sieve, excluding organic material, furnish Topsoil that conforms to the following limits:

Hydrometer Analysis

Particle Size Range	Percent (by Weight)
No. 4 - No. 200	5 - 70 (Retained)
No. 200 - 2 µm	20 - 80 (Retained)
Less than 2 µm	5 - 30 (Passing)

In addition, furnish Topsoil that analyzes at least 2 percent organic matter according to ASTM D2974.

(c) Wetland Topsoil - Furnish a native, naturally hydric wetland Topsoil consisting of Silts, Clays, and organic matter in combination that is free from substances detrimental to plant growth, such as noxious weeds, undesirable plant roots, refuse, sticks, or lumps. Provide wetland Topsoil that is from a Wetland with an existing, well established, healthy growth of the desired wetland plants. Obtain approval of the source before excavation of wetland Topsoil begins.

Excavate, at a minimum, the top 24 inch depth of existing wetland Soils using standard construction Equipment.

01040.15 Soil Conditioners - Soil conditioners are for modifying Soil structure and improving Soil aeration characteristics, as distinguished from plant foods, mulch, and Soil organism amendments. Furnish Soil conditioners free of noxious weeds, living plants and rhizomes, and substances detrimental to plant life. For mushroom compost and Peat moss only, submit a 15 pound sample for approval by the Agency prior to construction. Provide Soil conditioners that are free of weed seeds, excessive salts, chemicals detrimental to plant growth, and pest organisms. Soil conditioners proposed for use are subject to testing at any time or place the Agency deems appropriate.

Furnish one or more of the following Soil conditioners:

(a) Mushroom Compost - The used bedding material from commercial mushroom production.

(b) Commercially Manufactured Compost - Commercially manufactured medium compost material meeting the requirements of Section 03020, unless otherwise approved.

(c) Peat Moss - Horticultural grade, natural Peat moss in air-dry condition, free from woody substances, in bales or bags labeled for content and volume. Only Peat moss used in combination with one of the above composts is acceptable.

01040.16 Soil Amendments - Soil amendments are intended to improve Soil nutrition. Furnish Soil amendments that are free of materials detrimental to plant life. Furnish manufacturer or Supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material. Obtain approval for use before beginning Work. Soil amendments may include the following:

- Lime
- Dolomite Lime
- Gypsum
- Rock, Diammonia, or other Phosphate
- Calcium or Potassium Nitrate
- Iron Sulfate

01040.17 Soil Bio-Amendments - Soil bio-amendments are intended to increase beneficial Soil organism numbers or Soil organic nutrient content. Furnish bio-amendment products or materials that are free of substances or life forms detrimental to plant life and receive approval prior to use on the Project. Furnish manufacturer or Supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material. The following are typical Soil bio-amendments that may be identified in the Soil bio-amendment report:

(a) Bacterial Food Amendments:

- Simple sugars such as brown sugar, brown syrups, or molasses
- Plant extracts of Yucca or Nettle, usually containing sap of the plant comprised of a combination of simple sugars, proteins, and carbohydrates
- Fulvic acids
- Yeast, including baker's yeast, brewer's yeast, and champagne yeast
- Kelp meal
- Rock dust

(b) Fungal Food Amendments:

- Cellulose
- Lignin
- Humic acids - brown to dark brown products (black is not acceptable)

(c) Protozoa Food Amendments:

- Bacteria
- Hay infusions - A method of growing protozoa for Soil inoculation by using hay in water

(d) Nematode Food Resources - Nematodes come as four types: bacterial-feeders, fungal-feeders, root-feeders, and predatory nematodes. Predatory nematodes eat other nematodes, while the name of the other groups indicate what organisms they eat.

The primary source of material containing a wide diversity of beneficial nematodes is good compost. Provide certification that the compost contains beneficial nematodes and does not contain root-feeding or other detrimental nematodes.

(e) Mycorrhizal Inoculates - Commercially produced ectomycorrhizal and endomycorrhizal fungi that improve plant root absorption of Soil nutrients.

(f) Microbes - Commercially produced product designed to enhance microbiological activity in the Soil by the addition of beneficial and essential microbes. Commercial products may also contain vitamins, amino acids, plant growth hormones, micronutrients, and plant stress relievers.

(g) Earthworms - Common earthworms that are either "Red Wigglers" or "Night Crawlers" delivered in Peat moss or other damp medium.

01040.18 Fertilizer - The Soil amendment and bio-amendment reports will recommend fertilizer types and application rates. When identified in the report furnish commercial fertilizer meeting the requirements of 01030.14 and the following:

(a) Organic - Organic fertilizer 5-4-3, analyzing 5 percent nitrogen, 4 percent available phosphoric acid, and 3 percent soluble potash.

(b) Plant Bags and Tablets - Plant bags or tablets containing 20-10-5, or approved equal, may be used instead of granular fertilizer in pit planting.

Furnish plant bags or tablets that are controlled-release with a minimum one-year release period. Chemical formulation, rates and use will be approved by the Agency.

01040.19 Plants:

(a) Nomenclature - Botanical identification and nomenclature of plant materials shall be according to the most current edition of *Hortus Third*, by Bailey. The Agency may authorize use of other references such as the *Sunset Western Garden Book*, the *Flora of the Pacific Northwest*, by Hitchcock, or the *Manual of California Plants*, by Jepson.

Furnish plants that conform to the applicable requirements of the current issue of the *American Standard for Nursery Stock*, published by the American Association of Nurserymen. When a conflict exists between this publication and the Specifications, the Specifications will prevail.

(b) Quality - Provide plants that are healthy, first-class representatives of their species or variety, free from disease and insect pests, with top growth that is well developed and free of disfiguring knots, sun scalds, bark abrasions, wind or frost injury or any other objectionable features.

Furnish plants that are acclimated to the specific Project environmental site conditions prior to planting. Store all container-grown and balled and burlapped (B&B) plant materials acquired for fall planting a minimum of 3 months before planting, at a location north of the 42nd Latitude (Oregon - California border).

Furnish plants that possess top growth and root systems typical to their variety. Provide trees with central leaders that have a symmetrical, well-branched, straight trunk. Trees with a damaged or missing leader, multiple leaders or Y-crotches will be rejected, as will sheared conifer trees.

Protect plants at all times during handling, shipping, storage and planting against such detrimental effects as windburn, extreme weather conditions and drying of roots, root balls and foliage.

(c) Certification - Furnish a State inspection certificate and shipping certificate for each load or lot of plant material that includes the following information:

- Date of shipment
- Name of nursery where grown
- Name of plants (Including all names as specified in the Contract)
- Number of plants
- Grade or classification of plants (Verifying conformance with the Specifications)
- Size (Including height, spread, runner length, caliper and other measurements as required)
- Identify at least one plant (botanical and common name) within each group of like species
- Identify one plant (botanical and common name) within each different size category

(d) Inspection - Plants will be subject to inspection by the Agency, at any time and place. The Agency will make no plant material inspection at the source, except as it may elect. Notify the Agency of each delivery of plants to the Project site no less than 24 hours ahead of delivery. Do no planting until the plants have been inspected and approved for use. Any planting done without prior approval of the plants will be considered in violation of the Specifications.

The presence of noxious weeds in the Soil accompanying plants or at the nursery source will be cause for rejection of any or all plants from that source.

(e) Availability - Furnish a list of nursery sources for all specified plants within 90 Calendar Days after execution of the Contract. Verify, by this list, that all specified plant material has been located and will be available for use on the Project. If applicable, see 01040.19(g) for alternate requirements.

(f) Plant Substitution - No substitution of plant materials will be allowed unless written evidence is submitted that a specified plant or material cannot be obtained and has been unobtainable since the execution of the Contract. If substitution is allowed, it will be by written approval from the Agency for the nearest acceptable variety, size and grade. Make any request for substitution in writing to the Agency with ample time for approval without delaying the Work.

(g) Contract Grown Plant Materials - When required by the Special Provisions, include a contract growing agreement between the Contractor and a nursery Supplier in order to ensure plant availability or suitability.

If a contract growing agreement is part of the Project, submit a Contract Growing Plan that describes plant material size at delivery, growth environment, name and location of nursery, and the source for each plant (native seed, indigenous cuttings, or commercially grown). Submit this required information as part of the PWP.

(h) Definition of Plants and Descriptive Terms - The following definitions describe the distinctive habit and characteristics of the most common plant materials:

(1) Conifer Trees - Trees with needle or scale-like leaves that maintain live-leaf foliage throughout the year, and that usually bear seed from a woody cone.

(2) Deciduous Trees - Trees with leaves that are shed at the end of the growing season, and which remain leafless throughout dormancy.

(3) Transplanted Specimen Plants - Unique or large plants typically used in low numbers on projects. See the Plans for specimen type, size, and location. Deliver trees to the site that are dormant and with buds that have not yet swelled. Furnish plants that have an unbroken root ball sufficient to sustain continued growth. Ensure that the root ball size conforms to the current edition of the *American Standard for Nursery Stock*. Provide plants with no broken limbs or bark abrasions, and cleanly cut off any frayed roots or damaged limbs. Deliver trees that are balled and burlapped, boxed or moved by commercial tree spade.

(4) Balled and Burlapped (B&B) Plants - Plants excavated with Soil around the root system whose root ball is wrapped for shipping and handling. B&B materials are generally trees or shrubs, such as evergreens, that require a large ball of earth to sustain them after the transplant. Furnish plants that are balled and burlapped meeting the requirements of the latest edition of the *American Standard for Nursery Stock*, including minimum size of root balls.

Furnish plants with root balls securely wrapped in burlap or similar mesh fabrics not harmful to plants, and bound with removable twine or wire. Provide root balls that are firm, intact and held solidly together by a fibrous root system consisting of only the earth in which the plant was growing. "Made" balls will be rejected.

(5) Collected Plants - Plant material that is harvested from existing on- or off-site plant populations. Furnish collected plants that conform to all appropriate quality, grade and class requirements of the current issue of the *American Standard for Nursery Stock*.

(6) Container Grown Plants - Plants that are grown and delivered in containers which possess well-formed top growth and whose root growth is typical to the variety.

Furnish plants that are resident in their delivery containers long enough to have established new fibrous roots, have a root mass that will retain its shape, and hold 90 percent (visual estimate) of the root ball material when removed from their containers. Some root growth should be visible along the outer edges of the container. Root-bound container grown plants and "made" container plants will be rejected.

(7) Seedling Trees - Plants that are grown from seed in a nursery and brought to the site in a bare root condition. Provide seedlings labeled with age and certification (class number) which shows the number of seasons grown in a nursery seedbed, followed by the number of seasons grown in a transplant bed. Furnish seedling trees that are a minimum 2 years old.

Furnish seedling trees that are Oregon Department of Forestry "zoned" (grown) within approximately 500 vertical feet of the Project site elevation. Submit seedling zone information for the proposed plants to the Agency prior to construction.

(8) Bare-root Plants - Small deciduous plant material that is excavated for transplant with exposed roots. Furnish only bare-root plant materials that have dormant buds at the time of planting. Take great care to protect bare root plants against dehydration and sunburn.

(9) Plant Cuttings - Living, freshly cut branches from certain woody shrub or tree species that readily propagate when embedded in damp Soil. Furnish plant cuttings of regionally native species and dimensions as shown on the Plans. Obtain written approval of the cutting stock sources before taking any cuttings and furnish a brief, written description of the cutting sites and the date and time the cuttings were taken to the Agency. Take cuttings in such a manner so as to leave no long-term damage to the source population. If willow species are called for, select the local native shrub variety.

10) Fascine - Bound, cylindrical bundles of live plant cuttings that are placed in shallow trenches, partially covered with Soil, and staked in place, typically used to stabilize stream banks against erosion. Furnish only fascines of regionally native materials having the dimensions shown on the Plans.

(11) Brush Mattress - A combination of plant cuttings and fascines installed to cover and protect stream banks and shorelines. Brush mattress dimensions and any material requirements will be shown on the Plans.

(12) Tubeling Plants - Plants grown in containers that encourage deep root growth.

(13) Vines - Plants with growth primarily along stems, often having climbing characteristics, and typically attaching to walls by tendrils or other means.

(14) Groundcovers - Low growing or spreading plants.

(15) Wetland Plants - Plants that meet the definition of hydrophyte, which is any macrophyte that grows in water, or on a substrate, that is at least periodically deficient in oxygen as a result of excessive water content.

(16) Bulbs - For the purposes of this section, these will typically include the forms known as bulbs, corms, culms, plantlets, rhizomes, runners, small offsets, stolons and tubers. These plants will be collectively referred to as "Bulbs". The appropriate propagule (plant part that can be separated and used to grow another plant) will vary depending on the plant species.

(17) Sod Lawn - Grass sod grown on agricultural land that is commercially cultivated specifically for turf sod. Furnish sod that is free of weeds, diseases, harmful nematodes and insects. Provide sod that is mature, not less than 10 months old, and machine cut to a uniform thickness of 5/8 inch or more, excluding top growth and thatch. Broken pieces and torn or uneven ends will not be accepted. Plant sod within 36 hours of harvest.

01040.20 Mulch - Furnish plant bed mulch materials free of noxious weed seeds or plants and which contain no substance detrimental to plant life. Mulches are subject to inspection at any time and place at the discretion of the Agency. The following are some types of materials that fall under the category of "mulch", and may be used on projects:

(a) Bark Mulch - Ground, shredded or broken particles from the bark of fir, pine or hemlock trees which is free of non-bark debris, harmful bacteria, disease spores, pests and substances toxic to plant growth. Provide mulch that is the standard trade size known as "medium fine mulch".

(b) Cinder Mulch - Crushed lava cinders, screened to an approximate size between 3/16 inch to 5/8 inch. Furnish cinders free of fines and other non-cinder material.

(c) Straw Mulch - Provide straw mulch according to 01030.15.

(d) Rock Mulch - Round 3/8" - No. 4 pea gravel or round 2" - 3/8" Rock. Provide material that is free of fines and other non-gravel material. Rock colors may vary.

(e) Wood Chip Mulch - Mulch that is chipped from cleared site vegetation. Ensure that chipped material is free of any noxious weeds or invasive vegetation. Allowable size range or other qualities may be listed in the Special Provisions.

(f) Compost Mulch - Commercially manufactured medium compost material meeting the requirements of Section 03020, unless otherwise approved.

01040.21 Herbicides - The use of herbicide chemicals will be allowed only upon approval of the Agency. Select and apply chemical herbicides according to all applicable Federal, State and local laws, as well as the WCWP requirements of the PWP. The following are standard herbicide functional categories:

(a) Soil Sterilant - Chemical herbicide that is used to kill all new emergent vegetation, often including seeds or other plant parts.

(b) Pre-emergent - Chemical herbicide that is used to stop the germination of seeds before they grow above the Soil level.

(c) Post-emergent - Chemical herbicide that is used to selectively or non-selectively kill vegetation after germination and emergence above ground.

01040.22 Water - When required by the Special Provisions, furnish the following:

(a) Pressure Moisture Stress Sensor - A pressure chamber instrument capable of applying up to 40 bars or 600 psi to a small leaf or shoot in order to determine its water uptake potential. Instrument is to include all accessories necessary to perform a plant moisture stress test.

(b) Moisture Retention Chemicals - Granular chemical that are typically cross-linked potassium based polyacrylate or polyacrylamide copolymers. Provide commercial quality product from the QPL.

01040.23 Miscellaneous Items - Furnish miscellaneous items meeting the following requirements or provide commercial-quality products from the QPL. Obtain approval from the Agency prior to use.

(a) Anti-transpirant - Apply liquid anti-transpirant spray to all appropriate deliverable plant materials, prior to transport.

(b) Boulders - Furnish Boulders of indigenous materials, with source, dimensions, and other characteristics as shown.

(c) Browsing Protectors - Flexible, semi-rigid plastic or metal mesh, brown or light green in color, with stake supports.

(d) Game Repellent - A commercial nontoxic spray that makes vegetation unpalatable for animal forage.

(e) Root Barrier - A root barrier designed to contain and control root intrusion into unwanted areas.

(f) Tree Grates - Tree grates complete with frames, all required attachment hardware, and at least one issue of any specialty key or tool that is required to open or move the item for maintenance.

(g) Tree Stakes and Ties - Rough sawn tree stakes of 1 1/2 inches x 1 1/2 inches Douglas fir or pine, construction grade or better. Use stakes 6 feet long for trees less than 8 feet tall, and stakes 8 feet long for trees 8 feet or taller. Stain all tree stakes with an approved, dark green penetrating oil stain. Provide tree trunk protection of guying material of either a commercially available tree tie or a section of garden hose. Furnish tree guying material of a commercial product manufactured for this use, such as plastic chain, or stainless steel woven-wire with clamp fasteners. Size the guying material appropriate to the size of the tree and the wind factors of the area.

(h) Trunk Wrap - Typically manufactured of waterproof, crinkled paper and is designed to protect tree trunks against sunscald, loss of moisture and insect attack.

(i) Weed Control Geotextile - Weed control geotextile is typically manufactured of permeable, fibrous synthetic material and is generally for use under material such as mulch or gravel.

(j) Woody Coarse Debris - Logs or root-wads salvaged from on-site deciduous tree clearing and grubbing activity.

Construction

01040.40 General - Planting areas and plant locations shown on the Plans are approximate unless shown with dimensions. Be responsible for layout and staking for plant placement, subject to approval by the Agency before planting. The Agency will make only field measurements necessary to calculate and verify quantities for payment.

Adjust tree locations to avoid possible conflicts with vehicle recovery Clear Zones, utilities, Structures, miscellaneous appurtenances, and signing, as directed. In mowable grass areas, locate trees at least 10 feet from the edge of plant beds, other trees, fences, and ditch bottoms, unless otherwise specified.

01040.41 Planting Season (West of the Cascades) - Perform all plant installation Work from September 1 to May 15, unless otherwise specified. Container-grown materials located within irrigated areas may be planted at other times, depending upon written Agency approval.

Do not place lawn sod before March 15 or after September 30 without written Agency approval.

01040.42 Planting Season (East of the Cascades) - Perform all plant installation Work from October 15 to November 30, unless otherwise specified. Container-grown materials located within irrigated areas may be planted at other times, depending upon written Agency approval.

01040.43 Topsoil:

(a) Excavation - Prevent fouling of suitable material with subsoil or other detrimental matter. Form stockpiled Soil into windrows at least 6 feet high, not to exceed 13 feet high, to maintain and preserve Soil organism vitality.

(b) Subsoil Preparation - Grade and finish areas that are to receive Topsoil, allowing for the specified amounts of Topsoil. Scarify or till subsoil that is not loose and friable to a depth of 6 inches and obtain approval from the Agency before placing Topsoil.

(c) Hauling and Spreading - Haul and spread material without compacting the Topsoil or areas where it is placed. Protect from damage any surrounding objects, Pavement, Structures and areas that are traveled, crossed, or mounted by Equipment.

Smoothly spread the Topsoil over the specified areas to the thickness, grades, and Slopes shown or directed. Avoid wasting Topsoil and do not place material during wet conditions. Do not work saturated Soils in any manner. Material placed contrary to Agency instructions or in undesignated places will not be paid for and removal may be required at the discretion of the Agency.

(d) Finishing and Cleaning Up - Finish areas covered with Topsoil to proper grade, contour and Cross Section. Cultivate all Topsoil not in a loose and friable condition to a depth of at least 4 inches. Bring the surface to a condition ready for planting operations.

01040.44 Select Wetland Topsoil:

(a) Excavation - Stage construction so that excavated Soils may be moved directly to the Wetland mitigation location. If that is not possible, stockpile the material for not more than 28 days. Water

stockpiled material twice weekly and keep moist until used. Form stockpiled Soil into windrows at least 6 feet high, not to exceed13 feet high, to maintain and preserve Soil organism vitality.

(b) Subsoil Preparation - Excavate or grade areas to receive selected wetland Topsoil as shown on the Plans and finish as smooth as practicable through one Pass of standard construction Equipment. Have subsoil preparation inspected and approved by the Agency prior to spreading the selected wetland Topsoil.

(c) Hauling and Spreading - Transport select wetland Topsoil to the site by any means which meets all applicable regulations related to hauling potentially wet or moist materials. Spread the Topsoil to a depth of 6 inches minimum to 24 inches maximum, or to meet the finished elevations as specified on the Plans. Make as smooth as practicable without excessive Soil compaction. After spreading, have the area inspected and approved by the Agency prior to planting.

01040.45 Soil Amendments - Incorporate Soil amendments into the Topsoil when required by the Soil fertility test and Soil amendment report. The application rate will be verified by checking settings on the spreading or application Equipment.

01040.46 Soil Bio-Amendments - Incorporate the following Soil bio-amendments into the Topsoil of areas to be planted, according to the recommendations of the Soil bio-amendment report, the Supplier, or the following:

- Bacterial Food Amendments
- Fungal Food Amendments
- Protozoa Food Amendments
- Nematode Food Amendments
- Microbes and Biostimulants
- Earthworms - Add nine worms per cubic yard of Topsoil (this is approximately three worms for each 10 square feet of Topsoil at 12 inches depth).
- Mycorrhizal inoculation - Incorporate into the planting hole quantities of mycorrhizia sufficient to correct the Soil for the type of plants or grasses being grown.
- Mycorrhizal Inoculation (Injection) - Provide pre-measured packets containing live endomycorrhizal and ectomycorrhizal fungi.
- Mycorrhizal Inoculation (Root Dip) - Apply root dip material containing live endomycorrhizal and ectomycorrhizal fungi.

The application rate will be verified by visual inspection of application rates. A one-time application should be adequate, as long as pesticides, fertilizers or other toxic materials are not used at the same time. If it becomes necessary to apply pesticides that have non-target organism effects, or to apply fertilizer at rates greater than 13 pounds per acre, re-inoculate the organisms about 1 month after the pesticide or fertilizer was applied.

01040.47 Fertilizers - Incorporate fertilizer based upon recommendations of the Soil amendment and Soil bio-amendment reports or, with Agency approval, at the type and rate as follows:

Plant Bags/Tablets

Plant	Rate	Size
Tree	3 per tree	3/4 ounce
Shrub	2 per shrub	3/4 ounce
Vine/Ground Cover	1 per plant	3/16 ounce

Granular Fertilizer Rate

1 pound per tree per application
1/2 pound per shrub per application
1/8 pound per vine/ground cover per application

Evenly space planting bags or tablets around plants after planting pits are two-thirds filled with backfill. Mix granular fertilizer into the upper one-half of plant backfill.

The application rate will be verified by visual inspection. Furnish manufacturer or Supplier quality compliance certification according to 00165.35. Ensure that material testing methods meet the requirements of the Oregon Department of Agriculture appropriate to that material.

Do not allow the fertilizer application to conflict with the Soil bio-amendments. In case of questions, provide the Soil bio-amendment Supplier's written recommendations to the Agency.

01040.48 Planting Area Preparation - All planting areas shall be Weed Free before planting or seeding operations begin. Identify, kill, and remove plants according to 01030.62(b)(3).

Prepare planting areas according to the following methods, or as otherwise specified:

(a) Method "A" (Cultivated Planting Areas, Non-lawn) - Cultivate plant beds to a depth of 12 inches. Thoroughly mix 2 inches of Soil conditioners into the top 12 inches of plant beds. In addition, add Soil amendments, Soil bio-amendments and fertilizers, as shown or specified, according to the Soil amendment and Soil bio-amendment reports recommendations, into the top 12 inches of Topsoil.

Finish grades by raking to a grade tolerance of plus or minus 1 inch, with a smooth and firm condition, and an even grade that is free of undulations or low areas that could create standing water. Match existing grades at the perimeter. Finish to the proposed grades shown or specified.

On slopes that the Agency determines are too steep to cultivate, plants may be planted in individual planting holes prepared using method "B".

(b) Method "B" (Non-Cultivated Planting Areas) - Spray existing weeds and non-desirable vegetation with herbicide to kill all top growth and roots in areas not requiring cultivation. Use herbicides that have limited residual toxicity to permit safe planting as required under the Contract. Do not spray or otherwise harm plants to be saved. After inspection and approval, remove the dead top growth of plant material within 2 inches of the surface and dispose of according to Section 00320. Replace plants to be saved that are damaged by herbicide application at no additional cost to the Agency.

Add any Soil conditioners, Soil amendments, Soil bio-amendments or fertilizers with the backfill at each plant pit or to the seeding operation.

Finish Wetland mitigation planting areas to specified finish elevations, blending to existing ground smoothly, as required and directed. Except for projects that are less than 1 year in duration and unless otherwise approved, review the seasonal hydrology of the area to be planted for one full winter season (November 15 to February 28) prior to planting any wetland plants. Adjust plant types and planting locations as required or directed, based on the review of site hydrology.

When planting seedling plants, completely scalp vegetation from a 12 inch diameter area around each planting hole. Clear all debris such as wood and rocks from the planting spots, provided debris is not deeper than 12 inches. When debris is deeper, move the planting location. Use herbicides around seedlings only upon written approval of the Agency.

(c) Method "C" (Sod Lawn and Seeded Lawn Areas) - Cultivate existing ground to a depth of 6 inches, achieving a loose and friable condition suitable for fine grading. Remove all vegetation, rocks larger than 2 inch diameter, clods, roots, sticks, debris, and other matter detrimental to the growth of sod.

Uniformly spread Soil conditioners, Soil amendments, Soil bio-amendments, and fertilizer evenly over the area and thoroughly rototill into the Soil to a depth of 4 inches. Apply at rates recommended by Soil testing, or as follows:

Material	Rate (per 100 square yards)
Soil Conditioner	1/2 cubic yard
Fertilizer	10 pounds
Lime (Western Oregon only)	40 pounds

Fine grade and roll planting areas with a water-filled roller to provide a fine-textured, smooth, firm surface, free of undulations, irregularities or low areas that could create standing water. Grade areas receiving sod to within 1/2 inch of the designed grades, and 1 inch below adjacent walks, curbs and Pavement. Since sod thickness varies, adjust initial grades so the final sod Soil level is slightly below adjacent hard surface grades. Ensure that final sod grade does not create a pedestrian tripping hazard.

Furnish the Agency with sod mixture information and a quality compliance certificate from the sod grower, certifying sod compliance with mixture requirements, according to 01040.10.

Prior to completion of any sodding and seeding, re-grade ruts, footprints, washouts, or any other irregularities, and re-seed or re-sod repaired areas as originally specified.

(d) Method "D" (Rough Areas Seeded for Revegetation or Erosion Control) - Remove any matter detrimental or toxic to the growth of plants, including weeds, clods, rocks or debris. On Slopes 1V:3H or flatter, remove all debris larger than 2 inches in any dimension. On cut Slopes 1V:1.5H or flatter, roughen the surface with furrows parallel with slope contours and loosen the Soil to a depth between 3 inches and 6 inches.

(e) Method "E" (Temporary Seeding Areas) - If grading is required or directed, make Equipment Passes at right angles to the slope in order to form seed-holding tracks in the Soil.

01040.49 General Planting - Plant trees, shrubs, groundcover, vines, and bulbs using the following practices:

- Inspect plants after arrival at the Project and before planting. Do not install plant materials until each required inspection by the Agency is complete. Replace plants not meeting the requirements of the Specifications with plants as specified or otherwise directed, at no additional

cost to the Agency. Initial approval of plant materials for planting by the Agency will not constitute final acceptance.

- Protect all plants during shipping, handling, storage, and planting from windburn or exposure to harmful weather conditions, and root or root ball drying.
- When excavating planting holes, stockpile excavated Topsoil separately from subsoil. Do not include alkali Soil, subsoil, gravel, debris or rocks in the Topsoil. Dispose of any substandard excavated materials in a manner not harmful to plants or planting Work. Scarify planting pit sides and bottoms to eliminate glazed surfaces. Dispose of excess Soil in a manner that is not harmful to plants or planting Work.
- Do not plant in standing water unless approved by the Agency. If standing water is present within a plant pit, notify the Agency prior to planting to determine what corrective measures are required.
- Excavate tree plant pits a minimum of twice the diameter of the plant root ball or 2 feet larger than the root ball, whichever is greater. Dig shrub plant pits a minimum of 1 foot larger than the root ball diameter. Dig pits to the same depth as the root ball, root mass, or container. Spread root systems of bare root plants and container stock as necessary to keep plants from being root bound.
- Cleanly cut off broken or frayed roots of bare-root plants before planting. Spread out roots in their natural position within the pit and trim only damaged roots as approved by the Agency. Remove all labels, tags and attachment materials from the plants before final inspection.
- Set upright growing plants straight and plumb, and prostrate growing plants level to the ground surface. Set all plants so that, after settlement, they are at the same level as when growing in the nursery or container.
- Place the backfill then add Soil amendments, Soil bio-amendments, and fertilizers as recommended by the Soil amendment and bio-amendment reports. Moisten backfill completely after placing to eliminate air pockets and minimize settlement of the backfill. Form a shallow (2 inch high) water-holding saucer in the Soil around the plant unless directed otherwise.
- Balled and burlapped plants may be placed with the root ball wrapping removed or, if all materials are untreated and fully biodegradable, left in place. If the root ball wrapping (burlap) is left around the plant, completely remove all tie wire, string or twine and fold down the burlap from the top half of the root ball.
- Perform any required pruning using good horticultural practice appropriate to the type of plant. Prune to remove all dead, damaged, crossed or rubbing twigs and branches, and to compensate for loss of roots during planting. Make cuts close to the parent stem, but not flush or through the bark "knob" at the branch joint. Do not prune terminal ends of tree leaders without approval of the Agency.
- Apply bark or wood chip mulch of the type and depth as shown. Correct contamination of new mulch due to the Contractor's operations at no additional cost to the Agency. Feather mulch into plant material trunks, stems, canes or root collars, and leave 1 inch below the top of junction and valve boxes, curbs and Pavement edges. Any mulch placed to a thickness greater than specified will be at no additional cost to the Agency.
- Do not disturb protected existing vegetation unless approved by the Agency prior to construction.
- Dig pits for street trees that have hard surfaces around them so the crown of the root ball is 3 inches below the finished surface of the surrounding grade.
- Perform initial watering and continue with the watering frequencies according to 01040.71.

01040.50 Special Planting Requirements:

(a) Transplanted Specimen Plants - Use the following methods for transplanting specimen plants, unless otherwise specified:

(1) Mechanical Digging - Use a tree spade unless otherwise directed. Move only during the season that the tree is dormant. Treat deciduous plants with anti-transpirant prior to excavation. Confirm with the Agency that the size of the spade is appropriate to the size and type of tree prior to beginning Work. Dig the receiving hole prior to digging the tree to be transplanted. Take care not to damage the tree bark. Refill the original hole after transplanting. Do not move Oregon White Oak (Quercus garryana) by this method.

(2) Hand Digging - Before digging, obtain approval from the Agency for the size of container or root ball to be used for each plant. Begin digging at a diameter greater than the expected size of the root ball and remove dirt toward the plant until the surface roots show. When completely dug, secure the root ball with burlap and twine, wire basket or in a wooden box. Take special care to dig deep enough so that the taproot is not cut until it is smaller than 3/8 inch. Take care not to damage the tree bark. Refill the original hole and compact the Soil after transplanting.

Install perforated plastic drainpipe as shown. Add fertilizer, Soil amendments or bio-amendments to backfill Topsoil mixture. Stake or guy the tree as specified.

Provide one application of anti-transpirant before transplanting, and one application of Vitamin B1 growth hormone after planting to each specimen plant according to the manufacturer's recommendations.

Perform all replanting of specimen plants according to 01040.41 and 01040.42.

(b) Staking and Guying Trees - Stake and guy planted trees as shown or directed.

(c) Seedling Trees - Plant seedling trees using one of the following three methods:

- Planting hoe capable of opening a vertical hole broken out on three sides, with a minimum blade length of 12 inches and width of 3 inches.
- Planting shovel capable of opening a vertical hole broken out on three sides and at least 10 inches deep.
- Normal bare-root planting method.

No pre-staking of planting locations will be required. The Agency will be present as planting begins and will approve the spacing, planting method, and areas to be planted before Work can begin. Vary plant spacing in order to allow seedlings to be planted in suitable Soil. During the planting process, remove one tree at a time from the planting bag or other container to prevent drying of roots.

Place the roots of each seedling in the ground so that they assume a natural arrangement and do not twist, angle, bunch together or turn up at the ends. Plant seedlings so that the root collar is at or above the ground plane by no more than 1/2 inch. During planting, tamp Soil around the roots in the lower half of the hole. Then fill the hole to the surrounding Soil level and firmly pack so that no air pockets remain around the roots.

Ensure that seedlings do not pull loose with a tug strong enough to detach a small group of needles or small branch ends as applicable. Place a stake at the edge of each planting pit and install browsing protection and browsing repellant.

(d) Tubeling Plants - Place the tubeling into the planting pit without breaking the root mass. Set the top of the root collar 1/2 inch above finish grade, and gently tamp Soil around the plant to compact the backfill. Place a stake at the edge of the plant pit and attach a browsing protector around each plant.

(e) Collected Plants - After plants become dormant, excavate collected plants by hand, protecting the root mass against drying, freezing or breaking. If possible, plant all collected stock the same Day as gathered, or transport to a local nursery for temporary storage until final planting.

If immediate planting is not possible, place collected plants in heavy paper or plastic with slightly damp Peat moss or sterile potting Soil. Store dormant plants at 32 °F to 37 °F until planting. Examine stored material frequently for signs of stress or disease and correct storage conditions as necessary. Plant collected plants before dormant bud development.

(f) Bulbs - Plant dormant bulbs at a depth of 1 inch to 2 inches or to the grade they grew naturally. Compact the Soil firmly around the bulbs to prevent float-out and ensure good establishment. Dig holes large enough to naturally space bulbs within the planting area.

(g) Plant Cuttings - Collect and plant the cuttings while in winter dormancy, generally between October and March. Notify the Agency if conflicts exist with permit requirements. Store all cut material in ventilated plastic containers that allow free flow of water. Protect root systems from excessive drying at all times. Do not store plants in airtight containers.

Plant stock within 4 hours of harvest. If plants are a willow species, plant in the riparian zone on that portion of the slope where the plant stem ends will be in contact with year-round moist Soil as determined by the Agency. Make planting holes by forcing a steel bar or similar tool into the ground about 12 inches deep. Place the cuttings into the holes and tamp Soil firmly around the stems, leaving a minimum of 6 inches showing. Vary these dimensions as required for larger plant cuttings.

01040.51 Planting Wetland Plants - When planting wetland plants, do not use Soil amendments, mulch, or fertilizer. Plant rhizomes, tubers and plugs within the upper 2 inches to 3 inches in exposed muddy or moist Soils. When the water depth reaches or exceeds 1 inch notify the Agency of the potential need for adjustment to the planting.

01040.52 Placing Sod Lawn - Place sod only after approval of the Agency. Immediately before placing sod, water the Soil bed to prevent drying of grass roots. Lay the first sod row in a straight line, then place subsequent rows parallel to and tightly against each other, staggering lateral joints. Do not stretch or overlap the sod. Tightly butt all joints. Do not use sod segments containing less than 2 square feet of surface area.

After placement, diagonally roll and thoroughly water the sod. Apply a second application of 22-16-8 fertilizer at the rate of 510 pounds per 100 square yards and thoroughly water.

01040.53 Mulch - Apply mulch according to the following:

(a) Ornamental Plant Bed Areas - Submit a 15 pound sample of bark mulch to the Agency for visual inspection and approval. The approved sample will be the standard of acceptability for all mulch used on the Project.

Apply bark mulch after beds are made free of weeds and debris, the surface is brought to a smooth finished grade, and all planting Work (except for vines and groundcovers) is complete. Uniformly bark mulch planted areas to a nominal depth of 2 inches with bark mulch. Apply bark mulch so that it presents a smooth and even appearance as approved by the Agency (raking may be required).

Keep bark mulch off plants, Structures, Roadways, Shoulders, walks, and lawns. Uncover all plants covered by mulch material as soon as possible and leave the site in a neat, clean and finished appearance. When planting vines or groundcover, rake bark mulch away from planting pits so that

the bark is not contaminated. After planting, evenly spread excess Soil and rake bark mulch back into place.

Replace bark mulch that is displaced or blown away, and correct to the specified depth any bark mulch placed to a greater than specified depth, at no additional cost to the Agency.

Spread Rock or cinder mulch to a depth of 2 inches after planting trees and shrubs.

Spread compost on top of the Soil to a nominal depth of 3 inches.

(b) Non-Ornamental Plant Bed Areas - Apply mulch according to one of the following methods:

(1) Straw Mulch - Spread grass straw mulch to a nominal 2 inch depth and tackify, after planting of tubeling plants and seeding as required.

(2) Wood Chips - Spread wood chips to a nominal depth of 2 inches. Add 15 pounds of Ammonium Nitrate per 1,000 square feet to neutralize nitrogen loss.

(3) Compost Blanket - Spread compost on top of the Soil to a nominal depth of 3 inches.

01040.54 Water - Water all plants at intervals as required to maintain and promote healthy growth. Avoid excessive watering of shrub bed areas that may leach herbicide and damage adjacent lawns or desirable or protected vegetation. Repair all lawn vegetation damage at no additional cost to the Agency.

(a) Pressure Moisture Stress Sensor - When a pressure moisture stress sensor is specified, the Agency will test a 1 to 5 percent representative sample to ensure that the moisture stress level is below 20 bars of pressure and inform the Contractor if any material exceeds this limit. Any plant material found to have greater than 25 bars of pressure will be considered to be under extreme moisture stress. Provide sufficient water within 24 hours to bring the plant into normal range. The Agency will retest to determine the new representative pressure. Plant material that have 30 bars or greater will be considered to have reached its permanent wilting point. Replace all such material during the next planting period. Testing will occur mid-day at the following times until the end of the Establishment Periods:

- After plant delivery, during temporary storage, and before planting.
- At 1 month intervals throughout the summer season, up to the first fall rain or snow.
- At weekly intervals during extremely hot or dry summer periods.
- Any time the Agency believes the plant material may be under stress.

(b) Moisture Retention Chemicals - Utilize moisture retention chemicals according to the manufacturer's recommendation, depending upon specific applications.

01040.55 Miscellaneous Items - Place or install miscellaneous items as follows:

(a) Boulders - Place Boulders in locations as shown. Do not scar or break Boulders with Equipment. Ensure that one-third to one-half of each Rock is buried beneath finish grade. Verify all Rock placement with the Agency prior to installation.

(b) Tree Grates - Install grates, frames, and appurtenances as shown and according to the manufacturer's recommendations. Place frames flush at sidewalks and place guards plumb according to the manufactures recommendations.

(c) Weed Control Geotextile - Place weed control geotextile at finish Soil grade when planting is complete but before mulch placement begins. Place weed control geotextile with a minimum 4 inch overlap between rolls, turned under edges, and attached to the ground as recommended by the manufacturer.

(d) Woody Coarse Debris - Place woody coarse debris within the stream channel, facing upstream at approximately 45 degrees from the stream bank, or as shown or as directed. Anchor woody coarse debris to the stream channel bottom as shown.

(e) Anti-transpirant - Apply anti-transpirant according to the manufacturer's directions to all exposed foliage surfaces immediately before materials are delivered to the Project, or as otherwise specified. Provide certification of compliance.

(f) Game Repellent - Apply a game repellent to all exposed foliage surfaces immediately after materials are planted, or as otherwise specified. Re-apply to each plant every 120 days, or according to the manufacturer's printed instructions, until the end of the plant Establishment Period.

(g) Browsing Protectors - Install browsing protectors according to the manufacturer's recommendations.

(h) Root Barrier - Install root barrier according to the manufacturer's recommendation.

(i) Tree Stakes and Ties - Place tree stakes parallel with the prevailing winds and drive vertically into the ground at least 12 inches below the planting hole depth, or as shown. Do not drive stakes through the root ball.

(j) Trunk Wraps - Wrap tree trunks with the specified wrap, covering all exposed trunk between finish ground and the first whorl of tree branches.

01040.56 Cleanup During Construction - Maintain the Project in a neat, orderly condition. Remove unsightly construction materials at the end of each working shift. Clean all Pavement surfaces of mud, debris, or other materials that may, in the opinion of the Agency, cause problems. If material is not removed, the Agency reserves the right to have the cleanup Work performed and deduct the value of this Work from the monies otherwise due the Contractor.

Plant Establishment

01040.70 General - The Contractor is responsible for the survival of all plant material until the end of a plant Establishment Period of 1 calendar year. The plant Establishment Period will begin when all the original planting is complete. The original planting is considered complete when all the plant material has been planted to the satisfaction of the Agency.

Establishment Period Work includes removing all plants that have reached their permanent wilting point, are dead, dying, or which do not meet Specifications, and replacing them with healthy plants. All plants in place after this replacement will be recognized as the original planting and will be subject to the establishment Specifications. Repair, restore, and replace all plantings that have been damaged by vehicles, vandalized, and stolen according to 00170.80**.**

01040.71 Plant Care and Success Criteria - During the plant Establishment Period, maintain plants in a vigorous growing condition by regularly doing the following:

- Watering and fertilizing sufficiently to promote growth, unless otherwise specified.
- Weeding, cultivating, pruning, and repairing.
- Adjusting tree stakes and guys.

- Controlling weeds before they seed according to 01040.48.
- Controlling pests and noxious weeds before the reproductive cycle.
- Removing dead or non-vigorous plants.
- Replacing missing plants.
- Re-mulching of plant bed areas.

The determination of a successful plant Establishment Period will be made at periodic plant establishment inspections. A successful planting establishment for each inspection is defined as follows:

- All plants are surviving and have vigorous growth.
- Plants are free of insects and disease.
- Plants show signs of continuing health.
- Plants have not reached permanent wilting point.

At the discretion of the Agency, certain types of regularly spaced plantings such as groundcovers may be measured using an area sampling method. To determine the rate of survival, set out (delineate) representative plots measuring 100 square feet at the completion of the original planting at random locations in each general planting area. The representative plots will be mutually agreed upon between the Contractor and the Agency. Mark the plot corners with permanent markers such as re-bar, including date and identification. Delineate a minimum of three plots per acre of new planting area.

The use of representative plots is intended to simplify the measurement of planting establishment Work. If Work within the representative plots does not accurately reflect the condition of the entire planting areas, the Agency reserves the right to reject all establishment Work.

01040.72 Periodic Inspections - During the plant Establishment Period, the Agency will make three plant establishment inspections jointly with the Contractor at the following times:

- Spring, early May
- Summer, mid-July
- Fall, late September

Depending on when the Establishment Period begins, one of the above inspections will be the final inspection.

During each plant establishment inspection, the Agency may determine, based upon the specified success criteria, that corrective Work is required. If so, the Agency will provide the Contractor with a written notice of required corrective Work sent by hand-delivery or mail.

01040.73 Corrective Work - Complete all corrective Work within 15 Calendar Days after receiving the written notice of the required corrective Work to be taken. The 15-Day requirement excludes those days the Agency determines to be impractical for working.

The Contractor will be allowed to replace plants outside the Planting Season to perform corrective Work after each periodic inspection.

Provide plant replacements of the same variety, size, and quality as specified for the original plants, unless otherwise approved.

Notify the Agency when the corrective Work is complete. When the corrective Work has been re-inspected and is completed to the satisfaction of the Agency, the appropriate partial payment due the Contractor will be made.

If the Contractor does not perform the corrective Work within the 15-Day period after written notification, excluding those days the Agency determines to be impractical for working, the Agency may have the corrective Work done by others and deduct the entire cost of the corrective Work from monies due or to become due the Contractor under the Contract.

01040.75 Weed Control - Provide weed control according to 01030.42.

01040.77 Plant Establishment (Ornamental Areas) - In addition to these plant establishment requirements, perform the following:

(a) Watering, Fertilizing, and Mulching - Water all plants at the required intervals using the installed permanent or temporary irrigation systems, or such means as has been established for the Project. Avoid excessive watering of shrub areas adjacent to lawns that may leach herbicide and damage the lawn. Repair damaged lawns at no additional cost to the Agency.

If specified for the original planting, re-fertilize plants to promote vigorous growth.

Maintain the plant bed mulch at a 2 inch depth during establishment, unless otherwise specified. Rake to a smooth and even finish grade.

(b) Trimming and Pruning - Prune in order to enhance the natural growth of plants, eliminate dead growth and crossing branches, maintain growth within available space, minimize overgrowth onto walks and walls, and minimize tree canopy damage from winds.

Prune during the dormant season unless otherwise specified. Remove and dispose of all dead and critically damaged plant material to maintain the overall appearance of the Project.

(c) Transplanted Specimen Plants - Care for transplanted specimen plants immediately after the planting Work is completed. Water, fertilize, and protect specimen plants against disease and infestation as required to ensure the plants remain healthy and vigorous. Final acceptance of transplanted specimen plants will depend on plant health and condition.

(d) Sod Lawn - Mow, cut and fertilize sod lawns as required to maintain a healthy and vigorous condition. A schedule of feeding, mowing, and general treatment, including thatching and aeration will be listed in the Special Provisions. Final acceptance of sod lawn areas will depend on its health and condition. Keep sod lawns mowed to a height between 1 1/2 inches to 2 inches.

Do not perform the first mowing until the sod is firmly rooted and secure in place. Remove no more than one-third of the grass leaf during initial or subsequent cuttings.

01040.78 Plant Establishment (Mitigation or Other Non-Ornamental Areas):

(a) Watering and Mulching - Water all plants as necessary to promote and maintain growth using temporary irrigation methods. Keep planted areas raked to a smooth and even finish grade. Maintain mulch within plant saucers at a 2 inch depth, unless otherwise specified.

(b) Weeding - Perform weed control activities according to 01030.42.

(c) Soil Testing and Corrective Soil Amendments - If specified for the original planting, have a Soil test performed by a Soil ecology lab between the second and third periodic inspection. Present

the recommendations to the Agency at the third inspection. Apply the amendments as recommended by the Soil test report and as directed by the Agency.

01040.79 Final Inspection - After plant replacement Work and any other required Work has been completed, the Agency will make a final inspection. Ensure that all plant materials, planting beds and other facilities are according to the Specifications as a prerequisite for acceptance.

Measurement

01040.80 Measurement - The quantities of plantings and associated Work performed under this Section will be measured according to the following:

(a) Soil Testing - Soil testing will be measured on the unit basis for each test that is completed and accepted. Soil testing includes the required sampling, testing, analyses, and reports for one or more of the following:

- Soil particle size range test.
- Soil fertility test and Soil amendment report (including chemical analysis, acidity, salinity).
- Soil ecology analysis and Soil bio-amendment report.

(b) Topsoil and Wetland Topsoil - Topsoil and wetland Topsoil will be measured on the volume basis at the time of placement. Trucking invoices may be used to determine volumes if the quantities are verifiable to the satisfaction of the Engineer.

Topsoil taken from the required excavations according to 00330.10 will be measured according to 00330.82.

(c) Soil Conditioners - Soil conditioners will be measured on the volume basis in the hauling vehicle or in containers delivered to the Project site.

(d) Plant Materials - Plant Materials will be measured according to one of the following:

- **Unit Basis** - Under this method, plant Materials will be measured on a unit basis.
- **Average Area** - This method may be used when a plant bed area is greater than or equal to 3,000 square yards and will be measured as follows:
  - The total plant bed area will be measured on the area basis, along the ground surface.
  - 1 to 5 percent of the plant bed area will be selected and staked as 30 square yard representative plots.
  - All the plants in each staked representative plot will be counted. Unless otherwise approved, if the number of plants in a plot exceeds the number of required plants of the representative plot, the number of required plants will be used to represent the plot.
  - Based on the results of the plant count, the average number of plants per plot will be calculated.
  - The quantities of each item will be based on the calculated average number of plants per plot multiplied by the number of plots in the total plant bed area.

(e) Sod Lawn - Sod lawn will be measured on an area basis on the ground surface.

(f) Mulch - Mulch will be measured on the volume basis at the time of placement, or on the weight basis. Trucking invoices may be used to determine volumes if the quantities are verifiable to the satisfaction of the Engineer.

(g) Miscellaneous - Miscellaneous items will be measured as follows:

- **Tree Grates** - Tree grates will be measured on a unit basis. One grate includes two half grates, frame, hardware, tree guards, and appurtenances.
- **Woody Coarse Debris** - Woody coarse debris will be measure on a unit basis.
- **Boulders** - Boulders will be measured on a unit basis or on the weight basis.
- **Root Barrier** - Root barrier will be measured on the length basis.
- **Weed Control Geotextile** - Weed control geotextile will be measured on the area basis on the ground.

Payment

01040.90 Payment - The accepted quantities of plantings and associated Work performed under this Section will be paid for according to the following:

(a) Soil Testing - Soil tests will be paid for at the Contract unit price, per each, for the item "Soil Testing".

Payment includes mobilization, Soil sampling, testing, analyses, and preparation of the Soil amendment and bio-amendment reports.

(b) Topsoil and Wetland Topsoil - Topsoil, not taken from required excavations, will be paid for at the Contract unit price, per cubic yard, for the item "Topsoil".

Wetland Topsoil, taken from either the Project excavations or imported from other sites, will be paid for at the Contract unit price, per cubic yard, for the item "Wetland Topsoil".

Topsoil taken from required excavations according to 00330.10 will be paid for according to 00330.94.

No payment will be made for Topsoil or wetland Topsoil that is placed in nondesignated areas or which is contrary to the Agency's instructions.

(c) Soil Conditioners - Soil conditioners will be paid for at the Contract unit price, per cubic yard, for the item "Soil Conditioner".

(d) Plant Materials - Plants will be paid for at the Contract unit price, per each, for the appropriate items listed in the Contract Schedule of Items. Plant Materials will be listed by caliper size, size of container, or other size, or condition shown.

Transplanted plants will be paid for at the Contract unit price, per each, for the item "Transplanted Specimen Plants".

Partial payments for plant Materials will be made as follows:

At the time of the original planting 60%
After the first plant establishment inspection 10%
After the second plant establishment inspection 10%
After the third plant establishment inspection 10%
At completion of the establishment Period 10%

Partial payments made throughout the Establishment Period will be made for all surviving and replaced plants.

Upon completion of the Establishment Period, full payment will be made for all surviving and replaced plants, except for corrective Work performed by others according to 01040.73. The Agency will pay the Contract unit price only once for the specified quantity, whether or not plants are replaced.

If the Contractor requests partial payment for plant Materials on hand, payment will be made according to 00195.60.

(e) Sod Lawn - Sod lawn will be paid for at the Contract unit price, per square yard, for the item "Sod Lawn".

(f) Mulch - Mulch will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Bark Mulch	Cubic Yard
(b)	Cinder Mulch	Cubic Yard
(c)	Compost Mulch	Cubic Yard
(d)	Wood Chip Mulch	Cubic Yard
(e)	Grass Straw Mulch	Ton
(f)	Rock Mulch	Ton

(g) Miscellaneous - The accepted quantities of miscellaneous items will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Tree Grates	Each
(b)	Woody Coarse Debris	Each
(c)	Boulders	Each or Ton
(d)	Root Barrier	Foot
(e)	Weed Control Geotextile	Square Foot

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- Soil amendments
- lime, gypsum, or trace minerals
- Soil bio-amendments

- fertilizer
- herbicides
- anti-transpirants
- game repellant
- browsing protectors
- pesticides
- trunk wraps
- tree stakes and ties
- water
- pressure moisture stress sensors
- mulch materials required as part of replacement planting
- corrective Work during the plant Establishment Period

Section 01050 - Fences

Description

01050.00 Scope - This Work consists of constructing:

- Fences, gates, and gateways of barbed wire, woven wire fabric, chain link fabric, or combinations, to the lines and grades shown or directed.
- Protective fences, on and off Structure as shown or directed.

All dimensions shown on the Plans are horizontal and vertical measurement. Actual quantities required for the installation may be greater depending on the Slope of the terrain.

01050.01 Definitions:

(a) Fences - Fence, gates, gateways, and appurtenances, regardless of kinds and types.

(b) Gates - Swinging units to provide an opening in the fence line.

(1) Single Gate - A unit of 16 feet or less.

(2) Double Gate - Two single gate units used together.

(c) Gateway - Supported fence wire or fabric stretched between gate posts and fastened by bars, wire hinges and locking devices.

(d) Panel - That portion of fence between adjacent posts.

(e) Run - As used in this specification, run is defined as follows:

- **Fences, gates, and gateways** - The length of fence between end posts, intermediate end posts, corner posts, and gate posts.
- **Bridge protective fence** - A section of fence150 feet or less in length.

Materials

01050.10 Materials - Furnish Materials meeting the following requirements:

Bar Reinforcement	02510.10
Barbed Wire	03010.10
Chain Link Fabric	03010.30
Commercial Grade Concrete	00440
Fence Gates	03010.60
Fence Grounding	03010.50(e) and (f)
Fence Posts, Braces, and Appurtenances	02110.30, 03010.50
Guardrail Elements	02820.10
Pickets	03010.31
Protective Fence Materials, On and Off Structures	03010.75
Vinyl Clad Fabric	03010.40
Wildlife Fencing Fabric	03010.21
Woven Wire	03010.20

Construction

01050.40 General - Construct the several kinds and types of fences including the assembly and erection of all component parts and materials complete in place at the locations shown or directed. Confine activities and operations to the area immediately adjacent to the Right-of-Way line and within the highway Right-of-Way. Arrange for permits required from adjacent property owners to perform the Work.

Schedule the installation of fencing or provide temporary fencing or other adequate means to prevent livestock from entering the Project Right-of-Way, easements and/or adjoining properties according to 00170.92.

At Bridges, cattle passes and culverts, if shown or directed, connect the new fence to the Structure in a manner that permits free passage of livestock under or through the Structure.

01050.41 Lines, Grades, and Preparation Work - Unless otherwise directed, set fences so the fence fabric and wires are on Right-of-Way lines or Agency property lines, with posts set on Agency property. If directed, center concrete footings and fence posts 1 foot from the Right-of-Way or property line on Agency property.

Clear, grub and prepare the fence line area. Remove all shrubs, brush, snags, downed timber, float Rock, and other obstacles, including trees up to 6 inches in diameter which interfere with fence construction. If directed, preserve trees and geographic features on fence lines by varying the fence alignment to miss them.

Fill or excavate ground surface irregularities which interfere with maintaining specified clearance above ground surface of the bottom wire of the fence. Limit the width as necessary to provide a clear way for the fence.

Excavate for concrete footings to reasonably Neat Lines, but not less than the specified dimensions in Soil, or not less than 18 inches deep in Rock. Prevent disturbance of original ground at the sides and bottom of the excavation.

Clear and grade gate openings to permit the gate to swing in a horizontal plane according to 01050.48.

Dispose of materials removed under these provisions, including excess excavation, in a satisfactory manner.

01050.42 Optional Posts - Use steel or wood posts in barbed, or barbed and woven wire fence construction according to one of the following options, and once an option has been selected, use that option throughout the Project:

Option 1: Steel posts entirely in all types of fence.

Option 2: Treated wood posts entirely in:

- Type 1 fence
- Type 1-5W fence
- Type 2 fence
- Median fence on Median areas exceeding 16 feet in width

Option 3: Steel line post in combination with treated wood end posts, intermediate end posts, corner posts and gate posts in:

- Type 1 fence
- Type 1-5W fence
- Type 2 fence
- Median fence on Median areas exceeding 16 feet in width

01050.43 Installing Posts and Braces:

(a) General - Set all metal end posts, intermediate end posts, corner posts, gate posts, and chain link fence posts in concrete footings. Set all other posts firmly in the ground or in concrete footings as the Contractor elects.

Set posts to the depths shown. Reasonable variation in depths will be allowed and posts may be appropriately shortened or left slightly high, as approved by the Engineer, to:

- Avoid unnecessary penetration or excavation in Rock or other unusually firm material.
- Obtain desired grades along the fence.

Set all posts vertical, except on curved alignment set posts slightly off vertical, as directed, to offset the pull of the fence fabric and wires.

For bridge protective fence only, set all metal end posts, intermediate end posts, and chain link fence posts as shown.

(1) Driven Posts - Posts which are set by driving shall be free of damage when set. Remove and replace any driven posts which are split, twisted or bent, or have a badly misshapen tops.

(2) Dug Holes - Where Rock is encountered, set the posts to depths of not less than 18 inches and backfill with fine Granular Material. Do not exceed the post height shown by more than 3 inches.

When posts are set in dug holes, backfill in 6 inch layers with each layer separately and thoroughly tamped and compacted.

(3) Concrete Footings - Dimensions of footings shall not be less than shown and shall fill the excavated areas. Place the concrete with contact against firm Soil at the sides and bottom and tamp around the posts and brace ends after the posts and braces have been brought to and firmly held in proper position. Strike off, slope or crown and smooth the surface of the concrete at the ground level to shed water. Allow to cure for at least 5 Calendar Days before subjecting the posts and braces to strain.

(b) End Posts - Set end posts:

- At the beginning and end of new fence construction that is not terminating at gate posts.
- At the end of the intersecting line of existing fences just outside the line of the new fence.

(c) Intermediate End Posts - Set intermediate end posts in the line of the new fence:

- At each summit and at each valley in the grade of the fence where the algebraic difference in the grades of adjoining panels of fence exceeds 30 percent.
- At other points located along the new fence line to break the fence construction into approximately equal runs not exceeding the applicable lengths of runs shown.

(d) Corner Posts - Set corner posts as follows:

(1) Barbed and Woven Wire Fences - At angle of deflection exceeding 5 degrees for fences with steel line posts or 15 degrees for fences with wood line posts. Changes in line where the angle of deflection does not exceed the above limitations will be considered alignment angles. The adjacent line posts at alignment angles shall be made fast to the angle post by means of diagonal tension wires.

(2) Chain Link Fences - At angle points in fence alignment where the alignment of adjoining panels of fence changes direction by 20 degrees or more.

(e) Gate Posts - Set gate posts at the beginning or end of runs of fence to provide openings for gates or gateways.

(f) Line Posts - Set line posts along the line of fence, between end, intermediate end, corner, and gate posts, and at the spacings shown. Line posts may be set at spacings not exceeding 25 percent greater than specified or at closer spacings if approved. Set a line post in the new fence line at a point in alignment with each intersecting fence line approximately 1 foot from the end post of the intersecting fence line.

It is intended that the actual number of line posts will average to the number required for normal spacing.

(g) Braces - Construct braces before placing of fence fabric and wires on the posts.

(1) Metal Braces - Provide corner posts and intermediate end posts with two braces, one each direction from the post in the main fence lines. Provide end posts and gate posts with one brace in the line of the fence as shown.

Attach metal braces to the metal end, intermediate end, corner and gate posts and set in concrete footings.

(2) Wood Braces - Assemble and construct treated wood braces in conjunction with treated wood end posts, intermediate end posts, corner posts and gate posts to form units as shown. Fasten the wire brace guys to posts with three staples in each post. By means of a wood lever, twist together the four strands of wire between the posts until the entire assembly is taut and firm. Leave the lever in place. Drive the staples to provide contact with the wires without indentation of the posts.

01050.44 Barbed and Woven Wire Fence:

(a) Placing Fabric and Wire - Place fabric and wire on the face of the post which is away from the Highway or as shown. On curved alignment, place the fabric and wire on the face of the post against which the normal pull of the fabric and wire will be exerted.

Attach fence fabric and barbed wire to each post according to recognized standard practice for fence construction and as shown or directed.

(b) Splicing Fabric and Wire - Splices of fabric and splices of separate lines of wire between posts will be allowed provided that not more than two fabric or separate wire splices, spaced at least 50 feet apart, occur in any one run of fence. Use wrap or telephone type splices for the longitudinal woven wire and barbed wire with each end wrapped around the other wire for not less than six complete turns.

(c) Stretching Fabric - Stretch the barbed wire and woven wire fabric. Use care in stretching woven wire fabric, so the pull is evenly distributed over the longitudinal wires and not more than one-half of the original depth of the tension curves is removed.

(d) Fastening Fabric and Wire:

(1) At End, Intermediate End, Corner, and Gate Posts - Terminate the fence fabric and barbed wire at each end, intermediate end, corner, and gate post in the new fence line. Wrap each line of barbed wire and each longitudinal wire of the fence fabric around the post and then itself with at least four turns.

(2) At Line Posts - Fasten woven wire fabric to the post at top and bottom and at intermediate points not exceeding 12 inches apart. Fasten each line of barbed wire to each line post. Use approved wire ties or clamps to fasten the wires to metal posts. Drive staples, for use with wood posts, crosswise with the grain of the wood and pointed slightly downward. Drive the staples just short of actual contact with the wires to permit free longitudinal movement of those wires and to prevent damage to the protective coating.

(3) At Intersection of New and Existing Fence - Where existing fences intersect the new fence, cut the existing fence materials, or splice basically in kind new materials as necessary, and fasten each longitudinal wire of the fabric and each line of barbed wire to the new end post according to 01050.44(d)(1).

(e) Swinging Panels at Waterway Crossings - At waterway crossings subject to floating debris, if directed, construct wood framed swinging panels of fence fabric, barbed wire or combinations. Attach the panels to the lower wires of the fence to provide fenced closure of the waterway so there will be no unfenced side or bottom openings exceeding 6 inches when the waterway is at its lightest flow or is dry.

(f) Additional Panels at Depressions - If depressions in the ground surface leave unfenced openings greater than 12 inches in height beneath the bottom line of the fence, provide additional panels of fence fabric, barbed wire, or combinations between line posts, as approved, across the opening so no side or bottom openings exceeds 6 inches. If the bottom line of the fence leaves an unfenced opening beneath it of 12 inches or less, pull the fabric and wires down between posts and anchor with pins or posts driven at least 18 inches into the ground so there will be no bottom opening at any point along the fence greater than 6 inches in height.

(g) Stay Wires and Final Adjustments - Free the fabric and barbed wire in final position from warp and sag with stay wires placed approximately vertical to the grade of the fence. Appearance shall reflect first-class work. Retighten brace guys and leave the lever restrained against the fence fabric or fence wires.

01050.45 Chain Link Fence:

(a) Concrete Footings - Construct concrete footings according to 01050.43(a)(3).

(b) Chain Link Fence Rails and Tension Wires - Place longitudinal rails and longitudinal tension wires along the line of chain link fence, except at gates.

(1) Rails - Attach rails to end, gate and corner posts by clamps and sockets, and thread through loop caps on the end of line posts. Provide expansion sleeves or couplings at spacings not exceeding 200 feet in longitudinal top and bottom rails.

(2) Tension Wire - Attach tension wire to end, gate and corner posts by bands and clamps. Either thread the top tension wire through line post loop caps or hold in open slots in a manner

to limit vertical movement. Tie or attach the bottom tension wire to the bottom of line posts by ties or clamps in a manner that prevents vertical movement. Provide tension wires with one turnbuckle or one ratchet take-up in each run of fence.

(c) Chain Link Fence Fabric and Wire - Assemble and install chain link fence fabric and wire according to 01050.44 and the following:

(1) Splicing Fabric - Use spiral pickets of specified chain link fabric material for fabric splices. Use wrap or telephone type splices for tension wire and barbed wire with each end wrapped around the other wire for not less than six complete turns.

(2) Fastening Fabric - Fasten fabric to end, gate and corner posts and to gate frames as shown. Attach fabric to line posts with wire ties at top and bottom and at intermediate spacings not exceeding 18 inches. Fasten fabric to top and bottom rails and to longitudinal tension wires with metal bands or tie wires spaced as shown, but in no case greater than 24 inches apart.

(3) Screening Pickets - If shown, insert the screening pickets vertically in each diamond.

For bridge protective fence only, assemble and install chain link fence fabric and wire according to paragraphs (1), (2), and (3) of this Subsection.

01050.46 Protective Fence for Bridges - If welding of special connections for protective fence is required, prequalification of welders will not be required and inspection of welding will be visual.

01050.47 Fence Grounding:

(a) General - Except for bridge protective fence, provide at least one "ground" for each run of fence and place at any post within the run according to 00960.45(b). Fence grounding for bridge protective fence is not required.

Fasten each line of barbed wire, alternate longitudinal wires of fence fabric, and the rails and tension wire of chain link fences to the ground wire by clamps. Clamp the ground wires to the grounding rods.

(b) At Electrical Lines - Ground the fence directly below the point of crossing at each location where an electric transmission, distribution or secondary line crosses over the fence.

Ground the fence at each end or gate post or at intervals not to exceed 500 feet when an electric transmission, distribution or secondary line runs parallel or nearly parallel to and within 100 feet of the fence.

01050.48 Gate Installation:

(a) Metal Gates - Install metal gates and fittings between gate posts previously set as specified. Firmly attach the fittings to the posts and gates. Hinge each single gate in a manner which will prevent removal of the gate without tools. Set the gate in an approximately horizontal plane to swing freely inward and outward, and so it can be fastened securely in its latch holder, or in the case of double gates, in its latch holder and gate stops. Set double gates on their respective hinge pintles to provide a common horizontal plane in which each single gate swings.

Gates shall swing open at least of 90 degrees in each direction.

(b) Gateways - Construct gateways of the same material as the fence and as shown. Construct wire splices according to 01050.44(b). Provide a taut and well-aligned closure of the opening, capable of being readily opened and closed by hand.

01050.49 Removing and Rebuilding Fence - Remove and rebuild existing fences as shown or directed. Construct fences to approximately the same condition as the original fence. Salvage the materials in existing fences to be removed and rebuilt and incorporate in the rebuilt fences. Replace fence materials damaged beyond reuse at no additional cost to the Agency. Firmly reset posts to the staked alignment. Post spacing and the number of wires to be strung and stapled to the posts shall be the same as the original fence. Furnish and use new staples or clips to fasten the wires to the posts.

01050.50 Wildlife Fence:

(a) Concrete Footings - Construct concrete footings according to 01050.43(a)(3).

(b) Line Posts, Braces, End Posts, Corner Posts, and Gate Post - All post and brace components shall be metal. Do not use wood posts and braces.

(c) Braces - Install braces according to 01050.43(g)(1) and the following:

- Braces are required at fence starts, ends, and changes of direction. A single straight run of fence requires an intermediate end post and brace at intervals of no more than 600 feet.

(d) Wildlife Fence Fabric and Wire - Install wildlife fence fabric and wire according to 01050.44.

(e) Jumpouts - Construct jumpouts as shown or directed with borrow material conforming to 00330.12 that contains no particles with any dimension greater than 3 inches. Make jumpouts of uniform grade and compact until there is no reaction or yielding under the compactor. Jumpouts will be visually accepted by the Engineer.

Measurement

01050.80 Measurement - The quantities of fences, protective fences, gates, and associated items performed under this Section will be measured according to the following:

(a) Barbed and Woven Wire Fence and Gateways - Barbed wire fence, woven wire fence, and barbed and woven wire fence will be measured on the length basis. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates. Where existing fences are extended to intersect the new fence, the length of extension, from point of joining to the center of the new end post, will be measured and included for payment, if similar in design or type to a Pay Item, otherwise this Work will be paid for according to 00140.60.

(b) Metal Gates for Barbed and Woven Wire Fence - Metal gates for barbed and woven wire fence will be measured on a unit basis of each size of single gate and of each size of double gate, respectively. The size designation of gates for barbed wire and woven wire fence gates will be by width. The width will be the width of opening the gate is to fit.

(c) Chain Link Fence - Chain link fence will be measured on the length basis. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates.

(d) Metal Gates for Chain Link Fence - Chain link fence metal gates will be measured on a unit basis of each size of single gate and of each size of double gate, respectively. The size designation of chain link fence gates will be by width and height. The width will be the width of opening the gate is to fit.

(e) Protective Fence for Bridges - Bridge protective fence will be measured on the length basis. Measurement will be between beginning and ending locations as shown.

(f) Removing and Rebuilding Fence - Removing and rebuilding existing fence will be measured on the length basis, including gates. Measurement will be from center to center of posts, measured along the line and grade of fence removed and reconstructed.

(g) Wildlife Fence - Wildlife fence will be measured on the length basis. Measurement will be from center to center of posts, measured along the line and grade of each separate continuous run of fence as constructed, exclusive of gates.

(h) Metal Gates for Wildlife Fence - Metal gates for wildlife fence will be measured on the unit bases of each size of single gate and each size of double gate respectively. The size designation of the gates for wildlife fence gates will be by width. The width will be the opening the gate is to fit.

(i) Jumpouts - Jumpouts will be measured on the unit basis. Additional fence Material used in the jumpouts will be measured as wildlife fence.

Payment

01050.90 Payment - The accepted quantities of fences, protective fences, gates, and associated items performed under this Section will be paid for according to the following:

(a) Barbed and Woven Wire Fence - Barbed and woven wire fence and gates will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Type ____ Fence	Foot
(b)	____ Foot Single Gates	Each
(c)	____ Foot Double Gates	Each

In item (a) the type of fence will be inserted in the blank.

In items (b) and (c) the width of the gate opening will be inserted in the blank.

(b) Chain Link Fence - Chain link fence and gates will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	____ Chain Link Fence	Foot
(b)	____ Chain Link Fence with _____	Foot
(c)	____ Foot x ____ Inch Chain Link Single Gates	Each
(d)	____ Foot x ____ Inch Chain Link Double Gates	Each

In item (a) the type of fence will be inserted in the blank.

In item (b) the type of fence will be inserted in the first blank and the type of Material or pickets used for screening will be inserted in the second blank.

In items (c) and (d) the width of the gate opening will be inserted in the first blank and the height of gate be inserted in as the second blank.

(c) Protective Fence for Bridges - Bridge protective fence will be paid for at the Contract unit price, per foot, for the item "____ Foot Type ____ Protective Fence".

The height of the fence will be inserted in the first blank. The type of fence will be inserted in the second blank.

(d) Removing and Rebuilding Fence - Removing and rebuilding fence will be paid for at the Contract unit price, per foot, for the item "Removing and Rebuilding Fence".

New Material necessary to complete the rebuilding of fence will be included in payment made for the removing and rebuilding fence item.

(e) Wildlife Fence - Wildlife fence, gates, and jumpouts will be paid for at the Contract unit price, per unit of measure, for the following items:

	Pay Item	**Unit of Measure**
(a)	Wildlife fence	Foot
(b)	Jumpouts	Each
(c)	____Foot x 96 Inch Wildlife Fence Single Gate	Each
(d)	____Foot x 96 Inch Wildlife Fence Double Gate	Each

In items (c) and (d) the width of the gate will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Payment for Materials, Equipment, and labor involved in constructing panels of fence additional to normal fence construction at waterways and at ground surface depressions, according to 01050.44(e) and (f), will be paid for according to 00195.20.

Section 01070 - Mailbox Supports

Description

01070.00 Scope - This Work consists of removing and maintaining mailboxes and supports at temporary locations during construction, and installing mailboxes and newspaper boxes affected by construction on new supports at permanent locations as shown or directed.

Materials

01070.10 Reinforcement - Furnish reinforcement for concrete collars meeting the requirements of Section 02510.

01070.11 Concrete - Furnish concrete for concrete collars meeting the requirements of Section 00440.

01070.12 Tube Support Frame - Furnish tube support frames meeting either of the following requirements:

- Requirements of ASTM A500, Grade B, and galvanized according to AASHTO M 111 (ASTM A123).
- Tensile requirements of ASTM A53, Grade B, and galvanized with a minimum 0.9 ounce per square foot coating, as tested according to ASTM A90, on the exterior surface followed by a chromate conversion coating and a cross link polyurethane acrylic coating. A zinc base corrosive resistant interior coating shall also be applied.

01070.13 Mounting Brackets and Hardware - Furnish mailbox mounting brackets, angles, adapter plates, and hardware as shown and galvanize according to AASHTO M 232 (ASTM A153). Furnish mounting brackets for newspaper boxes as shown on the Standard Drawings.

01070.14 Post Mounting Socket - Furnish post anchors from the QPL.

Construction

01070.40 General - Protect and maintain mailboxes and supports at locations accessible to the delivery agent and as convenient as possible for the public being served. This may require removing and relocating the mailboxes and supports more than once to maintain service. When roadway construction is completed, install the mailboxes and newspaper boxes on new supports in their permanent locations as shown or directed.

Repair damaged galvanized surfaces, such as the cut end of the tube support frame or drilled holes, according to 02420.10(d), except add 1 1/2 ounces of leafing aluminum powder to each quart of high zinc dust content paint.

Install mounting brackets of the proper size to fit each existing mailbox.

If multiple supports are furnished for fewer than five mailboxes, install on the support Size 1 mounting brackets for the empty spaces.

If property owners want to keep the original mailbox support, place the support on the owner's property adjacent to the Work. Otherwise, dispose of the original mailbox support according to 00290.20.

Measurement

01070.80 Measurement - The quantities of mailbox supports and concrete collars will be measured on the unit basis of each kind of mailbox support and the number of concrete collars, regardless of size, installed in permanent locations.

Payment

01070.90 Payment - The accepted quantities of mailbox supports and collars will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Single Mailbox Supports	Each
(b)	Multiple Mailbox Supports	Each
(c)	Mailbox Concrete Collars	Each

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for:

- removing existing mailbox supports
- providing temporary installations
- installing new supports in permanent locations
- installing owner-furnished mailboxes and newspaper boxes

Section 01090 - Gravel Beds and Blankets

Description

01090.00 Scope - This Work consists of preparing areas for gravel beds and gravel blankets, and furnishing and placing Soil sterilant, weed control geotextile, and gravel bed Aggregates or gravel blanket Aggregates at locations shown or directed.

Materials

01090.10 Soil Sterilant - Furnish products with current legal labels listing active ingredients, which may include simazine, diuron, bromacil, sulfometuron-methyl, or from the QPL. Submit a sample of the proposed Soil sterilant's registered label to the Engineer for approval before using.

01090.11 Weed Control Geotextile - Furnish the following weed control geotextiles:

- 3 ounce, UV stabilized, nonwoven, polypropylene fabric
- 3.75 ounce, UV stabilized, needle-punched, polypropylene fabric
- Weed control geotextile from the QPL

01090.12 Aggregates - Furnish clean, uncrushed, nearly round Rock for gravel beds and gravel blankets meeting the following gradation requirements:

Sieve Size	Gravel Bed 3/4" - 1/2"	Gravel Blanket 1 1/2" - 1/2"
	Percent Passing (by Weight)	
2"		100
1 1/2"		80 - 100
1"	100	0 - 15
3/4"	80 - 100	–
1/2"	0 - 10	0 - 5

The Engineer may accept Aggregates by visual inspection.

Construction

01090.40 General - Prepare gravel bed and gravel blanket areas, and furnish and place Soil sterilant, geotextile, and Aggregates as follows:

(a) Excavation - Excavate and shape the areas for gravel beds and gravel blankets as shown or directed and according to Section 00330.

(b) Soil Sterilant - Furnish and place the approved Soil sterilant at a rate of application recommended by the manufacturer. During use of Soil sterilant strictly adhere to label cautions, especially those concerning existing plants or waterways in the immediate area.

(c) Geotextile - After the area has been treated with Soil sterilant, place the weed control geotextile over the prepared ground surface according to 00350.41(a). Extend or lap the geotextile as follows:

- **Gravel Beds** - Extend the geotextile approximately 2 inches up the sides of the bed and overlap at least 12 inches.

- **Gravel Blankets** - Lap the ends of the sheets 18 inches and the sides 12 inches.

(d) Aggregates - Place Aggregate cover as follows:

- **Gravel Beds** - Cover the geotextile with gravel bed Aggregates to the depth specified then level and roll with a water-filled landscape roller for a minimum of two complete coverages.

- **Gravel Blankets** - Cover the geotextile with gravel blanket Aggregates to the depth specified or directed.

Measurement

01090.80 Measurement - The quantities of gravel beds will be measured on the volume basis.

The quantities of gravel blankets will be measured on the area basis by surface measurement of the Material in place, limited to the established Neat Lines and grades as shown or directed.

Payment

01090.90 Payment - The accepted quantities of gravel beds and gravel blankets will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Gravel Beds	Cubic Yard
(b)	Gravel Blanket	Square Yard

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for excavation, Soil sterilant, or weed control geotextile.

PART 01100 - WATER SUPPLY SYSTEMS

Section 01120 - Irrigation Systems

Description

01120.00 Scope - This Work consists of installing irrigation systems and associated Equipment at locations shown or specified and as directed.

01120.01 Qualifications - In order to install certain kinds of Equipment or systems, manufacturer's certifications may be required, if described in the Special Provisions.

Materials

01120.10 General - Furnish only commercial quality materials and Equipment. All items proposed for use will be subject to testing to ensure compliance with the Specifications. Provide materials of the same function that are of the same type and the same manufacturer.

Submit a list of proposed materials for approval as soon as practicable after Award and before arranging for procurement of any materials, especially those materials or products not shown or specified. If any initially proposed materials are not approved, submit substitutes for approval. Any materials installed without approval will be subject to removal and replacement with acceptable material at no additional cost to the Agency.

Materials may be designated by trade name or by manufacturer's catalogue information as shown or specified. The use of a substitute material may be allowed if a written request for substitution and proof of equivalent quality and suitability are furnished. Make any request for substitution with ample time for approval without delaying the Work.

When alternate Equipment, such as sprinkler heads, is proposed for use with hydraulic characteristics differing from that originally shown, the following will be required:

- A redrafted, legible plan that shows the redesigned layout, location, or sizes of every affected system element as required for proper operation as originally designed. Furnish a plan showing every relevant system element, site feature, and plan element that was shown on the original plan. A plan made by marking up the original plan will not be accepted.
- A hydraulic calculation table for the alternate Equipment. At a minimum, show a complete calculation for one average sprinkler zone (section) and a complete calculation for the "worst case" sprinkler zone (i.e., the section that is farthest from the point of connection (P.O.C.), is the largest, or otherwise presents the most challenging hydraulics). Starting from the P.O.C., show the calculation with a step-down method with flow and loss at each piece of Equipment and length of pipe run between Equipment. Show the new total water required for each zone and the total for all zones to ensure that maximums for meter size, pipe sizes, and watering times will not be exceeded.
- Where any controller run-time change will be required, submit a separate page showing the total timing per controller required for each section, to show that timing changes will still allow all zones to be run within a reasonable time period.
- A cost page showing the Contractor's actual discount cost from the Suppliers, comparing the original plan costs versus the proposed Equipment costs for each type of item, such as pipe by size, where there is a change required. Show the line total of each type of item and the grand total for the proposed change.

01120.11 Pipe, Tubing, and Fittings - Furnish galvanized iron or steel, PVC, or polyethylene pipe as shown or specified that meets the following requirements:

(a) Galvanized Pipe and Fittings - Furnish pipe of standard weight, hot-dip galvanized iron or steel, standard threaded, coupled, and that meets the requirements of ASTM A53. Non-standard threaded fittings will be rejected.

(b) Polyvinyl Chloride Pipe and Fittings - Furnish PVC pipe and fittings of PVC compound Type 1, Grade 1, conforming to ASTM D2241 and certified approved by the National Sanitation Foundation. Provide pipe and fittings free from defects caused by poor materials, low quality of Work, or rough handling. Dimensional and quick burst tests of pipe and fittings may be required after arrival at the Project Site before materials will be accepted.

Furnish pipe and fittings as follows:

Used for	Class or Schedule
Main and lateral lines	Class 200 or Schedule 40 PVC
Irrigation sleeves	Schedule 40 PVC
Caps	Schedule 80 PVC
Direct bury pipe, not in sleeves, placed under road beds or other paved areas	Schedule 40 PVC

Unless otherwise specified, furnish entire Project with one pipe class or schedule type.

Furnish PVC threaded pipe of PVC 1120, schedule 80 material conforming to ASTM D1785.

Provide PVC solvent-weld pipe of PVC 1120 materials having a 200 psi minimum pressure rating with SDR 21 walls that conform to ASTM D2241.

Furnish PVC pipe fittings conforming to ASTM D2466, Type I, Grades 1 or 2.

Pipe may be belled on one end with the dimensions of the tapered bell conforming to ASTM D2672.

Install PVC pipe with walls heavier than SDR 21 when shown or specified.

(c) Non-Potable Colored Coded Pipe - Wherever non-potable, reclaimed or reuse water is used, furnish PVC pipe that is tinted purple and imprinted with the warning "Caution: Reclaimed Water - Do Not Drink". Provide pipe meeting the same AWWA and ASTM specifications as the potable water pipe sizes on which they are based.

(d) Polyethylene Pipe - Furnish polyethylene pipe of Class 80, SDR 15, medium density, meeting the requirements of ASTM D2239, conforming to U.S. Commercial Standard CS-255, and approved by the National Sanitation Foundation (NSF).

(1) Micro Tubing and Fittings - Where drip emitters are not required, furnish a blank type and provide any connections necessary. Provide tubing consisting of nominal-sized linear, low-density, minimum 1/4 inch outside diameter (OD) polyethylene.

(2) Low Volume (Drip) Tubing - Furnish drip tubing manufactured from specially formulated, chemical-resistant, low to medium density, virgin polyethylene or polybutylene which is selected for excellent weatherability and stress cracking resistance, and is designed specifically for use in drip irrigation systems. Provide drip tubing having a minimum wall thickness of 0.044 inch.

01120.12 Automatic Controllers - Provide Underwriter's Laboratories (UL) approved controllers as shown or specified. Furnish each outdoor controller with either a pedestal or wall mount brackets when appropriate. Provide and install the controller in a weatherproof and vandal-proof cabinet of corrosion-resistant metal. Furnish the controller housing or cabinet with hasp and lock or locking device. Provide locks or locking devices that are master-keyed and include three sets of keys for the locks. If the irrigation system serves both lawns and planting beds, furnish a controller that has a dual programming capability. Provide controllers that are compatible with and capable of operating the irrigation system as constructed.

The following are definitions of some controller-associated Equipment:

Rain Sensor - A sensor able to interrupt the power from the irrigation controller to the valves when the rainfall exceeds a pre-selected amount. Furnish rain sensors that are compatible with the system controller and are fully adjustable.

Soil Moisture Sensor - A sensor that interrupts programmed irrigation cycles until the Soil moisture reaches a predetermined condition at the sensor's probe location.

Central Controller - A computer system programmable to receive data from and provide commands to multiple irrigation systems remotely located from the central system location.

Satellite Controller - A satellite controller similar to a normal stand-alone controller and able to operate as one, but designed to be operated by a central controller located off-site.

Flow Sensor - The hardware located in a pipeline that senses water flow and sends resulting data by electronic pulses to the pulse output transmitter.

Pulse Output Transmitter - A device that reads electronic pulses from the flow sensor and sends data to the pulse-decoding device.

Pulse Decoder - A microprocessor-based device designed to read electrical pulses originating at the flow sensor (or other type of monitoring device) and send the data to a central control system for analysis and action. When reading water flow data, the pulse decoder may also be referred to as a flow monitor.

Weather Station - A field station that collects and stores various weather data for access and use by a central control system in modifying an irrigation program for weather conditions. Typical data collected over a time period are wind speed, wind direction, relative humidity, rainfall, solar radiation and air temperature.

01120.13 Quick-Coupling Equipment - Furnish quick coupling Equipment with a body of cast leaded semi-red brass alloy No. C84400 conforming to ASTM B584, and a service rating not less than 125 psi for non-shock cold water. Provide couplers having standard male pipe threads at the top and standard female pipe threads at the base. Ensure that the valve is designed to open only upon inserting a coupler key and close completely after removing the key, with absolutely no leakage of water between the coupler and valve body. Provide valve bodies to receive couplers that are designed with double worm slots to allow smooth opening and closing action with a minimum of effort. Ensure that slots notched at the base will hold the coupler firmly in the open position. Furnish couplers of one piece construction with steel reinforced side handles attached, a locking top and of the same material as the valve body. The coupler shall have stainless steel double guide lugs to fit the worm slots. Furnish two couplers and two hose swivels for operation of the valves, and two keys for the locking caps if quick-coupling valves are required. For non-potable water systems, furnish a color-coded, purple tinted cap that bears the printed warning "Caution: Reclaimed Water - Do Not Drink".

01120.14 Hose Bibs - Furnish bronze or brass hose bibs, with angle-type thread to accommodate a 3/4 inch hose connection, and with a key- operated design that prevents operation by wrench or pliers.

01120.15 Cross-Connection Control Devices - Cross-connection control devices will be shown on the Plans. Furnish and install cross-connection control devices meeting the requirements of the Oregon Health Division and the local water authority.

01120.16 Water Meter - Water meter procurement, installation, and associated costs will be the responsibility of the Agency. Be responsible for coordinating water meter needs in a timely fashion with the Agency.

01120.17 Valves:

(a) Gate Valves - Furnish gate valves of heavy-duty bronze conforming to the requirements of ASTM B62. Provide valves of the same size as the pipes on which they are placed and install with union or flange connections. Service rating (for non-shock cold water) shall be 150 psi. Valves shall be of the double disk, taper seat type, with rising stem, union bonnet and hand wheel or suitable cross wheel for standard key operation. The valves shall have the manufacturer's name, type of valve, and size clearly cast on them.

(b) Drain Valves - Furnish bronze or brass drain valves, 1 inch or 3/4 inch in size, manual angle globe type, with rising stem, hex brass union, removable bonnet and stem, and adjustable packing gland. Ensure that valves are designed for underground installation with a suitable cross wheel operable with a standard key. The valves shall have a service rating of not less than 150 psi non-shock cold water. Furnish three standard operating keys.

(c) Check Valves - Furnish heavy duty bronze or steel check valves which function by means of a hinged disc suspended from the body, and which is able to close of its own weight. Furnish valves that are of the same size as the pipes on which they are placed, unless otherwise specified, and with union or flanged connections. Provide valves that are rated for non-shock cold water service of not less than 150 psi. The valves shall have the manufacturer's name, valve type, and size cast on them.

(d) Pressure-Reducing Valves - Furnish pressure-reducing valves with a minimum of 150 psi working pressure and an adjustable outlet range of 20 psi to 70 psi, rated for non-shock cold water service up to 175 psi. The valves shall be factory set as shown or specified.

(e) Isolation Valve - Furnish isolation valves as shown on the Plans or Special Provisions. If no isolation valve is shown, furnish ball valves as shown below.

(f) Ball Valves - Furnish bronzed-bodied ball valves conforming to ASTM B62 and with a hard, chrome plated ball conforming to ASTM B124. The valve shall be non-shock cold water service-rated at not less than 400 psi. Plastic valves will not be accepted.

(g) Air Relief Valve - The air relief valve automatically relieves air pressure to break an air vacuum in the pipe section where it is located. Install air relief valves at the exact high point of each pipe section where relief is needed. (Note: air relief valves are not associated with backflow prevention).

(h) Control Valves:

(1) Manual Control Valves - Furnish manual valves of bronze or brass, angle type, with hex brass union, and with a service rating not less than 150 psi non-shock cold water. Provide valves for underground installation designed with a cross wheel suitable for operation with a standard

key. Furnish three suitable operating keys per irrigation system. Furnish valves that have removable bonnet and stem assembly, with adjustable packing gland housing for the long acme-threaded stem to ensure full opening and closing. Provide valves with discs that are full floating with replaceable seat washers.

(2) Automatic Control Valves - Furnish automatic control valves of a normally closed design, operated by an electric solenoid of the required rating, but not more than 6.5 W and operating on 24 V AC power. Ensure that solenoids directly attached to the valve bonnets or bodies have completely internal control parts. Provide bodies that are not less than 150 psi if brass or bronze and not less than 125 psi if plastic, with a manual control bleed cock to operate the valve without electric current. Ensure that the closing speed is not less than 5 seconds and the opening speed is not less than 3 seconds. Both shall be at a constant rate of opening and closing so the water flow is completely stopped when the valve is either manually or electrically closed. Provide valves having manual shutoff stems with cross handles that will adjust the valve from fully closed to wide open with the valve automatically operable in the adjusted position.

(3) Automatic Control Valves with Pressure Regulator - Furnish valves of the same manufacture as the automatic control valves, capable of reducing the inlet pressure to a constant lower pressure regardless of supply fluctuations, and which are fully adjustable.

01120.18 Valve Boxes and Protective Sleeves - Provide automatic control valves, flow control valves, pressure reducing valves, backflow preventers, filters and other serviceable fixtures with valve boxes that are extendable to obtain the depth required. Furnish boxes constructed of thermoplastic, with locking lids, green in color, and of the type shown or specified. Include a protective sleeve and cap with all manual drain valves and manual control valves.

01120.19 Electrical Wire and Splices - Unless otherwise specified, furnish electrical wiring used as a hot wire for each zone between the automatic controller and automatic valves of copper, minimum size AWG No. 14, and red in color. Furnish common wire that is a minimum AWG No.12 and white in color. Furnish type USE that is chemically cross-linked polyethylene or thermoplastic. Furnish Type UF that is color-coded or marked with number identification.

Make low voltage splices with one of the following:

- A waterproof sealed wire connector system that is sealed from moisture, securely joins two or more conductors both mechanically and electrically, is rated for direct burial according to the manufacturer's recommendations, and conforms to UL 486D for direct burial applications. Wrapping a splice in tape is not an acceptable method of waterproofing. Obtain approval of the sealed wire connector system from the Engineer before installation.
- Heat-shrinkable insulating tubing manufactured for use in irrigation electrical systems. Furnish heat-shrink tubing of a mastic-lined, heavy-wall, polyolefin cable sleeve.

Provide and install an extra wire with all wiring runs that is the same gauge, but of a different color than the hot wire and common wire. The extra wire will be reserved for future use or modifications to the system.

01120.20 Communication Cable - Furnish communication wire in central satellite control systems that is 18 gauge polyethylene (PE) 89, minimum 6 pair, or approved equal. Provide sufficient pairs to connect all decoding, sensing and monitoring devices to the Central Control Unit.

01120.21 Detectable Wire and Marking Tape - Provide a detectable wire using continuous No. 14 gauge, single strand locator wire that is blue in color. Provide marking tape consisting of inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents, and solvents likely to be encountered in the Soil. Furnish color-coded tape with the type of line buried below and

the word "Caution" imprinted continuously over its entire length in permanent black ink. Provide tape of the width recommended by the manufacturer for the depth of installation used.

Construction

01120.40 General - The irrigation Plans are a schematic design and may require adjustment. Do not install the sprinkler system as shown if it is evident that obstructions, grade differences, or differences in area dimensions create conditions different than anticipated in the design. Bring all such obstructions or differences to the attention of the Engineer. In the event this notification is not performed before construction begins on a part of the system where discrepancies exist, any revisions necessary to make the system operate as designed will be the Contractor's responsibility.

(a) Plumbing - Install all parts of the irrigation system according to the Oregon Plumbing Code and State and local laws. Make water service connections as shown and specified. Conform to the requirements of the jurisdictional water authority. Ensure that water velocities in PVC pipe do not exceed 5 feet per second, unless approved in writing by the Agency. Bring any velocities exceeding 5 feet per second created by pipe sizes shown on the Plans to the attention of the Agency before beginning construction. Correct excess velocities existing after construction, or caused by changes from the Plans, at no additional cost to the Agency, unless a written agreement has been made authorizing otherwise.

(1) Double Check Valve Assembly - Install, inspect, and test the double check valve assembly (DCVA) according to applicable regulations of the Oregon Health Division and the local water authority. Furnish test records on forms approved by the Oregon Health Division. Furnish forms filled out by a State-licensed Backflow Device Tester documenting that the DCVA is in good operating condition before any flushing and testing of downstream water lines. During the life of the Contract, test the DCVA annually, or more often if successive inspections indicate repeated failure. Repair or replace the DCVA whenever it is found to be defective.

(2) Reduced-Pressure Backflow Device - Install, inspect, and test the reduced-pressure backflow device (RPBD) according to the applicable portions of the Oregon Plumbing Code and applicable regulations of the Oregon Health Division and the local water authority. Apply the same specific testing requirements as stated for the DCVA above.

(b) Electrical Service - Install electrical service according to 00960.49, the *National Electrical Code*, and all State and local laws. Power sources will be as shown or as directed. Be responsible for coordination and installation of electrical service. Furnish and install meter bases at the power source conforming to the requirements of the power supplier. Give the power supplier's representative notice before making any installation. Provide a separate, dedicated circuit for the controller.

01120.41 Layout of Irrigation System - Stake the irrigation system, following the schematic design on the Plans, before construction begins. With prior approval, make alterations and changes in the layout to conform to ground conditions and to obtain adequate coverage of water. Comply with the requirements of 00150.50.

01120.42 Excavation - Excavate trenches no wider than necessary to lay the pipe or install the Equipment. Keep the top 6 inches of Topsoil, if applicable, separate from subsoil and replace this Topsoil as the top layer when backfilling. Provide smooth trench bottoms of sand or other material, free from rocks and Unsuitable Material. Excavate trenches in Rock or other Unsuitable Material at least 6 inches below the required depth and backfill with sand or other suitable material free from rocks.

Exercise care when excavating near existing trees. Where roots are 2 inches and greater in diameter, except in the direct path of the pipe, hand excavate and tunnel the pipe trench. When large roots are

exposed, wrap them with heavy burlap for protection and to prevent excessive drying. When digging trenches by machine adjacent to trees having roots 2 inches and less in diameter, hand trim the sides of the trench, making a clean cut of the roots. Treat all cut and trimmed roots 1/2 inch or larger in diameter with an approved tree wound dressing. Backfill trenches having exposed tree roots within 24 hours unless protected by continuously moist burlap or canvas.

Place detectable marking tape and tracer wire in the trench directly above, parallel to, and along the entire length of all nonmetallic water pipes and all nonmetallic and aluminum conduits installed under existing or planned Pavement. Use tape widths recommended by the manufacturer for the burial depth.

Pipe installation using a "pipe puller" may be approved if there is adequate Topsoil depth and the Topsoil is free of Rock. Obtain the Engineer's approval before using a pipe puller. Include any resultant changes in material or design with the request for use of this method.

If unforeseen bedrock is encountered during excavation that prevents the pipe from being buried at the specified depth, immediately bring it to the attention of the Engineer.

01120.43 Piping - Backfill all pipe between the top of the pipe and finished grade with a minimum of 18 inches of fill according to 01120.49. Where possible, place mains and laterals or section piping in the same trench. Separate all pipes by at least 2 inches. Place all pipelines a minimum of 3 feet from the edge of concrete sidewalks, curbs, guardrail, fences, traffic barriers or walls unless otherwise approved.

Place marking tape and tracer wire above all pressurized mainline, according to the manufacturer's instructions.

Place all live mains to be constructed under existing Pavement in sleeves jacked under the Pavement, unless otherwise shown. Place all PVC pipe installed under Pavement in pipe sleeves of Schedule 40 PVC, unless steel sleeving is shown or specified. Furnish pipe caps of Schedule 80 PVC. Install sleeves 2 feet below Subgrade when passing under Roadways. Extend sleeves 2 feet beyond the edge of gravel, edge of sidewalk or back of curbs. Mark sleeves with a 2 feet piece of No. 4 rebar driven flush with the ground or other adjacent surface. Place PVC caps over both ends of sleeves but do not glue. Solvent-weld sleeve sections. Pipe bedding and backfill shall conform to Section 00405. Extend the sleeve a minimum of 12 inches beyond the edge of Pavement. Perform all jacking operations according to an approved jacking plan. If obstacles are encountered during required jacking, notify the Engineer, who may authorize corrective measures according to 00140.60. Provide for complete drainage of all pipelines with manual drain valves installed at section low points. Drain valves may not be shown on the Plans.

01120.44 Pipe Jointing:

(a) General - During construction, plug or cap pipe ends to prevent entry of dirt, rocks and other debris.

(b) Galvanized Steel Pipe - Ensure that galvanized steel pipe has clean cut, well fitted standard pipe threads. Ream all pipe to its full diameter and remove burrs before assembly. Construct threaded joints using either a non-hardening, non-seizing multipurpose sealant, PTFE tape, or paste as recommended by the pipe manufacturer. Make all threaded joints tight with wrenches, without using handle extensions. Clean and remake joints that leak with new material. Use of caulking or thread cement to make joints tight will not be allowed.

(c) PVC Pipe - Handle and install PVC pipe, couplings and fittings according to the manufacturer's recommendations. Chamfer the outside of the PVC pipe to a minimum of 1/16 inch at approximately 22 degrees. Join pipe and fittings by solvent welding. Use only solvents that

penetrate the surface of both pipe and fitting with a result of complete fusion at the joint. Use solvent and cement only as recommended by the pipe manufacturer. On plastic to metal connections, work the metal connection first. Use a non-hardening compound on threaded connections. Thread connections between metal and plastic using only female threaded PVC adapters with threaded Schedule 80 PVC nipples.

(d) Polyethylene Pipe - Install polyethylene pipe and fittings according to the manufacturer's recommendations. Cut the ends of the polyethylene pipe square and insert the fitting to its full depth. Use stainless steel clamps for insert fittings.

01120.45 Installation:

(a) Sprinkler Heads - Position turf heads and other pop-up heads between 1/2 inch and 1 inch above finish grade, measured from the top of the sprinkler. Place sprinklers as close as practicable to walks, curbs, Pavement and lawn edges, but leave enough space to allow height adjustment. Do not place heads on risers in areas with any potential for pedestrian traffic, unless otherwise shown. Use swing riser assemblies that allow positioning for correct sprinkler height.

(b) Drip Emitters - Install emitters directly above the root mass of the plant being watered, according to the Plans or the manufacturer's recommendations.

(c) Low Volume Drip Tubing - Install drip irrigation tubing as shown and the manufacturer's recommendations.

(d) Controllers - Install controllers according to the manufacturer's recommendations and as shown. Receive approval of the location before installing. Since the controller will need to be accessed frequently, install it at a height, position, and location that allow ease of access.

(e) Valve Boxes and Quick Couplers - Position the tops of valve boxes, capped sleeves, and quick coupler valves between 1/2 inch and 1 inch above finish grade or mulch.

(f) Valves - Install valves so that access for maintenance is maintained.

(g) Central Control Equipment - If shown or specified, install the following Equipment according to the manufacturer's recommendations:

- Rain sensors
- Soil moisture sensors
- Flow meters
- Central control system with satellite controllers
- Weather stations

01120.46 Low Voltage Electrical Installation - Use direct burial wiring between the automatic controller and automatic valves. Install waterproof splices according to the manufacturer's recommendations. The wiring may share a common neutral. When more than one automatic controller is required, provide a separate common neutral for each controller and the automatic valves it controls. Run separate control conductors from the automatic controller to each valve. Provide and install an extra wire according to 01120.40.

Install wire adjacent to or beneath the irrigation pipe. Use plastic tape or nylon tie-wraps to bundle wires together at 10 foot intervals. Snake the wire from side to side in the trench to provide slack in the wire run. When it is necessary to run wire separate from the irrigation pipe, bundle and place the wire under detectable marking tape. Splices will be allowed only at junction boxes, valve boxes, pole

bases, or control Equipment. Leave a minimum of 2 feet of excess conductor at all splices, terminals and control valves to facilitate inspection and future splicing.

01120.47 Flushing and Testing:

(a) General - Provide gauges used in the testing of water pressures that are certified correct by an independent testing laboratory immediately before use on the Project. Retest gauges when directed. Test automatic controllers by actual operation for a period of 2 weeks under normal operating conditions. If adjustments are required, adjust according to the manufacturer's direction and test until operation is accepted as satisfactory.

(b) Sprinkler Head Flushing - Flush all sprinkler heads as recommended by the manufacturer.

(c) Sprinkler Head Testing - Test for leaks in heads and connections and correct as required.

(d) Main Line Flushing - To remove debris that may have entered the line during construction, flush main supply lines twice with the supply valve fully open. Flush first before placing valves and again after placing valves and before pressure testing.

(e) Main Line Testing - Purge all main supply lines of air and test with static water pressure of at least 150 psi for 60 minutes without introduction of additional service or pumping pressure. Test with one pressure gauge installed on the line where directed. Install an additional pressure gauge at the pump when directed. Lines showing loss of pressure exceeding 5 psi at the end of the specified test period will be rejected. Correct rejected installations and retest for leaks.

(f) Lateral Line Flushing - Flush all lateral lines once with the supply valve fully open prior to placement of sprinkler heads, emitters and drain valves. Flush long enough to remove any debris that enters the lateral lines during construction.

(g) Lateral Line Testing - Purge all lateral lines of air and test under operating line pressures with risers capped and drain valves closed. Maintain operating line pressures for 30 minutes through open valves and pressure regulating devices. Lines showing leaks when visually inspected at the end of the specified test periods will be rejected. Correct and retest lateral line installations that have been rejected.

(h) Lateral Line Alternate Test Method - When conditions prevent effective visual inspection of lateral lines, the Engineer may require that the lines be tested by use of pressure gauges. In that event, maintain the static water pressure equal to the operating line pressure in the lines for 30 minutes, with valves closed and without introduction of additional service pressure. Lateral lines showing loss of pressure exceeding 5 psi at the end of the specified test period will be rejected. Correct and retest lateral line installations that have been rejected.

(i) Testing of Micro Tubing - Micro tubing will be tested by visual inspection while operating and before burial. Tubing that has obvious leaks or that doesn't operate as designed will be rejected. To fully test micro tubing, a water collection procedure recommended by the manufacturer may be required. Correct all faults before retesting.

01120.48 Adjusting System - Before final inspection, adjust and balance all sprinklers to provide adequate and uniform coverage. Balance spray patterns by adjusting individual sprinkler heads with the adjustment screws or by replacing nozzles to produce a uniform pattern. Unless otherwise specified, water spray will not be allowed on Pavement, walks or Structures.

01120.49 Backfill - Do not start backfill until all piping has been inspected, tested and approved. Complete backfilling as soon as possible after approval. Ensure that backfill material placed within 6 inches of the pipe is free of rocks or other Unsuitable Material that might cut or otherwise

damage the pipe. Backfill from the bottom of the trench to approximately 6 inches above the pipe with continuous compaction in a manner that will not damage the pipe or wiring, and proceed evenly on both sides of the pipe. Thoroughly compact the remainder of the backfill without using heavy Equipment within 18 inches of any pipe. Ensure that the top 6 inches of the backfill is Topsoil material or, if suitable, is the first 6 inches of material removed in the excavation.

Pipe bedding material conforming to 00405.12 may be authorized in quantities determined by the Engineer. When authorized to proceed, fill the bottom 2 inches of the trench with approved bedding before laying pipe. After the pipe is in position, add enough bedding material to bring the backfill height to 2 inches above the pipe. Continue backfilling as usual.

If sufficient suitable backfill material is not available from trench excavation or other sources on the Project, notify the Engineer. Provide an estimate of imported backfill required, if possible. Unless otherwise shown or specified, imported pipe bedding material will be authorized according to 00140.60.

Maintenance

01120.60 System Operation - Repair, flush and test all main and lateral lines that sustain a break or disruption of service. Upon restoration of the water service, bring the affected lines up to operating pressure. After pressurizing, conduct a thorough inspection of all sprinkler heads, emitters, and other fittings, located downstream of the break or disruption of service, and repair. This inspection is required to ensure that the entire irrigation system is operating properly.

Completely install and test the irrigation system, and make it automatically operable before planting in a unit area except where otherwise shown, specified, or approved. Be fully responsible for all maintenance, repair, testing, inspection and automatic operation of the entire system until Final Acceptance. (See 00150.95.)

This responsibility includes, but is not limited to, draining the system before winter and reactivating the system in the spring and at other times as directed.

Be responsible for having annual inspections and tests performed on all cross connection control devices as required by the State Health Division until Final Acceptance. (See 00150.95.)

In the spring, when the drip irrigation system is in full operation, make a full inspection of all emitters. This involves visual inspection of each emitter under operating conditions. Make all adjustments, flushing or replacements to the system at this time to ensure the proper operation of all emitters.

Finishing and Cleaning Up

01120.70 As-Built Plans and System Orientation - Upon completion of the Work, submit corrected Working Drawings, schematic circuit diagrams, or other drawings necessary for the Engineer to prepare corrected Plans showing the Work as constructed. Provide drawings on 8 1/2 inches by 11 inches, 11 inches by 17 inches, or 22 inches by 36 inches sizes. Prepare and present a training and orientation session covering the operation, adjustment and maintenance of the irrigation system. Review corrected drawings and explain all features. Show locations of drain valves, if any, on the drawings. At this session, provide the Engineer with parts lists and service manuals for all Equipment. Notify the Engineer in writing not less than 2 weeks before the proposed date of the training and orientation session. The date and time of the session will be mutually agreed to.

01120.75 Drip Line Tubing Manufacturer Warranty - Furnish a manufacturer warranty that unconditionally warrants to the Agency the drip line tubing products and installation under this Section against failure of drip line tubing, according to this Subsection and 00170.85(c)(1).

"Unconditionally warrant" means that the warranty covers all failures, regardless of the source or cause of the failure, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of materials.

The Agency inspection of any portion of the Work during the Contract and during the product installation, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the obligations under this warranty.

(a) Warranty Period - The warranty period shall be for 5 years.

(b) Failure - For purposes of the warranty, failure is defined as any one or more of the following:

- Manufacturing defects
- Rot
- Electrolytic corrosion
- Stress cracking

(c) Remedy - Upon notification by the Engineer of a failure as defined above, provide the following remedy at no additional cost to the Agency:

- Repair failures within 60 Calendar Days.
- Use materials and procedures meeting the Specifications.
- Match repairs to finished grade.
- Coordinate timing of repair Work with the Engineer.

(d) Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure causes or may cause a hazard, the failure may be temporarily corrected by Agency or other forces at no additional cost to the Agency. Replace temporary repairs with permanent repairs at no additional cost to the Agency and according to the Specifications and within the time specified in 01120.75(c).

Measurement

01120.80 Measurement - No measurement of quantities will be made for Work performed under this Section.

Payment

01120.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract lump sum amount for the item "Irrigation System".

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for excavation, backfill, electrical service, or system orientation.

Section 01140 - Potable Water Pipe and Fittings

Description

01140.00 Scope - This Work consists of constructing potable water pipe and fittings 16 inches and smaller in diameter within a public Right-of-Way or easement.

Materials

01140.10 Materials - Furnish Materials meeting the following requirements:

Bolted, Sleeve-Type Couplings for Plain End Pipe	02475.60
Commercial Grade Concrete in Thrust Blocks	00440
Detectable Marking Tape and Wire	02470.60
Ductile Iron Pipe Fittings	02475.20
Ductile Iron Pipe	02470.20
Polyethylene Encasement	02470.50
Polyvinyl Chloride (PVC) Pipe fittings - 4" and larger	02475.40
Polyvinyl Chloride (PVC) Pipe fittings - under 4"	02475.45
Polyvinyl Chloride (PVC) Pipe - 4" and larger	02470.40
Polyvinyl Chloride (PVC) Pipe - under 4"	02470.45
Reinforcement	00530
Restrained Joints	02475.50
High Density Polyethylene Pipe	02470.31
High Density Polyethylene Pipe Fittings	02475.31

High Density Polyethylene (HDPE) pipe shall meet the requirements of ANSI/AWWA C906, Standard PE Code Designation PE 3408, minimum cell classification PE 334434C (ASTM D3350). Pipe may also be PE 4710 according to the pending revisions to ANSI/AWWA C906-07. Pipe shall be iron pipe size (IPS) outside diameter or ductile iron pipe size (DIPS) outside diameter. All HDPE pipe and fittings shall be of the dimension ratio (DR) as shown on the Plans.

01140.11 Handling Pipe and Fittings - Handle pipe and fittings to prevent damage to or contamination of the pipe, fitting, lining, or coating. Load and unload pipe and fittings using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped, skidded, or rolled against other pipe or fittings. If any part of the coating or lining is damaged, repair in a manner satisfactory to the Engineer. Damaged or contaminated pipe and fittings will be rejected. Immediately separate all damaged or contaminated pipe and fittings and remove from the Project Site.

If pipe requires temporary storage, store on cradles to prevent entry of dirt, other foreign material, or contamination. Keep the pipe or pipe joint free of dirt, other foreign material, or contamination during handling or laying operations. Remove, clean, and relay any pipe or fitting that has been installed with dirt, foreign material, or contamination in it. When pipe laying is not in progress, close the open ends of pipe with watertight plugs or by other approved means to ensure cleanliness.

01140.12 Cutting Pipe:

(a) General - When possible, use partial lengths of pipe supplied by the manufacturer to provide the proper spacing of valves, tees, or special fittings.

(b) Cutting Operation - Cut pipe with abrasive saws or with special pipe cutters. Square all pipe ends with the longitudinal axis of the pipe. Ream and smooth the interior edge and bevel the exterior edge of the cut ends. Flame cutting of ductile iron pipe will not be allowed.

Construction

01140.40 Trench Work - Excavate trench, prepare bedding, install pipe zone material, backfill, and dispose of excavated material according to Section 00405 and the following:

(a) Dewatering Trenches - Remove water encountered in the trench during pipe laying operations and maintain the trench until the ends of the pipe are sealed and provision is made to prevent floating of the pipe. Do not allow trench water or other deleterious materials to enter the pipe at any time.

(b) Bedding and Pipe Zone - For the purpose of these Specifications, all potable water pipes are considered flexible pipes. Use bedding and pipe zone material for flexible pipes as described in 00405.12 and 00405.13.

(c) Grade and Alignment Changes - Excavate potholes to locate utilities. Allow enough time between excavating potholes and pipe installation to change alignment and grade of the pipeline to avoid conflicts. Obtain approval from the Engineer before using fittings to avoid conflicts.

01140.41 Laying Pipe:

(a) General - Lay pipe to the lines and grades shown and established.

(b) Ductile Iron Pipe - Install ductile iron pipe according to AWWA C600 and the manufacturer's recommendations.

(1) Curves - Lay horizontal and vertical long radius curves with standard pipe by deflecting the joints. Use standard fittings and standard pipe lengths, unless otherwise shown. If shorter pipe lengths are required, the maximum allowable pipe lengths will be shown. Do not exceed 80 percent of the manufacturer's recommendations for the amount of deflection at each pipe joint when pipe is laid on a horizontal or vertical curve. Where field conditions require deflection or curves not shown, the Engineer will determine the methods to be used.

(2) Pipe Laying Procedure - When ductile iron pipe is laid on a curve, join the pipe in a straight alignment and then deflect it to the curved alignment. Widen trenches on curves for this purpose as allowed or directed.

(c) Polyethylene Encasement - Where shown, lay ductile iron pipe with a polyethylene encasement. Install polyethylene encasement according to AWWA C105 and the manufacturer's recommendations.

(d) Polyvinyl Chloride (PVC) Pipe - Install PVC pipe according to AWWA C605 and the manufacturer's recommendations.

Lay horizontal and vertical curves in pipe, as shown, with standard pipe by deflecting the joints. Use standard fittings and standard pipe lengths unless otherwise shown. If shorter lengths of pipe are required, the maximum allowable pipe lengths will be shown. Do not exceed 80 percent of the manufacturer’s recommendations for the amount of deflection at each pipe joint when pipe is laid on a horizontal or vertical curve. Where field conditions require deflection or curves not shown, the Engineer will determine the methods to be used. Do not bend PVC pipe segments.

(e) Water and Sanitary Sewer Separation - Comply with OAR 333-061 0050 governing horizontal and vertical separation between water and sanitary sewer facilities for installation of new water lines and appurtenances. Submit all proposals for variance in writing. The proposal shall include the reason for the variance, type of material and condition of the sewer line, and location of the water and sewer facilities, including horizontal and vertical skin-to-skin clearances Proposals

will be reviewed by the Engineer and approved, approved as noted, or returned for correction. Each variance will be addressed on a case-by-case basis.

(f) Other Utilities - Maintain a minimum vertical clearance of 12 inches between installed pipe and other utilities. Maintain a minimum horizontal clearance of 24 inches between installed pipe and other utilities. The Engineer's approval and additional protection are required for any pipe installation that does not maintain the specified minimum clearances.

01140.42 Jointing Pipe:

(a) General - Clean all parts of the pipe ends, couplings, fittings, and appurtenances to remove oil, grit, or other foreign matter from the joint. Keep the joint from contacting the ground. When assembling gasketed joints, apply an approved lubricant as specified by the pipe manufacturer.

For pipe not furnished with a depth mark, mark pipe with a depth mark before joint assembly.

(b) HDPE Pipe:

(1) Joints and Fittings - Join pipes and fittings using the thermal butt fusion method according to ASTM D3261. HDPE fittings shall be of the same class as the HDPE piping.

(2) Connections with Other Pipe Types - Connect HDPE pipe to other pipe types using manufactured fittings, as approved.

01140.43 Polyethylene Encasement:

(a) Installation - Install polyethylene encasement according to AWWA C105 except as modified by the Specifications. Wrap polyethylene encasement loosely around the pipe, fittings, and couplings, and secure with 2 inch wide polyethylene adhesive tape. Cover joints or seams in the polyethylene encasement using 2 inch wide polyethylene adhesive tape. The polyethylene encasement is not required to be watertight, but do not expose any part of the pipe, fittings, or coupling to the backfill. Exercise care during backfilling to prevent puncturing or otherwise damaging the polyethylene encasement.

(b) Connections - When connecting to existing polyethylene-encased pipe, cut the existing encasement within 1 foot of the connection couplings or fittings. After the connections are made, overlap the exiting polyethylene encasement a minimum of 3 feet and seal the overlaps with 2 inch wide polyethylene adhesive tape.

01140.44 Thrust Restraint:

(a) Concrete Thrust Blocks - Place concrete thrust blocks as shown, at bends, tees, dead ends, and crosses. Pour concrete thrust blocks in place against solid, undisturbed earth at the sides and bottom of the trench excavation. Shape the blocks so as not to obstruct access to the joints of the pipe or fittings.

(b) Restrained Joints - Where indicated or approved by the Engineer, restrain joints at bends, tees dead ends, crosses, and all pipe joints within the indicated or specified distance on each side of the bends, tees, dead ends, and crosses. Install joint restraint systems according to the manufacturer's recommendations.

01140.45 Marking Tape and Wire:

(a) Installation - Install marking tape and wire over all nonmetallic water lines, including service connections. Place a continuous solid copper wire along the top of all water pipe, including service

lines. Use cable ties to secure the copper wire to the top of the pipe at a maximum spacing of 10 feet. Tie all splices and make them electrically continuous and waterproof. Provide access to terminal ends of the wire at all valve boxes, meter boxes, hydrants, and vaults. The result of this installation shall be a continuous wire circuit electrically isolated from ground. Place the marking tape approximately 1 foot above the top of the pipe for its full length.

(b) Accessibility - Make ends of wire accessible in water meter boxes, valve boxes or casings, or outside the foundation of buildings where the pipe enters the building. Provide wire access at locations no more than 1,000 feet apart.

(c) Testing - Test for continuity and isolation from ground in the wire after all Work has been completed on the test section. Perform intermediate testing after backfilling operations and prior to surface restoration Work. Test continuity between access locations by use of a temporary wire connecting test points in-line with an ohmmeter. Measure resistance with an approved ohmmeter that has been properly calibrated. The continuity of a test section will be accepted if the resistance of the test section does not exceed 5 ohms for each 500 feet of location wire being tested. Measure isolation from ground with an approved 1000 volt Megger, applied for 1 minute. The isolation of a test section will be accepted if the isolation resistance of the test section is at least 10 megohms. Locate and repair all breaks or defects in the wire and re-test until specified results are obtained.

01140.46 Blowoff Assemblies - Construct blowoff assemblies as shown and at the locations shown.

01140.47 Connections to Existing Mains - Make necessary arrangements with the Engineer a minimum of 7 Calendar Days before making connections to existing water mains. Assemble all materials, Equipment, and labor necessary to properly complete the Work before starting.

(a) Notification - If the connection to the existing system involves temporary water system shutoff, provide written notices to the residents affected by the shutoff a minimum of 72 hours before the shutoff. Submit a draft written notification to the Engineer for approval 5 Calendar Days before providing written notice to the affected residents. The Engineer will advise which property owners are to be notified.

(b) Permission - The Work to perform the connection may need to be carried out during times other than normal working hours. Do not operate any valves on the existing system without specific permission of the Engineer.

(c) Connection Assemblies - Excavate potholes to expose existing piping at connection points before constructing the connection. If existing piping is different than shown, provide measurements of depth and a detailed sketch of existing piping configuration and alignment to the Engineer not less than 2 weeks before the expected construction.

(d) Uninterrupted Service - Once Work is started on a connection, proceed continuously without interruption, and as rapidly as possible until completed. Schedule main shutoffs to ensure that mains do not remain shut off overnight, on Fridays, over weekends, or on holidays.

(e) Cutting Main Lines - Cut existing water mains according to 01140.12. Remove the portions of pipe to provide for the installation of the required fittings at the points of connection. Determine the exact length of the existing water main that is to be removed. Bevel pipe ends to prevent damage to the transition coupling gasket during installation of the coupling. Clean the exterior of the existing pipe end to a sound, smooth finish before installation of the coupling.

01140.48 Maintaining Service:

(a) Service Transfer - Where existing services are to be transferred from old to new mains, plan and coordinate the Work with that of the Utility so that service will be resumed with the least possible inconvenience to the public.

(b) Connections by Utility - Allow the Utility to make connections into the new pipe at such locations as the Utility may elect to supply customers with water, after the affected section of pipe has passed hydrostatic and bacteriological tests. The installation of any such connections by the Utility shall not be construed as an acceptance by the Agency of any part of the Work required under the Contract.

01140.49 Backfilling - After the pipe is installed and inspected, backfill the trench according to Section 00405.

Field Testing

01140.50 Filling and Flushing - Fill pipes slowly with potable water at a maximum velocity of 1 foot per second while venting all air. Take all required precautions to prevent entrapping air in the pipes.

(a) Flush and Disinfect - Flush sections of pipe to be tested and disinfect to remove any solids or contaminated material that may have become lodged in the pipe. Flushing velocity shall be a minimum of 3 feet per second. If no hydrant is installed at the end of the main, provide a tap large enough to develop a velocity of at least 3 feet per second in the main. Perform flushing and disinfection according to AWWA C651-14

(b) Taps - Provide taps for temporary or permanent release of air, flushing, or chlorination.

(c) Disposal of Treated Water - Dispose of treated water flushed from mains. To protect aquatic life, de-chlorinate the treated waste water according to AWWA C655 before disposing of water into any storm drain or natural drainage channel. Dispose of disinfecting solution according to AWWA C655 and to the satisfaction of the Engineer and local authorities. If approved by the Engineer and the sanitary sewer Utility, disposal may be made to an available sanitary sewer, provided the rate of disposal will not overload the sewer.

01140.51 Hydrostatic Testing:

(a) General - Test all water mains and appurtenances in sections of convenient length under a hydrostatic pressure equal to one and one-half times the working pressure, but at least 150 psi, measured at the highest point of the test section. Furnish and operate all pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, and measuring Equipment necessary for performing the test. Provide certifications of accuracy for gauges used in the test from an approved laboratory.

(1) Backfill - Backfill the pipeline sufficiently to prevent movement of the pipe under pressure. Place all thrust blocks and allow time for the concrete to cure before testing. Where permanent blocking is not required, furnish and install temporary blocking and remove it after testing.

(2) Filling Pipe - Fill the mains with water and allow to stand under pressure a sufficient length of time to allow the escape of air and to allow the lining of the pipe to absorb water. The Agency will furnish the water necessary to fill the pipelines for testing, at a time of day when sufficient quantities of water are available for normal system operation.

(3) Time Test - Test by pumping the main up to the required pressure for at least 2 hours. Provide additional pumping during the test period to continuously maintain pressure within 5 psi

of that required. During the test, observe the section being tested to detect any visible leakage. Use a clean container to hold water for pumping up pressure on the main being tested. Sterilize this makeup water by adding chlorine to a concentration of 25 ppm.

(4) Measure Quantity - Accurately determine the quantity of water required to maintain and restore the required pressure at the end of the test period by pumping through an approved positive displacement water meter.

(5) Loss Formula - The quantity of water lost from the main shall not exceed the number of gallons per hour determined by the formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

Where:

L = allowable leakage in gallons per hour
S = length of pipeline tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the leakage test in psi

(6) Pressure Loss - There shall be no appreciable or abrupt loss in pressure during the test period.

(7) Leakage - Correct all visible leakage regardless of the allowable leakage specified above. If the actual leakage exceeds the allowable amount, locate and repair the leaks and retest the pipeline.

(8) Use of Hydrant Valves - Make all tests with the hydrant auxiliary gate valves open and pressure against the hydrant valve. After the pipe test has been completed, test each gate valve in turn by closing it and relieving the pressure beyond. This test of the gate valve will be acceptable if there is no immediate loss of pressure on the gauge when the pressure beyond the valve is relieved. Verify that the pressure differential across the valve does not exceed the rated working pressure of the valve.

(9) Test Section Length - Limit sections to be tested to 1,500 feet, unless longer test sections are approved. The Engineer may require that the first installed section of pipe installed by each crew, not less than 1,000 feet in length, be tested. Do not continue pipe laying more than an additional 1,000 feet until the first section has been tested successfully.

(10) Test Equipment Readiness - Prior to calling out the Engineer to witness the pressure test, set up all Equipment completely ready for operation and successfully perform the test to ensure that the pipe is in a satisfactory condition.

(11) Defective Materials or Workmanship - Replace defective materials or workmanship discovered during hydrostatic field testing. Whenever it is necessary to replace defective material or correct the workmanship, repeat the hydrostatic test until a satisfactory test is obtained.

(b) Testing Extensions from Existing Mains:

(1) Exceptions - When an existing water main is extended with new pipe to a new valve, and the distance from the existing pipe to the new valve is 18 feet or less, no hydrostatic test will be required if the section of new pipe between the new valve and the end of the existing main is installed with pretested, prechlorinated pipe. When the required hydrostatic tests are conducted

in the new main section beyond the installed new valve in the closed position, the normal pressure of the existing main may be present against the other side of the new valve.

(2) Required Testing - Where the distance between the end of an existing water main pipe extension and the new valve is more than 18 feet, do not connect the new pipe to the existing pipe until after hydrostatic tests have been made to the required pressure in both directions against the new valve. Test after installing a temporary cap or plug on the end of the new pipe, beyond the new valve, as close as possible to the existing pipe. Make the final connection to the existing main with pretested, prechlorinated pipe.

(c) Testing Sections with Hydrants Installed - When hydrants are included with the section of main pipe to be tested, conduct three separate tests as shown in the following table:

	Water Main Gate Valves	Hydrant Auxiliary Gate Valves	Hydrant Operating Stem Valves	Hose Ports
Test No. 1	Closed	Closed	Wide Open	Wide Open
Test No. 2	Closed	Wide Open	Closed	Wide Open
Test No. 3 [1]	–	Closed	Wide Open	Closed

[1] Test each hydrant to the required test pressure. When testing a hydrant singly, pressure in the supply main beyond the hydrant auxiliary gate valve shall be 25 psi.

(d) Testing Hydrants Installed on Existing Mains - For hydrants installed and connected to existing mains, install the hydrant connection, including hydrant tee, connection pipe and auxiliary gate valves, with pretested materials.

Before the hydrant connection is made to the existing main, subject the hydrant installation to hydrostatic Test No. 3 in 01140.51(c).

(e) Hydrostatic Testing of High Density Polyethylene Water Mains - Conduct the following hydrostatic tests on all HDPE pipe:

(1) Above-Grade Test - Before placing the pipe but after the pipe is butt fused and ready for installation, conduct an above grade test. Before beginning the test, fill the pipeline with water, pressurize to the test pressure according to 01140.51(a), and allow to stand without makeup pressure until the pressure reaches equilibrium. Equilibrium will usually occur within 2 to 4 hours.

After equilibrium has been reached, test the pipe according to 01140.51(a). Visually inspect the pipe for leaks during the test. Repair all leaks before installing the pipe in the trench or pulling the pipeline into the borehole. Repair leaks at fusion joints by cutting out the leaking fusion joint, re-fusing the joint, and conducting a new above grade test. Successful completion of the above grade test requires approval from the Engineer. Do not place the pipe in the trench or pull the pipe into place before successfully completing the above grade test.

(2) In-Place Test - Conduct an in place test after the pipe is placed in the trench or pulled into place. Before beginning the test, fill the pipeline with water, pressurize to the test pressure according to 01140.51(a), and allowed to stand without makeup pressure until the pressure reaches equilibrium. Equilibrium will usually occur within 2 to 4 hours.

01140.52 Disinfecting:

(a) General - Before placing new water mains in service, chlorinate and test new mains and repaired portions of, or extensions to, existing mains according to AWWA C651-14 and obtain a satisfactory bacteriological report.

The initial chlorine content of the water shall be not less than 25 ppm. A chlorine residual of not less than 10 ppm shall remain in the water after standing 24 hours in the pipe.

(b) Chlorine Application - Apply chlorine by one of the following methods:

(1) Calcium Hypochlorite - Apply a mixture of water and high-test calcium hypochlorite (65 - 70 percent Cl). First mix the dry powder as a paste and then thin to a 1 percent chlorine solution by adding water to give a total quantity of 7.5 gallons per pound (water to dry powder).

(2) Sodium Hypochlorite - Apply sodium hypochlorite, commercial grade (12.5 percent Cl) or in the form of liquid household bleach (5 - 6 percent Cl). This liquid chlorine compound may be used full strength or diluted with water.

(c) Point of Application - Apply the chlorinating agent at the beginning of the pipeline extension or any valved section of it, through a corporation stop inserted in the horizontal axis of the pipe. Supply the water injector for delivering the chlorine-bearing water into the pipe from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension. Alternate points of applications may be used when approved.

(d) Rate of Application - Control water from the existing distribution system, or other source of supply, to flow very slowly into the newly laid pipeline during application of the chlorine. The rate of chlorine application shall be in such proportion to the rate of water entering the newly laid pipe that the initial chlorine content of the water will be at least 25 ppm.

(e) Cross Connection Control - Make no connections between the existing distribution system and non-disinfected pipelines constructed under this Contract, unless a State Health Division approved backflow preventer is installed in the connecting line.

(f) Retention Period - Retain chlorinated water in the pipe at least 24 hours. After this period, the residual chlorine at pipe extremities and at other representative points shall be at least 10 ppm.

(g) Chlorinating Connections to Existing Water Mains - Follow the chlorinating procedure specified in AWWA C651-14. Liberally treat the exterior of the existing main at the connection point with hypochlorites. Swab or spray the interior of all new closure fittings, valves, and pipe required for the connection with a 1 percent hypochlorite solution. Disinfect the 5 feet of existing main adjacent to the connection point with a 100 ppm chlorine solution and then thoroughly flush the line.

(h) Flushing and Testing - Following the retention period, flush all chlorinated water from the newly laid pipe until the replacement water throughout its length is visually clear and shows, upon test, an absence of chlorine or a residual no greater than that normally found in the source of supply.

(1) Sampling Tap - Install a sampling tap ahead of the flushing hose for convenient sanitary sampling.

(2) Sampling Frequency for New Mains - For new mains, collect one set of samples every 1200 feet along the pipe and one set at the end of the pipe. If water from the trench enters the pipe or, in the opinion of the Engineer, excessive quantities of dirt or debris have entered the

new main, increase sampling frequency to collect a sample set every 200 feet along the pipe, in addition to the sample set required at the pipe end.

(3) Service Resumption - Do not place the lines into service before a satisfactory report is received from the local or State health department on samples collected from representative points in the new system. Samples will be collected and bacteriological tests obtained by the Engineer.

(i) Repetition of Chlorinating and Testing - If the initial treatment results in a chlorine residual of less than 10 ppm at the end of the retention period or an unsatisfactory bacteriological test, repeat the original chlorination procedure until satisfactory results are obtained.

01140.60 Surface Restoration - Restore trench surfaces according to Section 00495.

Measurement

01140.80 Measurement - The quantities of potable water pipe and fittings will be determined as follows:

(a) Pipe, Fittings and Couplings - The quantities of pipe of the various kinds, types, sizes and backfill classes will be measured on the length basis and will be horizontal measurement along the top of the finished trench, with no deduction for fittings, valves, and couplings.

For PVC fittings 4 inches or greater, in addition to measurement of the pipe, an allowance of 12 pipe diameters will be made for each factory-fabricated bend, sleeve, reducer or coupling, and an allowance of 18 pipe diameters of the larger diameter pipe will be made for each factory-fabricated tee or cross. The allowance will be added to the quantity for pipe of the same diameter.

Ductile iron pipe fittings will be measured on the unit basis.

(b) Extra Trench Excavation - The quantities of removal and backfill of extra trench excavation will be measured on the volume basis for each backfill class. The backfill classes are defined in Section 00405. When the pipeline grade is lowered in excess of 12 inches below the grade shown, or when pipeline horizontal alignment is changed by more than 12 inches after the original trench has been excavated, all additional excavation and backfill, outside the limits of the original trench, that is required to construct the change will be classified as extra trench excavation. The depth will be the actual depth removed for the changed line or grade as directed. The width will be the actual width removed for the changed line or grade, but in no case will the measured width exceed the allowable widths specified in 00405.41(c).

(c) Blowoff Assemblies - The quantities of blowoff assemblies will be measured on the unit basis.

(d) Connections to Existing Mains - The quantities of connections to existing mains will be measured on the unit basis.

Trench resurfacing will be measured according to 00495.80.

Installation under Pavement by tunneling, jacking, or boring methods will be measured according to 00406.80.

Payment

01140.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	____ Inch Potable Water Pipe, Fittings and Couplings with Class ____ Backfill	Foot
(b)	____ Inch Potable Water Pipe, Fittings and Couplings with Restrained Joints and Class ____ Backfill	Foot
(c)	Extra Trench Excavation with Class ____ Backfill	Cubic Yard
(d)	Blowoff Assembly, ____ Inch	Each
(e)	____ Inch Connection to ____ Inch Existing Main	Each
(f)	____ Inch Ductile Iron Pipe with Class ____ Backfill	Foot
(g)	____ Inch Ductile Iron Pipe with Restrained Joints and Class ____ Backfill	Foot
(h)	Ductile Iron Pipe Tees, ____ Inch	Each
(i)	Ductile Iron Pipe Wyes, ____ Inch	Each
(j)	Ductile Iron Pipe Slip Joints, ____ Inch	Each
(k)	Ductile Iron Pipe Cross, ____ Inch	Each
(l)	Ductile Iron Pipe Bend, ____ Inch	Each
(m)	Ductile Iron Pipe Coupling, ____ Inch	Each
(n)	Ductile Iron Pipe Reducer, ____ Inch	Each

The Contract unit price for the appropriate Pay Items reflects plan requirements or the Contractor's choice from the applicable options listed on the Pipe Data Sheets if shown.

In items (a) and (b), the nominal diameter of pipe, fittings and couplings will be inserted in the first blank. The class of backfill will be inserted in the second blank. The quantities include the pipe plus the allowance for the fittings and couplings.

In item (c), the class of backfill will be inserted in the blank.

In item (d), the nominal diameter of assembly will be inserted in the blank.

In item (e) the nominal diameter of pipe will be inserted in the first blank and the nominal diameter of the main line will be inserted in the second blank.

In item(s) (f) and (g), the nominal diameter of pipe will be inserted in the first blank. The class of backfill will be inserted in the second blank.

In item(s) (h), (i), (j), (k), (l), (m), and (n), the nominal diameter of the fittings or couplings will be inserted in the blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

Trench resurfacing will be paid for according to 00495.90.

Installation under Pavement by tunneling, jacking or boring methods will be paid for according to 00406.90.

No separate or additional payment will be made for:

- trench excavation
- bedding
- pipe zone material
- backfill Work
- polyethylene encasement
- concrete thrust blocks
- detectable marking tape and wire
- flushing, hydrostatic testing and disinfection, and water for testing
- exposing and cleaning existing mains, cutting and removing existing pipe, draining existing mains, disinfecting existing mains, and refilling existing mains
- PVC fittings under 4 inch
- HDPE fittings

Section 01150 - Potable Water Valves

Description

01150.00 Scope - This Work consists of furnishing and installing valves in potable water systems at the locations shown or at other locations as directed.

Materials

01150.10 Materials - Furnish Materials meeting the following requirements:

Backflow Prevention Devices	02480.70
Ball Valves	02480.23
Butterfly Valves	02480.22
Combination Air Release/Air Vacuum Valves	02480.60
Commercial Grade Concrete in Precast Concrete Blocks	00440
Commercial Grade Concrete in Thrust Blocking	00440
Gate Valves	02480.20
Hydraulic Cushion Check Valves	02480.40(c)
Hydraulically Operated Valves	02480.50
Power-Actuating Devices	02480.24
Spring-Loaded Plug or Disc Check Valves	02480.40(b)
Swing Check Valves	02480.40(a)
Tapping Sleeve and Valve Assemblies	02480.30
Valve Boxes	02480.25
Valve Stem Extensions	02480.26

01150.11 Handling - Handle valves so as to prevent damage to the valve, lining or coating. Load and unload valves using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped or skidded. Damaged valves will be rejected. If damage is confined to the coating or lining, it may be repaired in a manner satisfactory to the Engineer. Immediately place all damaged valves apart from the undamaged and remove the damaged valves from the site as soon as possible.

01150.12 Connecting Ends - Furnish valves with connecting ends as shown and as required for connection to pipe and fittings furnished.

Construction

01150.40 General - Install valves, back flow devices, and tapping sleeves according to the Plans and the manufacturer's recommendations. Join to the pipe according to Section 01140 and AWWA Standards for the type of connecting ends furnished. Thoroughly clean and repair joints prior to installation.

(a) Valve and Valve Box Installation - Set valves, valve boxes, and valve box extensions perpendicular to the pipe. Install valve operator extensions when required. Center the valve box and valve box extension over the operating nut of the valve. Place valve box and valve box extension over the valve or valve operator so that the valve box extension does not transmit shock or stress to the valve. Install the valve box extension of the unit first, supported by backfill or by a closed-cell foam collar not less than 2 inches in thickness. Do not allow the valve box extension to rest directly on the body of the valve or on the water main.

(b) Valve Operator Extensions - Install a valve operator extension with Rock guard on all valves that have the valve nut operator installed 3 feet or more below finish grade. Hot-dip galvanize extensions after fabrication.

(c) Backfilling - Backfill around valves according to Section 00405. Set the cast iron valve box cover flush with the Roadbed or finished paved surface.

01150.41 Combination Air Release/Air Vacuum Valves - Install combination air release/air vacuum valves as shown. Slope all piping to permit escape of any entrapped air. Perform trenching and backfilling according to 01170.40 and Section 00405.

01150.50 Field Testing - After installation, operate valves from full open to full closed to make sure valves do not bind during operation. Correct all deficiencies in the operation of the valves. Verify the number of turns from full open to full closed and provide to the Engineer for the Agency's records.

01150.51 Hydrostatic Testing - Subject valves to hydrostatic testing according to 01140.51. Correct all defects to the satisfaction of the Engineer.

01150.52 Disinfecting - Disinfect valves according to 01140.52.

Measurement

01150.80 Measurement - The quantities of valves will be measured on the unit basis.

Payment

01150.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	____ Inch ____ Valve	Each
(b)	____ Inch ____ Valve With ____ Actuator	Each
(c)	____ Inch ____ Check Valve	Each
(d)	____ Inch ____ Backflow Prevention Assembly	Each
(e)	____ Inch Hydraulically Operated Valve	Each
(f)	____ Inch Combination Air Release/Air Vacuum Valve Assembly	Each
(g)	____ Inch Tapping Sleeve and ____ Inch Valve Assembly	Each

In items (a) through (f), the size of the valve or assembly will be inserted in the first blank.

In items (a) through (d), the type of valve, check valve, or assembly will be inserted in the second blank.

In item (b), the type of actuator will be inserted in the third blank.

In item (g), the size of tapping sleeve will be inserted in the first blank. The size of valve assembly will be inserted in the second blank.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for earthwork not covered under other Pay Items, jointing, blocking of valves, protective coatings, valve boxes, valve box extensions, valve operator extensions or hydrostatic testing.

Section 01160 - Hydrants and Appurtenances

Description

01160.00 Scope - This Work consists of furnishing and installing hydrants and appurtenances in potable water systems at the locations shown or at other locations as directed.

Materials

01160.10 Materials - Furnish Materials meeting the following requirements:

Bollards	00815
Commercial Grade Concrete in Thrust Blocking	00440
End Connections	02485.20
Gate Valves	02480.20
Hydrants	02485.10
Hydrant Extensions	02485.40
Tie Rods	02485.60
Traffic Flange	02485.50
Valve Boxes	02480.25
Valve Stem Extensions	02480.26

01160.11 Handling of Hydrants:

(a) Loading and Unloading - Handle hydrants to prevent damage to the hydrant, lining or coating. Load and unload hydrants using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped, skidded, or rolled against other hydrants. Damaged hydrants will be rejected. If damage is confined to the coating or lining, it may be repaired in a manner satisfactory to the Engineer. Immediately place all damaged hydrants apart from the undamaged hydrants and remove the damaged hydrants from the Project Site.

(b) End Caps - Provide factory applied end caps on pipe connection ends. Maintain end caps through shipping, storage, and handling to prevent damage and prevent dirt and moisture from entering the hydrants.

Construction

01160.40 Setting Hydrants - Inspect all hydrants upon delivery in the field to ensure proper working order. Install hydrants as shown or directed.

(a) Touchup Painting - After all installation and testing is complete, paint the exposed portion of the hydrant with one coat of the type and color of coating designated by the Engineer.

(b) Out-of-Service Hydrants - Identify all hydrants not in service by covering with a properly secured burlap or plastic bag.

01160.41 Hydrant Laterals - Install hydrant laterals, consisting of ductile iron pipe, from the auxiliary gate valve at the main to the hydrant, according to Section 01140 and as shown.

01160.42 Hydrant Restraints - Restrain the thrust created in the hydrant lateral as shown.

01160.43 Gate Valves and Valve Boxes - Install gate valves and valve boxes according to Section 01150, except that the end connections shall be provided with lugs for tie rods, or the bells shall provide sufficient clearance between the body of the valve and the hub to permit the installation of tie rods.

01160.44 Hydrant Bollards - Construct hydrant bollards according to Section 00815 at the locations shown.

01160.46 Moving Existing Hydrants - Move existing hydrants where shown. As shown, remove the existing hydrant lateral tee from the main if the main is to remain active, and insert a new section of pipe into the water main in place of the existing hydrant lateral tee. Where the existing main to which the existing hydrant lateral tee is connected is to be abandoned or temporarily activated after the existing hydrant is moved, plug the open end of the hydrant lateral pipeline. Provide temporary thrust restraint if temporarily reactivated.

01160.47 Reconnecting Existing Hydrants - Reconnect existing hydrants where shown. Leave the location and elevation of the existing hydrant unchanged, but change the existing hydrant lateral to connect with a new gate valve and hydrant tee provided in a new main. Install new hydrant lateral according to Section 01140 where the lateral extends to connect to the new main. Where existing hydrants were not restrained, restrain the new connections as shown.

01160.48 Hydrant Extensions - Install hydrant extensions where required.

Field Testing Installations

01160.50 General - After installation, operate hydrants from full open to full closed to ensure that they do not bind during operation. Correct all malfunctions in the operation of the hydrants.

01160.51 Hydrostatic Testing - Perform hydrostatic testing of hydrants according to 01140.51. Correct all defects in materials or workmanship to the satisfaction of the Engineer.

01160.52 Disinfecting - Disinfect hydrants according to 01140.52.

Measurement

01160.80 Measurement - The quantities of Work performed under this Section will be measured on the unit basis.

New pipe and tees for hydrant connections will be measured according to 01140.80. Gate valves will be measured according to 01150.80. Hydrant bollards will be measured according to 00815.80.

Payment

01160.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

	Pay Item	Unit of Measurement
(a)	Hydrant Assemblies	Each
(b)	Resetting Existing Hydrants	Each
(c)	Moving Existing Hydrants	Each
(d)	Reconnecting Existing Hydrants	Each
(e)	Hydrant Extensions	Each

Item (a) includes thrust restraints, concrete blocks, gravel, and painting.

Item (b) includes thrust restraints, painting, and reconnecting to the main.

Item (c) includes thrust restraints, painting, reconnecting to the main, and plugging abandoned laterals if needed.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

New pipe and tees for hydrant connections will be paid for according to 01140.90. Gate valves will be paid for according to 01150.90. Hydrant bollards will be paid for according to 00815.90.

Section 01170 - Potable Water Service Connections, 2 Inch and Smaller

Description

01170.00 Scope - This Work consists of furnishing and installing service connections, 2 inch in diameter and smaller, from the main to the water meter, and furnishing and installing sampling stations. The water meter will be furnished and installed by others unless otherwise shown or specified.

Materials

01170.10 Materials - Furnish Materials meeting the following requirements:

Angle Meter Valve	02490.30(b)
Bronze Nipples and Fittings	02490.60
Copper Tubing Service Pipe	02490.40(a)
Corporation Stops	02490.30
Customer Service Valves	02490.60
Meter Boxes	02490.70
Meter Setters	02490.50
Polyethylene Tubing Service Pipe	02490.40(b)
Saddles	02490.20
Sampling Stations	02490.80
Service Fittings	02490.40(c)

Construction

01170.40 General - Except for class 52 or greater ductile iron pipe, make all service connections to water mains, using saddles as specified and of the size and type suitable for use with both the water main and the pipe being installed. For class 52 and greater ductile iron pipe, make direct taps for corporation stops according to the recommendations of the Ductile Iron Pipe Research Association (DIPRA), unless direct taps are prohibited by the Special Provisions. Install service pipelines perpendicular to the main, unless otherwise shown.

(a) Trench Depth - Construct the depth of trench for service connection piping to provide a minimum of 30 inches of cover over the top of the pipe. Ensure that the main is not damaged during installation of the service. Excavate and backfill for service connections according to Section 00405, except install the service pipeline under existing Pavement, curbs and sidewalks by boring methods approved by the agency having jurisdiction over the roadway. Resurface the trench according to Section 00495.

(b) Installation - Furnish and install water service assemblies at the locations shown, or as directed. Service pipe, meter assemblies, fittings, and appurtenances shall conform to the details and standards of the agency having jurisdiction. As shown, install the water service saddle, corporation stop, water service pipe, meter assembly, and meter, and reconnect the customer service pipe to the installed meter assembly.

Cut customer service pipes using tools specifically designed to leave a smooth, even, and square end on the pipe. Ream cut ends to the full inside diameter of the pipe. For pipes that will be connected using couplings that seal to the outside surface of the pipe, clean pipe ends to a sound, smooth finish before installing couplings.

Make service connections to water mains according to the recommendations of the pipe manufacturer and appropriate AWWA standard for water service installation. All water services

shall be continuous without splices between the main and the meter unless otherwise approved by the agency having jurisdiction.

Install water service assemblies to match finished lines and grades, and maintain proper clearances and cover for the entire service connection. Adjust the meter box to the finished grade after the surface has been acceptably restored. When meter boxes are to be installed in driveways or a vehicular Traveled Way, use approved traffic rated meter boxes.

01170.41 Reconnecting Existing Services - Where shown, construct new service connections and angle valves to reconnect existing meter assemblies to the new mains. Verify the location of existing service connections and meter assemblies in the field. Notify affected customers of the service interruption at least 24 hours prior to service interruption. Use insulating couplings at all connections between existing galvanized steel or iron pipe and new copper pipe. All fittings, appurtenances, and other miscellaneous materials on the sections of existing pipe that have been removed become the property of the Contractor.

01170.42 Sampling Stations - Install sampling stations according to the manufacturer's recommendations and at the locations and depths shown or as directed. Install service connections and perform trenching, backfilling, and surface restoration according to 01170.40.

Field Testing Installations

01170.50 Flushing and Disinfecting - Before tapping the main for installation of service connections and sampling stations to existing water mains, liberally treat the exterior of the existing main with hypochlorites. Before making connections, swab or spray the ends of all service pipes, the connection points of all appurtenances, and the sampling stations with a 1 percent hypochlorite solution. Thoroughly flush the service connections and sampling stations. For installation of service connections and sampling stations concurrent with new water mains, flush and disinfect service connections and sampling stations according to Section 01140.

01170.51 Hydrostatic Testing - For installation of service connections and sampling stations that connect to existing water mains, apply system pressure to new installations prior to backfilling and repair any visible leaks. For installation of service connections and sampling stations concurrent with new water mains, perform hydrostatic testing of service connections and sampling stations according to Section 01140. Correct all defects in materials or workmanship and retest until satisfactory results are obtained.

Measurement

01170.80 Measurement - The quantities of water service connection piping and water service line will be measured on the length basis.

The quantities of reconnecting existing services, sampling stations, water meter assemblies, and relocating meter assemblies will be measured on the unit basis.

Payment

01170.90 Payment - The accepted quantities of Work performed under this Section will be paid for at the Contract unit price, per unit of measurement, for the following items:

Pay Item	Unit of Measurement
(a) ____ Inch Water Service Connection Piping	Foot
(b) Reconnecting Existing Water Services, ____ Inch	Each
(c) Water Sampling Stations	Each
(d) ____ Inch ____ Water Service Line	Foot
(e) ____ Inch Water Meter Assembly	Each
(f) Relocate ____ Inch Water Meter Assembly	Each

In items (a) and (b), the nominal pipe diameter will be inserted in the blank.

In item (d), the nominal pipe diameter will be inserted in the first blank. The type of pipe will be inserted in the second blank.

In item(s) (e) and (f), the nominal size of the meter will be inserted into the blank.

Items (a) and (d) include excavating, tapping the main, laying and jointing the pipe and fittings, corporation stop, saddle, appurtenances, backfilling, surface restoration, testing, and flushing and disinfection of the water service.

Item (b) includes excavating, tapping the main, laying and jointing the pipe and fittings, appurtenances, backfilling, surface restoration, testing, and flushing and disinfection of the reconnected service connection.

Item (c) includes excavating, tapping the main, water sampling station, laying and jointing the pipe and fittings, curb stops, valve box, appurtenances, backfilling, surface restoration, concrete pad, testing, and flushing and disinfection of the sampling station.

Item (e) includes excavating, installation of meter box when specified, angle meter valve, meter setter, customer service valve and appurtenances, backfilling, surface restoration, testing, and flushing and disinfection.

Item (f) includes meter when specified, angle meter valve, customer service valve, meter box, meter setter, fittings, and appurtenances necessary to install the meter assembly, and abandoning the existing water service at the mainline.

Payment will be payment in full for furnishing and placing all Materials, and for furnishing all Equipment, labor, and Incidentals necessary to complete the Work as specified.

PART 02000 - MATERIALS

Concrete Materials and Additives

Section 02001 - Concrete

Description

02001.00 Scope - This Section includes the requirements for the properties, submittals, production, quality control and acceptance of portland cement concrete (concrete) for structural, precast prestressed, and paving applications.

02001.02 Abbreviations and Definitions:

f'_c	-	Minimum Specified Compressive Strength at 28 days
f'_{cr}	-	Required Average Compressive Strength
GGBFS	-	Ground Granulated Blast Furnace Slag
HPC	-	High Performance Concrete
HRWRA	-	High-Range Water-Reducing Admixture (super-plasticizer)
IC	-	Internally Cured
LWFA	-	Lightweight Fine Aggregate
PPCM	-	Precast prestressed concrete member
SCM	-	Supplementary Cementitious Materials
SSD	-	Saturated Surface-Dry
w/cm Ratio	-	Water-Cementitious Material Ratio
WRA	-	Water Reducing Admixture

Cementitious Materials - Portland cement and supplementary cementitious materials.

High Performance Concrete - Concrete designed for enhanced durability and performance characteristics. High performance concrete is identified by the letters "HPC" in front of the concrete class designation (for example, HPC4500 – 1 1/2).

Internally Cured Concrete - Concrete designed to utilize lightweight fine aggregate to mitigate shrinkage.

Moderate Exposure - Elevations below 1,000 feet.

Pozzolans - Fly ash, silica fume, and metakaolin.

Severe Exposure - Elevations 1,000 feet and above.

Supplementary Cementitious Materials - Fly ash, silica fume, metakaolin, and ground granulated blast furnace slag.

02001.10 Materials - Furnish Materials meeting the requirements of the following:

Aggregates	02690
Cement	02010
Chemical Admixtures	02040
Concrete Modifiers	02035
Supplementary Cementitious Materials	02030
Synthetic Fiber Reinforcing	02045
Water	02020

02001.15 Concrete Mix Design - Submit current or new mix designs, prepared by a CCT, with the information listed in 02001.15(c), for each required class of concrete to the Engineer for review. Allow 21 Calendar Days for the review. Design mixes by the volumetric method in ACI 211.1 to achieve the properties of 02001.20 and 02001.30 when tested according to 02001.15(b). Provide a design that is workable, placeable and finishable given the specific conditions for the Project and Structure. Do not proceed with concrete placement until the Engineer has determined that the mix design complies with the Specifications. Review of concrete mix designs does not relieve the Contractor of the responsibility to provide concrete meeting the Specification and Project Site requirements.

(a) Current Mix Designs - Mix designs that meet the requirements for the specified class of concrete and are currently being used or have been used within the past 12 months on any project, public or private may be submitted for review. Provide individual tests results that comprise the average if more than one data point exists. For paving designs the flexural strength testing must be from within the last two years. For HPC designs the length change and permeability tests must be from within the last two years.

(b) New Mix Designs - Make at least one trial batch for each concrete mix design. Notify the Engineer at least 48 hours before making each trial batch. The Engineer may witness preparation and testing. Prepare and test trial batches using the same materials, at the same proportions, and having the same plastic properties of concrete that will be used in the Project. Simulate haul time, batching sequence and mixing conditions to ensure the trial batch is representative of the mixture that will be delivered to the Project. Furnish all Materials, Equipment, testing and Work required for designing the mixes at no additional cost to the Agency.

(1) Trial Batch Plastic Properties - For each trial batch, test according to the following test methods:

Test	Test Method
Sampling Fresh Concrete	WAQTC TM 2
Concrete Temperature	AASHTO T 309
Slump	AASHTO T 119 [1]
Air Content	AASHTO T 152
Density	AASHTO T 121
Yield	AASHTO T 121
Molding Concrete Specimens	AASHTO T 23 or R 39 [2]
Water Cement Ratio	[3]

[1] For drilled shaft concrete test the slump retention by subsequent tests at half-hour intervals for the duration of the estimated drilled shaft placement, including temporary casing extraction. Report in table or graphical format.
[2] Cast cylinders in single use plastic molds
[3] Use ODOT's Field Operating Procedure for AASHTO T 121 in the MFTP

(2) Trial Batch Hardened Properties - When applicable, test properties according to the following test methods:

Test	Test Method
Compressive Strength	AASHTO T 22
Flexural Strength	AASHTO T 97
Length Change	AASHTO T 160
Permeability	AASHTO T 277

a. Compressive Strength Tests - For each trial batch, cast and cure at least three test cylinders according to AASHTO T 23 or AASHTO R 39, in 6 inch by 12 inch or 4 inch by 8 inch single use plastic molds. The use of unbonded caps according to ASTM C1231 is permitted. Test at 28 days according to AASHTO T 22.

b. Flexural Strength Tests - For each paving concrete trial batch, cast and cure at least three flexural beams according to AASHTO T 23 or AASHTO R 39. Test flexural beams at 28 days according to AASHTO T 97.

c. Length Change Tests - For all HPC mix designs, except for precast bridge rail elements, make at least three specimens from the trial batch for length change testing. Sample prisms shall have a square, 4 inch by 4 inch cross section. Wet cure the samples until they have reached an age of 28 days, including the period in the molds. Following the wet cure, air store and measure samples according to AASHTO T 160, Section 11.1.2 for 28 days. Report length change results at total specimen age of 56 days.

d. Permeability Tests - For alternate HPC mix designs, make at least three specimens from the trial batch for permeability testing. Prepare, cure, dry and test according to AASHTO T 277. Report permeability in coulombs at 90 days.

(c) Required Submittals for Mix Designs - Submit the following information for each concrete mix design:

(1) Supplier's Information - Provide the supplier's unique mix design identification number and batch plant location.

(2) Mix Design Constituent Proportions:

- Weight per cubic yard (pounds per cubic yard) of cement, SCM, fine Aggregates and coarse Aggregates (SSD), mix water, concrete modifiers, and chemical admixtures
- Absolute volumes of cement, SCM(s), fine Aggregates and coarse Aggregates (SSD), mix water, air content, concrete modifiers, and chemical admixtures
- Dosage rates for chemical admixtures (ounces per cubic yard)
- w/cm Ratio including all chemical admixtures

(3) Aggregates - Identify the Aggregate source by the ODOT source number. Report current values of the following:

- Bulk specific gravities (SSD)
- Fine Aggregate absorptions
- Coarse Aggregate absorptions
- Dry-rodded density of coarse Aggregates

- Average stockpile gradations
- Fineness modulus of sand used in the mix design calculations

(4) Cement - For each cement used, provide the following:

- Manufacturer
- Brand name
- Type
- Source or location plant
- QPL product number

(5) SCM - For each SCM used, provide the following:

- Manufacturer
- Brand name
- Source
- Class
- QPL product number

(6) Concrete Modifiers - For each concrete modifier used, provide the following:

- Manufacturer
- Brand name
- QPL product number

(7) Admixtures - For each admixture used, provide the following:

- Manufacturer
- Brand name
- Design dosage rate
- QPL product number

(8) Synthetic Fiber Reinforcing - For each synthetic fiber reinforcing used, provide the following:

- Manufacturer
- Brand name
- Design dosage rate
- QPL product number

(9) Water - Identify the source of water to be used and provide a certificate of compliance certifying that the water meets the requirements of 02020.10.

(10) Plastic Concrete Tests - Report the temperature, slump, density, air content, yield, and w/cm Ratio of the trial batch or the average of these values for the cylinder sets presented for evaluation of a current mix design.

For drilled shaft concrete, report the following additional information:

- The total time estimate from initial batching through drilled shaft placement, including haul time, placing concrete, and temporary casing extraction.
- Initial slump test results and subsequent results at 30-minute intervals, verifying a minimum slump of 4 inches is maintained for the total time estimated for drilled shaft placement, including temporary casing extraction. Report data in a table or graph format.

(11) Compressive Strength Test Results - Report the individual test results and the ASTV of cylinders from the trial batch for new mix designs. For current designs, provide the individual tests and the average of the cylinder sets presented for evaluation.

(12) Strength Analysis - Provide an analysis, showing all calculations, demonstrating that the mix design meets the requirements of 02001.20(a).

(13) HPC Test Results - For all HPC except precast bridge rail elements, report the length change according to 02001.15(b)(2)(c).

For alternate HPC designs only, report the permeability according to 02001.15(b)(2)(d).

(14) Quality Control Personnel - Provide the name and certification number of the CCT who prepared the mix design, the QCT who performed the plastic concrete tests and cast the test cylinders, the CSTT who tested the cylinders, and the ODOT certification number of the laboratory where the cylinders were tested.

02001.20 Concrete Properties, Tolerances, and Limits - Provide concrete that is workable, placeable, uniform in composition and consistency, and having the following properties:

(a) Strength - Provide concrete meeting the required classes shown in the Contract Documents. The class of concrete designates the minimum required compressive strength, f'_c at 28 days.

Table 02001-1

Concrete Strength and Water/Cementitious Material (w/cm) Ratio		
Type of Concrete	**Strength f'_c (psi)**	**Maximum w/cm Ratio**
Structural	3300	0.50
	3300 (Seal)	0.45
	4000	0.48
	4000 (Drilled Shaft)	
	HPC4500	0.40
	HPC (IC) 4500	
	5000 +	
Paving	4000	0.44
	5000	0.48
PPCM's (with cast-in-place decks and no entrained air)	5500	0.44
	6000 +	0.42

(1) Required Average Compressive Strength (f'_{cr}) - Except for PPCM designs, provide calculations demonstrating compliance with ACI 301 section 4.2.3.3 using the ASTV from either field results or trial batch cylinders.

(2) Flexural Strength - Provide paving concrete mix designs with a minimum of 600 psi at 28 Days.

(b) Air Entrainment - Provide all concrete, except PPCM with cast-in-place decks, seal concrete, and drilled shaft concrete with entrained air in the amounts shown in Table 02001-2. Field measured entrained air content shall be within ± 1.5 percent of target air entrainment values.

Table 02001-2

Air Entrainment		
Nominal Maximum Aggregate Size, inch	**Moderate Exposure (Percent)**	**Severe Exposure (Percent)**
3/8	6.0	7.5
1/2	5.5	7.0
3/4	5.0	6.0
1	4.5	6.0
1 1/2	4.5	5.5

(c) Slump - Provide concrete at the appropriate slump shown in Table 02001-3. Take corrective action to maintain a consistent slump at the point of discharge from the delivery vehicle.

Table 02001-3

Concrete Slump	
Condition	**Slump**
Concrete without WRA	4" max.
Concrete with WRA	5" max.
Concrete with HRWRA	6" ± 2"
Precast Prestressed Concrete with HRWRA	10" max.
Seal Concrete	8" ± 2"
Drilled Shaft Concrete	8 1/2" ± 1 1/2" [1]
[1] Maintain a minimum slump of 4 inches throughout drilled shaft placement, including temporary casing extraction.	

(d) Temperature - Provide concrete, at time of placement, at a temperature between a minimum of 50 °F and a maximum of 90 °F, except the maximum bridge deck concrete temperature shall be 80 °F.

(e) Durability - For HPC designs, except designs for precast bridge rail elements, the following additional requirements apply:

Test	Test Method	Acceptance Value
Length Change	AASHTO T 160	-0.045%
Permeability	AASHTO T 277	1,000 Coulombs (max.) at 90 days [1]

[1] Only required for alternate HPC designs. See 02001.30(b)(2).

Concrete Mix Designs

02001.30 Concrete Constituents:

(a) Portland Cement - Use Type I or II cement for structural or paving concrete. Use Type III cement for precast prestressed concrete.

(b) Supplementary Cementitious Materials - SCM may be used separately or in combinations up to the specified maximum percentage by mass according to the following:

(1) General Limits - SCM may be used separately or in combination as shown:

Separate SCM	**Maximum**
Fly Ash + Other Pozzolans	30%
GGBFS	50%
Silica Fume	5%

Combined SCM	**Maximum**
Fly Ash + Other Pozzolans + GGBFS + Silica Fume	50%*
Fly Ash + Other Pozzolans + Silica Fume	30%*

*Fly ash + other pozzolans shall constitute no more than 25% and silica fume shall constitute no more than 5% of the total weight of cementitious materials.

When silica fume is added to truck mixed concrete, mix the batch a minimum of 100 revolutions at the mixing speed specified by the manufacturer before leaving the batch plant.

(2) HPC Cementitious Composition - Provide HPC with one of the following:

- Cementitious material with 66 percent portland cement, 30 percent fly ash or GGBFS, and 4 percent silica fume.
- Cement with SCM proportioned according to 02001.30(b)(1) and with trial batches performed to demonstrate that the proposed alternate mix design provides a maximum of 1,000 coulombs at 90 days when tested according to AASTHO T 277.

(c) Blended Hydraulic Cement - Blended hydraulic cement may be used subject to the limits of 02001.30(b) and 02010.20.

(d) Chemical Admixtures - Use chemical admixtures according to the manufacturer's recommendations. Use WRA in all seal concrete and in Class 5000 concrete or greater. Use HRWRA in all HPC.

Use a hydration stabilizer from the QPL in all concrete for bridge decks. Use an appropriate amount to extend the initial set time of the concrete by 90 minutes.

(e) Aggregate - If the nominal maximum size of the coarse Aggregate is not included as a part of the class of concrete, or shown on the Plans, any size from 1 1/2 inch to 3/8 inch nominal maximum size Aggregate may be used according to ACI guidelines except:

- Use 1 1/2 inch nominal maximum size Aggregates in bridge deck concrete.
- Use 1 1/2 inch nominal maximum size Aggregates in paving concrete unless otherwise indicated.
- Use 3/8 inch nominal maximum size Aggregates in drilled shafts unless otherwise indicated.

(1) HPC Coarse Aggregate Content - Proportion all HPC for a minimum coarse Aggregate absolute solid volume according to Table 02001-4:

Table 02001-4

Absolute Solid Volume	
Maximum Nominal Aggregate Size	**Cu. Yd. (Aggregate) / Cu. Yd. (concrete)**
3/8"	0.36
1/2"	0.38
3/4"	0.40
1"	0.42
1 1/2"	0.44

Two or more Aggregate products or sources meeting Specifications may be blended to improve concrete properties. Blending non-specification Aggregate Materials, except for gradation, with specification Materials is not allowed.

(f) Synthetic Fiber Reinforcing for Concrete - Use synthetic fiber reinforcing from the QPL and according to Section 02045 in all high performance concrete. Use synthetic fiber reinforcing according to the manufacturer's recommendations at the rate designated on the QPL. Fiber packaging is not allowed in the mixed concrete.

02001.40 Concrete Production - Produce concrete according to the following sections of ASTM C94, Standard Specification for Ready-Mixed Concrete:

ASTM Section	ASTM Title
9.	Measuring Materials
10.	Batching Plant
11.	Mixers and Agitators
12.	Mixing and Delivery[1]

[1] When haul time or placement conditions warrant exceeding the time of discharge, submit a detailed breakdown of the estimated time needed from batching to discharge of a load along with the measures that will be taken to ensure slump, temperature and uniformity will be maintained. This request must be submitted in advance and may establish a new time limit at the Engineer's discretion.

(a) Delivery Tickets - Send a concrete delivery ticket with each load of concrete supplied to the Project. Each delivery ticket shall include the following information:

- Concrete supplier's name, address and telephone number
- Address and telephone number of batch plant if different from above
- Date and time the concrete batch was produced
- ODOT mix design number
- Size of load batched
- Weights or volumes of constituents batched in the load
- Amount of water that can be added at the Project Site
- Amount of water added at the Project Site

(b) Adjusting Concrete Proportions - After a mix design has been reviewed and accepted, submit any proposed adjustments to concrete proportions for review. Significant changes to the mix design, as determined by the Engineer, may require verification of performance by trial batch according to 02001.32. Significant changes include, but are not limited to the following:

- Decreases in cementitious material content.
- Changes in cement source.
- Increases in SCM quantity replacing cement.
- Changes in SCM source.
- Substitution of aggregates from a different source.
- Admixture product changes.
- Large admixture dosage changes, excluding seasonal adjustments for air entraining agents and Type A or D water reducers (± 25 oz/cubic yard).

02001.50 Quality Control - Provide quality control according to Section 00165 and the following:

- Sample and test according to the MFTP.

- Provide certified technicians to sample and test the mix for temperature, air content, slump, water-cementitious ratio, density and yield, from the first load of each placement, whenever there is a visible change in the slump of the concrete, and when a set of cylinders is obtained.
- If the results of any test are outside of the Specification limits, stop placement of the load. Correct the load or, if the load cannot be corrected, do not incorporate it into the Work. Test subsequent loads before any further concrete placement. Correct subsequent loads if any of the tests are still outside the Specification limits. Return to the specified test frequency when the test results from two consecutive loads are shown to meet the Specification limits.
- The Contractor shall designate a person responsible for accepting and rejecting concrete onsite.

Certified Technician duties:

(a) Certified Aggregate Technician (CAgT) -

- Sample and test Aggregates.
- Sample and test each stockpiled size according to the test procedures and at the frequencies shown in the *Field Tested Materials Acceptance Guide* section of the MFTP.
- Record and evaluate test results according to Section 00165.
- Provide Stat-Spec results to the Engineer.
- Notify the CCT whenever a fine aggregate fineness modulus varies by more than ± 0.20 from the mix design it is to be used in.
- Test the fine and coarse aggregates for total moisture content according to AASHTO T 255.

(b) Quality Control Technician (QCT) -

- Attend pre-placement meetings for bridge deck pours and paving.
- Be at the concrete placement site when concrete placement is in progress.
- Have a copy of the mix design on site and available during concrete placement.
- Obtain and check each batch ticket upon arrival of the concrete at the Project Site for the correct mix design.
- Sample the concrete and test for ambient air temperature, plastic concrete temperature, slump, air content, density, w/cm Ratio and yield at the frequencies required by and according to the tests listed in the MFTP, after concrete mixture proportions are adjusted in the field, and at such times as requested by the Engineer.
- Notify the Contractor and the Engineer immediately when the concrete is not in compliance with the Specifications.
- Be in direct contact with the CCT by telephone, radio or other means to convey information.
- Notify the CCT of loads rejected and the reason for rejection.
- Notify the CCT immediately whenever the w/cm Ratio varies from the mix design target by more than ± 0.03.
- Notify the CCT immediately whenever the air content varies from the mix design target by more than ± 1.5 percent.
- Notify the CCT immediately whenever the slump varies from the allowable limits of Table 02001-3.
- Notify the CCT immediately whenever the density of the plastic concrete varies from the mix design target by more than ± 3.0 pounds per cubic foot.

(c) Concrete Control Technician (CCT) -

- Prepare new concrete mix designs.
- Notify the Engineer at least 48 hours prior to trial batching.
- Control the quality of concrete during production.
- Submit proposed adjustments of the mix design, in writing, to the Engineer for approval by the middle of the following work shift.
- Ensure approved adjustments are implemented prior to proceeding with production.
- Before batching is started and when there is a significant change in the slump of the concrete ensure moisture contents of the coarse and fine aggregate are verified by the CAgT. Make necessary adjustments to maintain consistent concrete properties. Provide moisture content test results to the Engineer upon request.
- Monitor concrete properties and compressive strength tests throughout the duration of the Project.
- Make adjustments to loads that fail to meet the air content or slump criteria of the Specifications prior to the 90-minute time limit. Adjustments shall comply with the provisions of ASTM C94.
- Make adjustments to maintain a satisfactory over-design f'_{cr}.
- Perform an analysis and verify the accuracy of coarse and fine aggregate moistures whenever the w/cm Ratio varies from the mix design target by more than ± 0.03.
- Perform an analysis and make necessary adjustments whenever the unit weight of the plastic concrete varies from the mix design by more than ± 3.0 pounds per cubic foot.
- Perform an analysis whenever the fineness modulus of the fine aggregate varies by more than ± 0.20 from the established mix design. If necessary to maintain proper workability, ability to pump or ability to finish, make an adjustment to the coarse/fine aggregate ratio and submit to the Engineer by the middle of the following work shift.

02001.60 Acceptance of Concrete - Acceptance of concrete will be according to Section 00165 and the following:

(a) Aggregate - Acceptance of aggregate will be according to 02690.12.

(b) Plastic Concrete - Acceptance of plastic concrete will be based on tests performed by the Contractor's QCT, according to the tolerances and limits of 02001.20, when discharged within the time allotted in 02001.40.

(c) Hardened Concrete - Cast and cure test specimens according to AASHTO T 23 in 6 inch x 12 inch or 4 inch x 8 inch, single-use plastic molds and test at 28 days according to AASHTO T 22.

(1) General - For all classes of concrete, acceptance of hardened concrete will be based on an analysis of compressive strength tests of cylinders cast by the QCT. Test cylinders at an Agency certified laboratory.

(2) Acceptance - Hardened concrete with an ASTV meeting or exceeding the specified design strength, f'_c will be accepted for strength. If the ASTV is less than f'_c but at least 85 percent of f'_c, the Engineer may review the results to determine if the concrete represented by the cylinders is suitable for the intended purpose. Remove concrete that has an ASTV less than 85 percent of f'_c unless otherwise authorized, in writing, by the Engineer. If the concrete is removed, the cost of removal, replacement and all related Work is the Contractor's responsibility. If the

Engineer determines that the concrete is suitable for the intended purpose, the concrete may be allowed to remain in place, subject to a price adjustment according to 00150.25. If an ASTV falls below f'_c, the Contractor may submit a written plan outlining a proposed alternate method of evaluating compressive strength. Submit the plan for review by the Engineer within 3 days of the test. Provide evidence that a reasonable f'_{cr} (over-design) was maintained and that there is credible evidence (besides low strength) which warrants consideration of this option. The Engineer may allow an alternate method of acceptance if the compressive strength test results are determined to be suspect from definable external factors.

Section 02010 - Portland Cement

Description

02010.00 Scope - This Section includes the requirements for portland cement and blended hydraulic cement.

Materials

02010.10 Portland Cement:

(a) Types - Furnish one or another of the following types as elected:

- Type I
- Type II
- Type III

Do not mix or alternately use differing brands or types of cement, or the same brand or type of cement from different mills without prior written approval.

(b) Specifications - Portland cement shall conform to the requirements of AASHTO M 85 or ASTM C150 for low alkali cement except as follows:

- Cement shall have a total alkali content (sodium and potassium oxide calculated as $Na_2O + 0.658\ K_2O$) not exceeding 0.60 percent.
- All cement types shall contain a maximum of 8 percent tricalcium aluminate (C_3A).
- The time-of-setting tests will be by either the Gillmore test or the Vicat test.
- Types I and II maximum fineness (specific surface) as determined by AASHTO T 153 air permeability test shall be 430 m^2/kg. If $C_3S + 4.75\ C_3A$ is less than or equal to 90, the fineness criteria does not apply.

(c) Acceptance - Portland cement shall be from the QPL.

02010.20 Blended Hydraulic Cement - Blended hydraulic cement shall be either Type IS-portland blast-furnace slag cement, Type IP-portland-pozzolan cement, Type IL-portland-limestone cement, or Type IT-ternary blended cement according to AASHTO M 240.

Furnish blended hydraulic cement from the QPL.

Section 02015 - Portland Cement Concrete Repair Material

Description

02015.00 Scope - This Section includes the requirements for portland cement concrete repair materials.

Materials

02015.10 Materials - All PCC repair materials are acceptable for structural applications when used according to the manufacturer's recommendations.

02015.20 Portland Cement Concrete Repair - Furnish PCC repair Material from the QPL.

02015.30 Portland Cement Concrete Repair, Polymer Modified - Furnish polymer modified PCC repair Material from the QPL.

02015.40 Portland Cement Concrete Repair, High Performance - Furnish High Performance PCC repair Material from the QPL.

02015.50 Portland Cement Concrete Repair, Surface - Furnish Surface PCC repair Material from the QPL.

Section 02020 - Water

Description

02020.00 Scope - This Section includes the requirements for water used in mixing concrete, mortar, grout, and other applications when specified or directed.

Materials

02020.10 Water:

(a) General - Water used in mixing or curing concrete, mortar, grout, and in mixing cement-treated Base shall be reasonably clean, and free of oil, sugar, organic matter, or other substances injurious to the finished product.

(b) Potable - Potable water may be used without testing if the Contractor provides a quality compliance certificate verifying that the water has met the limits and ranges of ASTM C1602, according to tests made within the last 2 years.

Water approved for public use by the Oregon Health Division may be accepted for use without testing.

(c) Non-Potable, Unknown Quality, or Suspected Quality - Non-potable, unknown quality, or suspected quality water shall be tested at no additional cost to the Agency. Test according to ASTM C114 and ASTM C1603. Water from concrete production operations is considered unknown quality. Results of testing shall comply with the limits and ranges of ASTM C1602 and shall be available for review upon request.

Section 02030 - Supplementary Cementitious Materials

Description

02030.00 Scope - This Section includes the requirements for fly ash, silica fume, and ground granulated blast furnace slag used in portland cement concrete.

02030.01 Abbreviations:

SCM - Supplementary Cementitious Materials

Materials

02030.10 Fly Ash - Furnish Class C, Class F, or Class N fly ash from the QPL and conforming to AASHTO M 295 (ASTM C618).

02030.20 Silica Fume - Furnish silica fume from the QPL and according to the following:

(a) Types - Provide the silica fume as a slurry containing silica fume, water, and a high range water reducer, or as a densified powder. The silica fume portion shall conform to AASHTO M 307. Total alkalis, as equivalent Sodium Oxide (Na_2O), shall be 1.5 percent maximum.

(b) Acceptance - Silica fume will be accepted for immediate use if accompanied by a test results certificate according to 00165.35. If the silica fume is supplied as a slurry, the certificate shall indicate the silica fume content of the slurry as a percent by weight. If the silica fume is supplied as a densified powder, do not allow the packaging to enter the concrete mixture.

02030.40 Ground Granulated Blast Furnace Slag (GGBFS) - Furnish GGBFS from the QPL and conforming to AASHTO M 302.

02030.50 Metakaolin - Furnish metakaolin from the QPL and conforming to AASHTO M 295 (ASTM C618) Class N.

02030.60 Blended - Furnish blended GGBFS and Fly Ash from the QPL.

Section 02035 - Concrete Modifiers

Description

02035.00 Scope - This Section includes the requirements for concrete modifiers used in portland cement concrete.

Materials

02035.10 Styrene-Butadiene Latex - Furnish latex concrete modifiers from the QPL that are a nontoxic, film-forming, polymeric emulsion in water to which all stabilizers have been added at the point of manufacture. Latex modifiers shall be homogeneous and uniform in composition, and shall meet the following requirements:

Polymer Type Stabilizers	**Styrene Butadiene**
Latex	Nonionic Surfactants
Portland Cement Composition	Polydimethyl Siloxane
Solids, % by weight, min.	46.0
Volume Density, lb/gal, min.	8.4 at 77 °F
pH	9.0 to 11.0
Color	White

Latex that has not been stored according to the manufacturer's recommendations will not be accepted.

Section 02040 - Chemical Admixtures

Description

02040.00 Scope - This Section includes the requirements for air-entraining, water-reducing, retarding, and accelerating admixtures.

Materials

02040.10 Materials - Furnish admixtures from the QPL.

Section 02045 - Synthetic Fiber Reinforcing for Concrete

Description

02045.00 Scope - This Section includes the requirements for synthetic fiber reinforcing used in high performance concrete (HPC) bridge decks, silica fume concrete (SFC) overlays, and PCC.

Materials

02045.10 Synthetic Micro Fiber Reinforcing - Furnish synthetic polyolefin micro fiber reinforcing from the QPL.

02045.20 Synthetic Macro Fiber Reinforcing - Furnish synthetic polyolefin macro fiber reinforcing from the QPL.

02045.30 Synthetic Blended Fiber Reinforcing - Furnish synthetic polyolefin blended fiber reinforcing from the QPL.

02045.80 Acceptance - Acceptance of synthetic fiber reinforcing will be according to 00165.35(b) when accompanied by a quality compliance certificate.

Section 02050 - Curing Materials

Description

02050.00 Scope - This Section includes the requirements for liquid compounds, polyethylene films, and curing blankets used to cover concrete and other surfaces to retain moisture and to cure.

Materials

02050.10 Liquid Compounds - Furnish liquid membrane-forming curing compounds from the QPL and meeting the requirements of ASTM C309.

All compounds shall be Type 1-D, Type 2, Class A or B.

Only Type 2, Class B resins will be allowed for the following concrete Pavement applications:

- Plain concrete Pavement.
- Continuously reinforced concrete Pavement.
- Plain concrete Pavement repair.
- Reinforced concrete Pavement repair.

02050.20 Polyethylene Films - Furnish clear or white polyethylene films for curing concrete meeting the requirements of ASTM C171.

02050.30 Curing Blankets - Furnish curing blankets from the QPL.

Section 02055 - Concrete Surface Retarders

Description

02055.00 Scope - This Section includes the requirements for concrete surface retarders.

Materials

02055.10 Concrete Surface Retarders - Furnish concrete surface retarders from the QPL.

Section 02060 - Concrete and Crack Sealers

Description

02060.00 Scope - This Section includes the requirements for concrete and crack sealers.

Materials

02060.10 Low Modulus Concrete and Crack Sealer - Furnish low modulus concrete and crack sealer from the QPL.

02060.20 High Modulus Concrete and Crack Sealer - Furnish high modulus concrete and crack sealer from the QPL.

02060.30 Water Repellent Concrete Sealer - Furnish water repellent concrete sealer from the QPL.

Section 02070 - Bonding Agents

Description

02070.00 Scope - This Section includes the requirements for epoxy and non-epoxy bonding agents.

Materials

02070.10 Epoxy Bonding Agents - Furnish epoxy bonding agents from the QPL.

02070.20 Non-Epoxy Bonding Agents - Furnish non-epoxy bonding agents from the QPL.

Section 02080 - Grout

Description

02080.00 Scope - This Section includes the requirements for grout.

Materials

02080.10 Epoxy Grout - Furnish epoxy grout from the QPL.

02080.20 Non-Epoxy Grout - Furnish non-epoxy grout from the QPL.

02080.30 Keyway Grout - Furnish keyway grout from the QPL.

02080.40 Portland Cement Grout - Furnish portland cement grout consisting of one part portland cement and three parts sand by weight, thoroughly mixed with a minimum amount of water to produce a thick, creamy consistency. Sand shall meet the requirements of 02690.30 and cement shall meet the requirements of Section 02010.

02080.50 Tendon Grout - Furnish tendon grout from the QPL that meets vertical rise requirements.

02080.60 Structural Grout - Furnish structural grout from the QPL.

02080.70 UHPC Grout - Furnish Ultra-High Performance Concrete (UHPC) grout used in the keyways of precast prestressed concrete members or other applications when shown. Furnish UHPC grout from the QPL.

Section 02090 - Lime

Description

02090.00 Scope - This Section includes the requirements for granular quicklime and hydrated lime.

Materials

02090.10 Granular Quicklime - Furnish granular quicklime (CaO) that has a minimum calcium hydroxide content of 113 percent and meeting the following grading requirements:

Grading Requirements

Sieve Size	Percent Passing (by Weight)
3/8"	100
No. 100	25 maximum

Determine grading and hydroxide content by testing according to AASHTO T 27 and AASHTO T 219.

02090.20 Hydrated Lime - Furnish hydrated lime meeting the requirements of ASTM C1097.

02090.30 Acceptance - Provide a quality compliance certificate for lime according to 00165.35.

Wood Products

Section 02110 - Posts, Blocks, and Braces

Description

02110.00 Scope - This Section includes the requirements for wood posts and blocks for guardrail, median barrier, signs, fence posts, and braces for fencing.

Materials

02110.10 Guardrail Posts:

(a) General - Furnish posts for guardrail and median barrier of the size shown, manufactured from Douglas fir, Hem-fir, or Southern Yellow Pine. Wood for posts shall have a minimum extreme fiber bending stress (F_b) of 1,200 psi. Only treated posts from approved Suppliers that are listed in the *Nonfield-Tested Materials Acceptance Guide* will be allowed.

(b) Grading - Grading of posts shall conform to the following:

- **Douglas Fir** - Conform to the requirements for No. 1 posts and timbers as specified in either paragraph 80.11 of the current WWPA Grading Rules, or paragraph 131-b of the current WCLIB Grading Rules.

- **Hem-fir** - Conform to the requirements for select structural posts and timbers as specified in either paragraph 80.10 of the current WWPA Grading Rules, or paragraph 131-a of the current WCLIB Grading Rules.

- **Southern Yellow Pine** - Conform to the requirements for No. 1 timbers as specified in section 402 of the current Southern Pine Inspection Bureau (SPIB) Grading Rules.

(c) Certificates - Furnish certificates of lumber inspection by a recognized inspection agency.

(d) Fabrication - Before preservative treatment, bore all holes and make all necessary cuts as shown.

(e) Preservative Treatment - Treat posts according to Section 02190.

(f) Seasoning and Checking - Each preservative treated post shall show evidence of reasonable amount of seasoning and/or conditioning having occurred prior to treatment, so that further shrinkage of treated posts will not create checking which would expose untreated wood.

At the time of inspection at the plant and at the time of installation each treated post will be subject to inspection for evidence of seasoning having occurred. The presence of checking on the surface of the post will not be cause for rejection unless the width of the widest check, shake, or split exceeds 1/2 inch (surface measurement).

If an otherwise acceptable treated post has a through check, shake, or end split in the same slope of grain or plane as the bolt hole and extending from the top of the post to within 3 inches of the bolt hole, the post will be rejected unless it is provided with a tight fastening across the separation, centered on the post, and 2 inches below the top. Fasten with a 1/2 inch diameter galvanized bolt and nut with a galvanized washer under the bolt head and under the nut after final curing of post is achieved. Treat holes for fastenings according to 00570.40.

(g) Inspection, Rejection and Marking at Plant - Posts shall be subject to inspection at the treating plant at any time before, during or after treatment. Normally, inspection of treated posts will be made by the Agency's Inspector not later than 10 Calendar Days after treatment, provided the Inspector is notified of the time that treating is to be done.

Inspection of treated posts for compliance with the requirements of 02110.10(e) will be according to applicable AWPA standards, except as follows:

- The Inspector will choose the number of treated posts from any one charge of the treating cylinder for determining penetration of treatment.
- Each post selected for testing shall be representative as a basis of acceptance or rejection of a pro rata number of posts in the charge.
- If 20 percent of the posts randomly selected for testing fail to conform to requirements, all of the posts in the entire charge from which they are selected may be classed as unacceptable.

At the Inspector's discretion, each treated post or a representative random selection of treated posts may be inspected for compliance with the requirements of 02110.10(f) "Seasoning and Checking".

Posts which fail to conform to requirements of this Subsection will be subject to rejection at the treating plant singly, by partial lots, or by whole lots. (A "lot" comprises the posts in any charge of the treating cylinder.)

Each treated post shall bear a permanent mark or metal tag which identifies the Supplier and year of treatment, placed by the Supplier either:

- On the top of the post, or
- On the back of the post, 8 inches to 10 inches below the bolt hole.

(h) Field Inspection, Acceptance and Rejection - At the time of installation inspect each post for:

- Width of widest check, shake, or split.
- Damage to treated wood affecting soundness.
- Visible exposure of untreated wood.
- Conformance to the requirements of 02110.10(b) through 02110.10(f).
- Preservative visibly leaching from the post.

Posts that show a check, shake, or split exceeding 1/2 inch in width (surface measurement) on any surface will be rejected.

Posts that show surface damage may be repaired by field treating with preservatives according to AWPA Standard M 4. Repair posts that have splits or checks, or where shakes have opened or deepened sufficiently to expose untreated wood, by treating with a field preservative from the QPL applied to all opened or deepened wood separations and completely filling the separations to the surface of the post.

Remove treated wood posts that have been rejected for any one or more of the above deficiencies or faults and not repaired as stated above.

Acceptance of Material will be according to 00165.35, 02110.10(g), and the Specifications.

02110.20 Guardrail Blocks:

(a) General - Furnish wood guardrail blocks of the dimensions shown. Blocks shall be either Douglas fir or Hem-fir meeting the requirements of 02110.10, or pine or Southern Yellow Pine meeting the requirements of 02110.20(b) and 02110.10 except for 02110.10(b). The requirements of marking and branding the treated blocks, according to the last paragraph of 02110.10(g), will be waived provided that the Supplier of the treated blocks furnishes certification with each shipment stating that the blocks conform to Specifications and that the preservative treating was done under the inspection and with the approval of the Engineer.

(b) Grading - Pine guardrail blocks shall conform to the requirements of paragraph 80.11 of the current WWPA Grading Rules. Southern Yellow Pine guardrail blocks shall conform to the requirements for No. 1 timber as specified in section 402 of the current SPIB Grading Rules.

(c) Recycled Plastic - Recycled plastic guardrail blocks from the QPL may be used.

(d) Acceptance - Acceptance of Material will be according to 00165.35 and this Section.

02110.30 Fence Posts and Braces - Fence posts and brace rails shall be of the sizes and dimensions shown and shall be of sound Douglas fir, western hemlock, or western pine free from decay, end splits, and multiple crooks. Seasoning checks of not more than 5/16 inch width (surface measurement) will be allowed. Allowable crooks may be in one plane only. A line drawn between the centers of the butt and tip of each post and brace rail shall not fall outside of the actual longitudinal centerline of the post or rail by more than 1.67 percent of its length, with an allowable maximum of 2 inches.

Posts and brace rails may be square, rough, or dressed lumber, or may be peeled round posts, as the Contractor elects. Round members shall be free from bark, protruding knots and irregularities detrimental to a pleasing appearance.

Fabricate posts and brace rails before pressure treatment. Where field boring or field cutting of a treated member is required, field-treat the exposed untreated surface of the member according to 00570.40. The size of holes after treatment shall not exceed the size of the dowels or bolts to be inserted by more than 1/16 inch.

Posts intended to be driven may be machine-pointed on either the small end or the large end, before pressure treatment.

Pressure treat the posts and brace rails according to Section 02190.

Acceptance of Material will be according to 00165.35 and the Specifications.

02110.40 Wood Sign Posts - Fabricate wood sign posts from Douglas fir, surfaced four sides (S4S) and free of heart center (FOHC).

(a) Grading - Grading requirements for wood sign posts shall conform to the applicable paragraphs of either the current WCLIB Grading Rules or the current WWPA Grading Rules, as follows:

Species	4" x 4"	4" x 6"	6" x 6" and Larger
Douglas Fir	No. 1 124-b WCLIB 42.11 WWPA	No. 1 123-b WCLIB 62.11 WWPA	No.1 131-b WCLIB 80.11 WWPA

(b) Posts - Construct wood sign posts according to the applicable portions of Section 00570, modified or supplemented as follows:

(1) Length - The length of the posts shall be shown or, where not shown, each post shall be of sufficient length to provide proper sign mounting, a proper mounting height and the required foundation depth.

(2) Framing and Boring - Cut, frame and bore timber before pressure treating, to the extent practicable.

(3) Preservative Treatment - Pressure-treat wood sign posts after fabrication according to Section 02190.

(4) Cuts and Abrasions - Treat cuts, abrasions and bolt-holes, prior to shipping, with the same preservative as originally used to treat the post, except that if the post was originally treated with pentachlorophenol - volatile petroleum solvent (LPG) solution, cuts, abrasions and bolt-holes shall be treated with pentachlorophenol - mineral spirits solvent solution according to AWPA Standard M4.

(5) Field Repair - Field treat damaged or drilled pressure-treated posts according to 00570.40.

(c) Acceptance - Acceptance of Material will be according to 00165.35 and this Section.

Section 02120 - Poles and Piling

Description

02120.00 Scope - This Section includes the requirements for wood poles for use in illumination and signal installations, and timber piling for Structures.

Materials

02120.10 Wood Poles - Furnish all wood poles meeting the current edition of ANSI O5.1, Specifications and Dimensions (for Wood Poles), for Class 4 machine shaved Douglas fir, and treated meeting the requirements of Section 02190. All poles shall be round, sound, well-proportioned from butt to tip, and without short kinks or crooks.

02120.20 Timber Piling - Furnish timber piling meeting the requirements of ASTM D25.

The butt or tip size, or whether the piling are to be friction or bearing piles, will be identified in the Special Provisions. All foundation piles shall be Douglas fir.

Treat timber piling according to Section 02190.

02120.30 Timber Pile Straps - Straps shall be approximately 1 1/4 inch wide and 0.03 inch thick, manufactured from cold-rolled, heat-treated steel having a minimum ultimate tensile strength of 150,000 psi. The strap shall encircle the pile once and be fastened with a clip that is crimped so that the joint will have a minimum tensile strength of 80 percent of the tensile strength of the strap. Install the strap after pressure treating of the pile.

02120.40 Acceptance - Acceptance of poles and piling will be according to 00165.35 and this Section.

Section 02130 - Timber and Lumber

Description

02130.00 Scope - This Section includes the requirements for timber and lumber.

Materials

02130.10 Timber and Lumber - Unless otherwise shown or specified, all lumber and timber shall be S4S Douglas fir. Grading requirements shall be according to the Special Provisions.

All lumber shall be grade-stamped or have a mill certification by an American Lumber Standards certified inspection agency.

02130.20 Acceptance - Acceptance of Material will be according to 00165.35 and this Section.

Section 02140 - Glued Laminated Timber Members

Description

02140.00 Scope - This Section includes the requirements for glued laminated timber members.

Materials

02140.10 General - Furnish all structural glued laminated lumber as shown and specified.

Manufacture of structural glued laminated work shall conform to the manufacturing requirements of the current ANSI/AITC A190.1 *American National Standard, Structural Glued Laminated Timber*.

Provide quality control according to the AITC 200 *Inspection Manual for Glued Laminated Timber*.

Lumber shall be Douglas fir, southern pine, western larch, or other species, as shown or specified. Lumber used shall be of a stress grade to provide glued laminated members with the minimum stress values in bending and tension shown or specified.

Adhesives shall meet the requirements of the glued laminated lumber standards, and be waterproof.

Unless otherwise specified, appearance of members shall be architectural grade as defined in AITC 110 *Standard Appearance Grades for Structural Glued Laminated Timber*.

Seal surfaces of members with penetrating sealer and apply a coat of end sealer to the ends of all members as soon as practicable after end trimming, according to *AITC Standard for Preservative Treatment of Structural Glued Laminated Timber*. Use a clear sealer compatible with the preservative treatment used according to Section 02210.

Bundle wrap members according to *AITC Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection*.

Furnish shop details from the fabricator and obtain approval before commencing the Work. Details shall conform to the current AITC Typical Construction Details.

02140.20 Acceptance - Glued laminated timber members will be accepted according to 00165.35 and this Section.

Section 02150 - Lumber and Timber Connectors

Description

02150.00 Scope - This Section includes the requirements for connectors, bolts, nuts, washers, nails, and miscellaneous hardware for joining lumber and timber.

Materials

02150.10 Lumber and Timber Connectors:

(a) General - Galvanize connectors for treated Structures, except those of malleable iron or lightweight connectors, according to AASHTO M 111 (ASTM A123).

For all connectors and hardware that contact lumber or timber treated with Alkaline Copper Quaternary (ACQ) or Copper Azole (CA), except those used with fence posts, sign posts, guardrail post, or guardrail blocks, furnish connectors according to one of the following:

- Fabricate connectors and all associated hardware, including fasteners, with Type 304 or Type 316 stainless steel according to ASTM A480.
- Coat all connectors and associated hardware, including fasteners, according to ASTM F2833, Grade 1 or ASTM F1136, Grade 3, or approved equal.

Contact between stainless steel and non stainless steel will not be allowed.

(b) Split Ring Connectors - Provide 2 5/8 inch and 4 inch inside diameter split rings manufactured from steel conforming to ASTM A830, Grade Number 1010 (AISI C1010, SAE 1010). Each ring shall form a closed true circle with the principal axis of the Cross Section of the ring metal parallel to the geometric axis of the ring. Bevel the metal section from the central portion toward the edges to a thickness less than the mid-section. Cut through the ring in one place in its circumference to form a tongue and slot.

Cut connector grooves in timber concentric with the bolt hole and conforming to the cross-sectional shape of the rings, to provide a snug fit. The inside diameter of the groove shall be larger than nominal ring diameter so that the ring can expand slightly during installation.

(c) Shear Plate Connectors:

(1) Pressed Steel Type - Provide 2 5/8 inch diameter pressed steel shear plates manufactured from steel conforming to ASTM A830, Grade Number 1010 (AISI C1010, SAE 1010). Each plate shall be a true circle with a flange around the edge, extending from one face of the plate only and at right angles to the face. The plate portion shall have a central bolt hole and two small perforations on opposite sides of the hole and midway between the center and circumference.

(2) Malleable Iron Type - Provide 4 inch diameter malleable iron shear plates manufactured according to ASTM A47, Grade No. 32510, for malleable iron castings. Each casting shall consist of a perforated round plate with a flange around the edge projecting from one face of the plate only and at right angles to the face. The plate portion shall have a central bolt hole reamed to size with an integral hub concentric with the bolt hole and extending from the same face as the flange. Galvanize malleable iron type connectors according to AASHTO M 232 (ASTM A153).

(d) Bolts, Nuts, Nails, and Miscellaneous Hardware - Provide machine bolts and drift bolts according to ASTM A307 or ASTM A36. Washers may be cast ogee or malleable castings, or cut from steel plate.

Galvanize bolts, nuts, washers, lag screws, and wood screws, according to ASTM F2329. Provide bolts, nuts, washers, lag screws, and wood screws in standard type and make, unless otherwise shown.

(e) Lightweight Metal Connectors - Lightweight metal connectors are mass produced plate or sheet steel connectors with a maximum thickness of 1/4 inch, used to connect wood members to wood, concrete or masonry. Provide lightweight metal connectors as shown with the required minimum capacities as specified in 00570.15 of the Special Provisions. Provide copies of the test reports from the *International Code Council* (ICC-ES) showing that the supplied connectors meet the minimum capacities listed in the Special Provisions. All lightweight metal connectors shall be Type 304 or Type 316 stainless steel according to ASTM A480, or galvanized according to ASTM A23 or ASTM A653, coating designation G185.

(f) Nails and Miscellaneous Hardware - Provide dowels according to ASTM A307 or ASTM A36.

Galvanize rough hardware, drift pins, dowels, clamps, anchors, joist hangers, and nails according to AASHTO M 232 (ASTM A153).

Provide rough hardware, drift pins, dowels, clamps, anchors, joist hangers, and nails in standard type and make, unless otherwise shown.

02150.20 Acceptance - Lumber and timber connectors will be accepted according to 00165.35 and this Section.

Section 02190 - Preservative Treatment of Timber

Description

02190.00 Scope - This Section includes the requirements for preservative treatment of lumber, timber, round timber piling, guardrail posts and blocks, sign posts, fence posts, and other items as specified.

Materials

02190.10 General - All preservative treatment shall be according to AASHTO M 133 and its referenced AWPA Standards, except use the following according to the AWPA Standard:

- Category UC4C, Commodity Specification Section E for round timber piling in fresh water and on land.
- Category UC5A, Commodity Specification Section G for round timber piling exposed to salt or brackish water.
- Category UC4B, Commodity Specification Section A for fence and sign posts.
- Category UC4B, Commodity Specification Section A for guardrail posts and blocks.

02190.20 Drying After Treatment - When using waterborne preservatives, dry items according to AWPA T1, Section 7.

During the drying period and until the treated items are installed on the Project, separate each layer of treated items using spacers that are at least 1/2 inch thick.

The maximum moisture content shall be 19 percent prior to installation.

Collect all spacers and other treated wood waste from the construction site and dispose of them according to 00290.20.

02190.30 Field Treatment - Field-treat cuts, abrasions, bolt holes, drilled surfaces or any other damaged wood surfaces according to AWPA M4, Section 6 with a preservative from the QPL.

Coatings

Section 02210 - Coating Materials for Timber and Concrete

Description

02210.00 Scope - This Section includes the requirements for coating Materials used on timber and concrete.

Materials

02210.10 General:

(a) Manufacturing - Furnish coating Material meeting the following requirements:

- All coats in the coating system shall be from the same manufacturer.
- Multi-component coating materials shall be proportioned by the manufacturer with each component in its correct proportion and furnished in separate containers ready for field mixing.
- Be homogeneous, free of contamination, and of a consistency suitable for the specified use.
- Not vary in composition without prior notice by the manufacturer and approval of the Engineer.
- The coating material is not reformulated.

Use the coating material before expiration of the manufacturer's recommended shelf life.

(b) Packaging - Package the material in containers meeting the following requirements:

- Be new steel or plastic of not more than 6 gallon capacity.
- Meet U.S. Department of Transportation's Hazardous Material Shipping Regulations.
- Be original and unopened.
- Be labeled with the following:
  - Manufacturer's name
  - Exact title of coating material
  - Manufacturer's batch number
  - Date of manufacture

02210.20 Coating Materials for Timber - Furnish coatings for timber from the QPL under the category "Timber Coatings".

02210.21 Sealer for Timber - Furnish clear sealers for timber from the QPL under the category "Timber Sealers".

02210.30 Coating Materials for Concrete - Furnish coatings for concrete from the QPL under the category "Latex Emulsion Paint".

Geosynthetics and Slope Protection

Section 02320 - Geosynthetics

Description

02320.00 Scope - This Section includes the requirements for geosynthetics used in various applications.

02320.01 Definitions - Geosynthetic terms are defined in 00350.01.

Materials

02320.10 Acceptance:

(a) General Requirements - Furnish all geosynthetics meeting the following requirements:

- Free of defects, cuts or tears.
- Resistant to ambient temperatures, acid and alkaline conditions, micro-organisms and insects.
- For the intended purpose and have dimensional stability.

(1) Geotextiles - Furnish woven or nonwoven geotextiles meeting the following requirements:

- Fibers used in manufacture of geotextiles, and threads used in joining geotextiles by sewing, shall consist of long-chain synthetic polymers, composed of at least 95 percent by weight of polyolefins or polyesters. They shall be formed into a stable network such that the filaments or yarns retain their dimensional stability to each other, including selvages.
- Meet or exceed the properties specified in 02320.20.
- Be free of any chemical treatment or coating that might significantly reduce permeability.

(2) Geogrids - Furnish geogrids meeting the following requirements:

- Geogrid reinforcements approved as Type 1 MSEW Geogrid on the QPL.
- Geogrid for Subgrade reinforcement approved as Subgrade Reinforcement Geogrid on the QPL.

(b) Acceptance Requirements - The actual minimum average roll values furnished by the manufacturer shall be based on representative test results from the manufacturing plant which produced the geosynthetic, and shall meet or exceed each of the specified minimum values. All geosynthetics shall be clearly labeled as being part of the same production run certified as meeting all applicable requirements.

(c) Manufacturer's Test Certification - Furnish test result certificates according to 00165.35 from the geosynthetic manufacturer, and the following:

(1) Geotextiles - For geotextiles, include the following:

- Manufacturer’s name, lot number, roll number, production facility address, and full product information (style, brand, name, etc.).
- Chemical composition of filaments and yarns, including polymer(s) used.

- Minimum average roll values for each of the specified properties from the same lot of geotextiles as the delivered material.

(2) Geogrids - For mechanically stabilized earth retaining wall geogrid, include the following:

- Average roll values for each of the specified properties from the same production run as the delivered material.
- Production run number, production plant name, and location.
- Manufacturer's name and address.
- Full product name and information.
- QPL Product Category and the Standard Specification Subsection number.
- Retaining wall location referencing the drawing name, detail, and structure number.
- Polymer types for geogrid and coating, if present.
- Primary resin type, class, grade, and category for HDPE (ASTM D1248) and PP (ASTM D4101).

For subgrade reinforcement geogrid, include the following:

- Minimum average roll values and average roll values for each of the specified properties from the same production run as the delivered material.
- Production run number, production plant name and location.

(d) Manufacturer's Sampling/Testing - The manufacturer's reported property values shall be based on the following sampling and testing requirements:

(1) Sampling - Sample all geosynthetics according to ASTM D4354. The production unit used for sampling shall be a roll or sheet.

(2) Geotextile Testing - Perform the specified tests to determine geotextile properties for the intended applications. The tensile strength requirements shall be tested in both machine and cross-machine directions.

(3) Geogrid Testing - For mechanically stabilized earth retaining wall geogrid, provide laboratory test results that demonstrate the average roll value for each geogrid product is greater than or equal to the geogrid ultimate wide width tensile strength reported for the initial geogrid product evaluation and approval on the QPL. Determine the ultimate wide width tensile strength (T_{ult}) according to ASTM D6637. If the average roll value for each geogrid reinforcement product is less than the geogrid ultimate wide width tensile strength identified on the QPL, the entire production run will be rejected.

(e) Agency Check Tests - The Agency reserves the right to sample and test products for compliance with pertinent requirements, according to 00165.02.

When the Agency performs check tests, the entire production run will be accepted or rejected according to 00150.25, if any of the average roll values of tested rolls are less than the specified minimum values.

02320.11 Seam Testing and Acceptance:

(a) Factory Seams - Where factory seams are made, the sheets of geotextile shall:

- Be sewn together using a lock type stitch Type 301 or 401 as shown.

- Be sewn with polymeric thread that is at least 95 percent, by weight, polyolefin or polyester, and as resistant to deterioration as the geotextile being sewn.
- Have test results showing that the seams meet or exceed 90 percent of the specified tensile strength minimum values for the intended application.
- Nylon thread will not be allowed.

(b) Field Seams - Where field sewn seams will be used, furnish:

- The manufacturer's test result certificate, according to 00165.35, that includes wide strip, tensile strength test results and verifies that seam tensile strength and seam grab tensile strength meet or exceed 90 percent of the minimum specified tensile strength values for the geotextile.
- A field-stitched seam test sample.

02320.20 Geotextile Property Values:

Table 02320-1 Geotextile Property Values for Drainage Geotextile [1, 2]

Geotextile Property	ASTM Test Method	Unit	Geotextile Property Requirements			
			Type 1		Type 2	
			Woven	Nonwoven	Woven	Nonwoven
Grab Tensile Strength (minimum) Machine and Cross Machine Directions	D 4632	lb	180	115	250	160
Grab Failure Strain (minimum) Machine and Cross Machine Directions	D 4632	%	< 50	≥ 50	< 50	≥ 50
Tear Strength (minimum)	D 4533	lb	67	40	90	56
Puncture Strength (minimum)	D 6241	lb	370	220	495	310
Apparent Opening Size (AOS) (maximum) U.S. Standard Sieve	D 4751	—	40	40	40	40
Permittivity (minimum)	D 4491	sec^{-1}	0.5	0.5	0.5	0.5
Ultraviolet Stability Retained Strength (minimum)	D 4355 (at 500 hours)	%	50	50	50	50

[1] All geotextile properties are Minimum Average Roll Values (MARV). The test results for any sampled roll in a lot shall meet or exceed the values shown in the table.

[2] Woven slit film geotextiles (geotextiles that are made from yarns of a flat, tape-like character) are not acceptable.

Table 02320-2 Geotextile Property Values for Riprap Geotextile [1, 2]

Geotextile Property	ASTM Test Method	Unit	Geotextile Property Requirements			
			Type 1		Type 2	
			Woven	Nonwoven	Woven	Nonwoven
Grab Tensile Strength (minimum) Machine and Cross Machine Directions	D 4632	lb	250	160	315	200
Grab Failure Strain (minimum) Machine and Cross Machine Directions	D 4632	%	< 50	≥ 50	< 50	≥ 50
Tear Strength (minimum)	D 4533	lb	90	56	110	80
Puncture Strength (minimum)	D 6241	lb	495	310	620	430
Apparent Opening Size (AOS) (maximum) U.S. Standard Sieve	D 4751	—	40	40	40	40
Permittivity (minimum)	D 4491	sec^{-1}	0.5	0.5	0.5	0.5
Ultraviolet Stability Retained Strength (minimum)	D 4355 (at 500 hours)	%	70	70	70	70

[1] All geotextile properties are Minimum Average Roll Values (MARV). The test results for any sampled roll in a lot shall meet or exceed the values shown in the table.

[2] Woven slit film geotextiles (geotextiles that are made from yarns of a flat, tape-like character) are not acceptable.

Table 02320-3 Geotextile Property Values for Sediment Fence [1]

Geotextile Property	ASTM Test Method	Unit	Geotextile Property Requirements		
			Supported	Unsupported	
			—	Elongation [2] ≥ 50%	Elongation [2] ≤ 50%
Grab Tensile Strength (minimum) Machine and Cross Machine Directions	D 4632	lb	90 90	120 100	120 100
Apparent Opening Size (AOS) (maximum) U.S. Standard Sieve	D 4751	—	30	30	30
Permittivity (minimum)	D 4491	sec^{-1}	0.05	0.05	0.05
Ultraviolet Stability Retained Strength (minimum)	D 4355 (at 500 hours)	%	70	70	70

[1] All geotextile properties are Minimum Average Roll Values (MARV). The test results for any sampled roll in a lot shall meet or exceed the values shown in the table.

[2] Measured according to ASTM D4632.

Table 02320-4 Geotextile Property Values for Subgrade Geotextile (Separation) [1]

Geotextile Property	ASTM Test Method	Unit	Geotextile Property Requirements	
			Woven	Nonwoven
Grab Tensile Strength (minimum) Machine and Cross Machine Directions	D 4632	lb	180	113
Grab Failure Strain (minimum) Machine and Cross Machine Directions	D 4632	%	< 50	≥ 50
Tear Strength (minimum)	D 4533	lb	68	41
Puncture Strength (minimum)	D 6241	lb	371	223
Apparent Opening Size (AOS) (maximum) U.S. Standard Sieve	D 4751	—	30	30
Permittivity (minimum)	D 4491	sec^{-1}	0.05	0.05
Ultraviolet Stability Retained Strength (minimum)	D 4355 (at 500 hours)	%	50	50

[1] All geotextile properties are Minimum Average Roll Values (MARV). The test results for any sampled roll in a lot shall meet or exceed the values shown in the table.

Table 02320-5 Geotextile Property Values for Embankment Geotextile [1]

Geotextile Property	ASTM Test Method	Unit	Geotextile Property Requirements	
			Woven	Nonwoven
Grab Tensile Strength (minimum) Machine and Cross Machine Directions	D 4632	lb	315	200
Grab Failure Strain (minimum) Machine and Cross Machine Directions	D 4632	%	< 50	≥ 50
Tear Strength (minimum)	D 4533	lb	110	80
Puncture Strength (minimum)	D 6241	lb	620	430
Apparent Opening Size (AOS) (maximum) U.S. Standard Sieve	D 4751	—	30	30
Permittivity (minimum)	D 4491	sec^{-1}	0.02	0.02
Ultraviolet Stability Retained Strength (minimum)	D 4355 (at 500 hours)	%	50	50

[1] All geotextile properties are Minimum Average Roll Values (MARV). The test results for any sampled roll in a lot shall meet or exceed the values shown in the table.

Table 02320-6 Geotextile Property Values for Pavement Overlay Geotextile [1]

Geotextile Property	ASTM Test Method	Unit	Geotextile Property Requirements
			Nonwoven
Grab Tensile Strength (minimum) Machine and Cross Machine Directions	D 4632	lb	100
Grab Failure Strain (minimum) Machine and Cross Machine Directions	D 4632	%	≥ 50
Asphalt Retention (minimum)	D 6140	oz./sq.ft.	2.8
Melting Point (minimum)	D 276	°F	300

[1] All geotextile properties are Minimum Average Roll Values (MARV). The test results for any sampled roll in a lot shall meet or exceed the values shown in the table.

Section 02340 - Rock Gabion Baskets

Description

02340.00 Scope - This Section includes the requirements for Rock gabion baskets of twisted or welded wire mesh.

Materials

02340.10 General - Provide wire mesh Material free of breaks in the wire, breaks at weld points or other deficiencies. Individual wires of either style mesh shall meet the following minimum requirements:

Galvanizing .....0.80 oz. per sq. ft. minimum
Tensile strength * .....60,000 psi minimum
Wire diameter tolerance limit ..... ± 0.004"

* Tensile area includes galvanizing

Welded wire shall also conform to AASHTO M 55 (ASTM A185) except that the weld shears shall be 600 pounds for 11 gauge, and 800 pounds for 9 gauge wires. All wire sizes are after galvanizing.

Tie wires and internal connecting wires shall be galvanized and no smaller than 13 1/2 gauge. Spiral binders may be used as an alternate to tie wire for basket assembly and basket-to-basket connections. Spiral binders shall be 9 gauge, galvanized, and have a 3 inch pitch. High tensile fasteners of the locking spring steel clip or clamp-on ring type may be used as alternates to tie wire for basket assembly only. High tensile fasteners shall be fabricated from 11 gauge steel wire with a minimum tensile strength of 240,000 psi. Provide a Class 3 zinc coating according to ASTM A764. High tensile fasteners shall provide a closed position tensile strength of 600 pounds.

All wire shall be galvanized according to ASTM A641.

02340.12 Twisted Wire Mesh Gabion Baskets - Furnish gabion panels of the twisted mesh style manufactured from 11 gauge with 9 gauge selvage wires. The mesh shall form a uniform hexagonal pattern and shall be formed with a non-raveling twist. The major axis (maximum line dimensions) of any hexagonal opening shall not exceed 4.75 inches. The area of the hexagonal opening, approximately 3.2 inches by 4.5 inches, shall not exceed 9.5 square inches.

02340.20 Welded Wire Mesh Gabion Baskets - Furnish gabion panels of the welded mesh style manufactured from 11 gauge or 9 gauge wire. The mesh shall form a nominal 3 inch by 3 inch grid pattern and conform to AASHTO M 55 (ASTM A185). The maximum line dimension of any opening shall not exceed 4.75 inches. The 12 inch and 18 inch high mattresses shall be made from 11 gauge panels. Gabions of square Cross Section (cubical-celled units) may be made with either 9 gauge or 11 gauge panels, except that within the same unit, panels of dissimilar wire sizes may not be mixed.

Galvanized 9 gauge stiffeners, placed diagonally in the baskets at the vertical one-third points, as shown on the Plans or as recommended by the manufacturer, may be used instead of perpendicular cross ties.

02340.30 PVC Coated Wire Mesh Gabion Baskets - The wire type used for PVC coated wire mesh gabions shall be either twisted wire mesh or welded wire mesh and shall conform to 02340.00 and 02340.12 or 02340.20.

The PVC coating for twisted wire mesh gabions shall be extruded onto the wire core before weaving the coated wire into a double twisted hexagonal mesh. The use and minimum diameter of the various wires is as follows:

- Gabion Panel wire core shall be manufactured from galvanized 12 gauge wire core. The overall minimum diameter of the galvanized wire core plus PVC coating shall be 0.136 inch.
- Selvage and reinforcing wire shall be of heavily galvanized 10 gauge wire core coated with PVC and having an overall minimum diameter (galvanized wire core plus PVC coating) of 0.165 inch.
- Lacing and connecting wire shall be of heavily galvanized 13 1/2 gauge wire core coated with PVC and having an overall minimum diameter (galvanized wire core plus PVC coating) of 0.120 inch.

02340.40 Fabrication - Fabricate gabions so that the sides, ends, lid and diaphragms can be assembled at the construction site into rectangular baskets of the specified sizes. Dimensions for heights, lengths and widths of gabion baskets shall be as indicated on the Plans with a tolerance of plus or minus 3 percent. Gabions shall be of single unit construction. Either connect the base, lid, ends and sides into a single unit or connect one edge of these members to the base section of the gabion in such a manner that strength and flexibility at the point of connection are at least equal to those of the mesh.

If the length of the gabion exceeds its horizontal width, equally divide the gabion by diaphragms into cells whose length does not exceed the horizontal width. The diaphragm material shall be of the same mesh and size as the body of the gabions. Furnish the gabion with the necessary diaphragms secured in proper position on the base in such manner that no additional tying at this juncture will be necessary.

Assemble the wire mesh panels (base, ends, sides, diaphragms and lid) so strength and flexibility at connections are at least equal to those of a single panel.

02340.50 Acceptance - Provide a quality compliance certificate for gabion baskets according to 00165.35.

Section 02350 - Metal Bin Retaining Walls

Description

02350.00 Scope - This Section includes the requirements for galvanized steel sheets and hardware for the assembly of metal bin retaining walls.

Materials

02350.10 Base Metal, Galvanizing, and Thickness - Design all members, fittings and appurtenances as integral units or parts of the whole assembly. The galvanized sheets used in fabricating the members shall conform to the requirements of AASHTO M 218. Bolts, nuts and miscellaneous hardware shall be galvanized or otherwise protected with approved coatings and shall be of sizes and shapes suitable for use with the members furnished.

Fabricate the members from the specified base metal of the thickness shown. In the absence of given thickness or dimensions for any member, fitting or appurtenance, the thickness of metal or dimensions of the member shall be as required to fully develop the strength of the members whose thickness and dimensions are given, and which are used in structural combination.

02350.20 Fabrication - Fabricate all members so members of the same nominal size are fully interchangeable. Fabricate and punch the members so no drilling, punching or drifting to correct defects in manufacture will be required during field assembly. Any members having improperly punched holes will be rejected. Replace with a member with properly punched holes.

Drainage and Water Distribution Materials

Section 02410 - Concrete Pipe

Description

02410.00 Scope - This Section includes the requirements for nonreinforced and reinforced concrete pipe and concrete drain pipe and tile.

Materials

02410.10 Concrete Pipe - Furnish concrete pipe meeting the following requirements:

(a) End Designs - Where rubber gasket joints are used, modify the design of the ends of the pipe sections according to ASTM C443 to accommodate rubber gaskets.

(b) Sloped or Skewed Ends - If the ends of pipe require sloped ends, skewed ends or both, fabricate the ends in a manner that provides good workmanship and a smooth finish, and protection to otherwise exposed reinforcement where applicable.

(c) Markings - Indent the markings required by AASHTO M 86 (ASTM C14) in the outside surface of each section of pipe.

(d) Concrete Pipe Field Permeability Tests - The Engineer may require field permeability tests on a maximum of 5 percent of each lot, class, or size of pipe according to ASTM C497 on pipe 24 inches in diameter and smaller.

Provide all the necessary labor, Equipment, water and Materials at the site for performing field permeability tests.

At the option of the pipe Supplier, and with the approval of the Engineer, individual field permeability tests may be performed at the point of manufacture.

(e) Concrete Pipe Plant Air Test - The Engineer may require that each length of concrete pipe 12 inches in diameter and smaller be given an individual air test at the point of manufacture. Use test Equipment approved by the Engineer and a test pressure of at least of 10 psi. Each length shall show no appreciable loss of air after 5 seconds.

When individual air testing is performed, no field or shop permeability tests will be required.

(f) Nonreinforced Concrete Pipe - Provide nonreinforced or plain circular concrete pipe and special sections conforming to the requirements of AASHTO M 86 (ASTM C14) or ASTM C985 and this Section.

(g) Reinforced Concrete Pipe - Provide reinforced concrete pipe and special sections conforming to the requirements of AASHTO M 170 (ASTM C76) and this Section, except as follows.

(1) Special Sections - Furnish special sections such as elbows, wyes, tees, crosses, bends and reducers as shown, specified or directed. In the absence of any design or Specifications, the special sections shall be of the design recommended by the manufacturer for the intended use. Generally the special sections shall conform to the requirements specified for the pipe with which it is to be used.

Fabricate special sections with components from tested and approved lots. Maintain production dates of components.

(2) Load Strength - Reinforced concrete pipe having the same D-load strengths as those specified to be furnished under AASHTO M 170 (ASTM C76) may be furnished according to AASHTO M 242 (ASTM C655).

(3) Acceptance - The basis of acceptance for reinforced concrete pipe manufactured according to AASHTO M 170 (ASTM C76), and AASHTO M 242 (ASTM C655) will be Paragraph 5.1.1 of AASHTO M 170.

(h) Concrete Drain Pipe - Use circular, nonreinforced perforated concrete pipe and special sections for subsurface drainage conforming to the requirements of AASHTO M 175 (ASTM C444), Type 1, all applicable requirements of AASHTO M 86 (ASTM C14), except indent the markings required by AASHTO M 86 (ASTM C14) in the outside surface of each section of pipe.

(i) Concrete Drain Tile - Provide concrete drain tile conforming to the requirements of AASHTO M 178 (ASTM C412).

02410.80 Acceptance - Except as provided in 02410.10(g)(3), acceptance of nonreinforced concrete pipe, reinforced concrete pipe, concrete drain pipe, concrete drain tile, and hardware will be according to 00165.35 and this Section.

Section 02415 - Plastic Pipe

Description

02415.00 Scope - This Section includes the requirements for polyethylene pipe, polypropylene pipe and polyvinyl chloride pipe.

02415.01 Definitions:

Corrugated Polyethylene Pipe - Pipe that is extruded to form a smooth inner wall and a corrugated external wall. The corrugations are hollow.

Polyethylene Pipe - Pipe using high density polyethylene (HDPE) resins are included in three specific sub-categories; corrugated, solid-wall, and steel-reinforced.

Solid-Wall Polyethylene Pipe - Pipe that is extruded to form a solid pipe wall. The joint may be either butt fused or bell and spigot.

Steel Reinforced Polyethylene Pipe - Pipe that is extruded to form a smooth inner wall and a corrugated external wall. The corrugations are solid and contain a continuous steel reinforcement band.

Materials

02415.10 Corrugated Polyethylene Pipe - Furnish corrugated polyethylene pipe from the QPL and meeting the following requirements:

Corrugated polyethylene drain pipe ..... AASHTO M 252
Corrugated polyethylene culvert pipe ..... AASHTO M 294, Type S or D
Corrugated polyethylene storm sewer pipe ..... AASHTO M 294, Type S or D

The allowable nominal inside diameter of corrugated polyethylene pipe is as follows:

Corrugated polyethylene drain pipe ..... Up to 24"
Corrugated polyethylene culvert pipe ..... 12" - 60"
Corrugated polyethylene storm sewer pipe ..... 12" - 60"

Furnish watertight joints for corrugated polyethylene pipe from the QPL and meeting the requirements of ASTM D3212 when used for culvert or storm sewer. Furnish soil tight joints for corrugated polyethylene drain pipe.

02415.20 Solid-Wall Polyethylene Pipe - Furnish solid-wall polyethylene pipe and fittings from the QPL or that meet the following requirements:

- Resin that has a hydrostatic design basis (HDB) of 1,600 psi when tested and analyzed according to ASTM D2837 and has a material designation code of PE3608 or PE4710 as listed by the Plastic Pipe Institute.
- Resin meeting the requirements of ASTM D3350 and has a minimum cell classification of PE345464C (Code D or E may also be used for pipe bursting and lining pipe and for slip lining pipe).
- The pipe does not contain recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material pipe. Do not recycle pipe, excluding black colored pipe, that is stored outside.

- Pipe and fittings meeting the requirements of ASTM F714 and ASTM D3261 as modified for the specified material.
- With legible markings, by the pipe manufacturer, with the following information:
  - ASTM designation number
  - The letters PE followed by the material designation code
  - Nominal pipe size
  - Dimension ratio
  - Name and trademark of manufacturer
  - Production code from which the date and place of manufacture can be determined

02415.30 Steel Reinforced Polyethylene Pipe - Furnish steel reinforced polyethylene pipe from the QPL and meeting the following requirements:

Steel reinforced polyethylene culvert pipe.....ASTM F2562
Steel reinforced polyethylene storm sewer pipe.....ASTM F2562

The allowable nominal inside diameter of steel reinforced polyethylene pipe is as follows:

Steel reinforced polyethylene culvert pipe..... 24" - 72"
Steel reinforced polyethylene storm sewer pipe..... 24" - 72"

Furnish steel reinforced polyethylene pipe joints and gaskets meeting the following requirements:

Bell and spigot couplings..... ASTM D3212
Elastomeric gaskets .....ASTM F447

For steel reinforced polyethylene pipe, provide either factory installed gaskets on the couplings or manufacturer installed gaskets on the pipes. Provide at least silt tight joints for culvert pipe and water tight joints for storm sewer pipe. Provide watertight joints from the QPL and meeting the requirements of ASTM D3212.

02415.40 Polypropylene Pipe - Furnish polypropylene pipe and fittings from the QPL and meeting the following requirements:

Dual wall polypropylene pipe and fittings .....ASTM F2736
Triple wall polypropylene pipe and fittings.....ASTM F2764
Watertight joints ..... ASTM D3212

The allowable nominal inside diameter of polypropylene pipe is as follows:

Dual wall polypropylene pipe..... 12" - 30"
Triple wall polypropylene pipe ..... 30" - 60"

02415.50 Polyvinyl Chloride Pipe - Furnish polyvinyl chloride pipe (PVC) subsurface drain pipe and fittings meeting the requirements of ASTM D2729.

Furnish PVC sanitary, storm, culvert, siphon, and irrigation pipe and fittings with 2 feet or more cover that have a minimum pipe stiffness of 46 psi or a minimum SDR of 35 and meet the requirements of sewer pipe ASTM D3034, ASTM F679, or ASTM F794.

Furnish PVC sanitary, storm, culvert, siphon, and irrigation pipe and fittings with less than 2 feet but at least 1 foot cover meeting the requirements of AWWA C 900 or AWWA C 905.

02415.80 Acceptance - Acceptance of polyethylene pipe, polypropylene pipe, polyvinyl chloride pipe and hardware will be according to 00165.35 and this Section.

Section 02420 - Metal Pipe

Description

02420.00 Scope - This Section includes the requirements for corrugated steel pipe, helical rib pipe, arch type pipe, aluminum pipe, ductile iron pipe, and special sections intended for use for storm drainage, underdrains and culverts, and not intended for the conveyance of sanitary or industrial waste.

Materials

02420.10 Corrugated Steel Pipe and Pipe Arches - Furnish corrugated steel pipe, helical rib pipe, pipe arches and special sections meeting the requirements of AASHTO M 36 (ASTM A760) Types I, IA, and II, except as follows:

(a) Shapes - Provide either full-circle or elliptical pipe, as the Contractor may elect, unless otherwise shown or specified. The shapes of pipe fabricated and furnished may include any of the following:

- **Full-Circle Pipe** - Fabricate helical rib pipe in full-circle Cross Section only.
- **Arch-Type Pipe**
- **Elliptical Pipe** - Full-circle pipe distorted 5 percent out-of-round by shop fabrication to form an elliptical Cross Section with the major axis vertical.
- **Half-Circle Pipe** - Fabricate as half sections of full-circle pipe of the same diameter.
- **Nestable Pipe** - Fabricate in two separate half sections designed to fit and fasten together to form a full-circle Cross Section of specified diameter. Fasten the two half sections together by approved means which shall provide at least 90 percent of the strength of a standard riveted longitudinal seam.

(b) Connecting Bands - Use connecting bands conforming to the details shown on the Plans to make field joints for pipes and pipe arches not requiring watertight joints.

(c) Special Sections - Furnish special sections such as elbows, wyes, tees, crosses, bends, reducers and flared inlets as shown or as directed.

Generally, special sections shall conform to the requirements specified for the pipe with which they are used, and shall be connected to the pipe or to each other with connecting bands specified for use with the pipe to which they are connected.

For elbows of 30 degrees or greater total angle, use three-piece sections of approximately equal length and equal-angle segments or pieces.

Weld joints according to recognized standard practice and repair any damaged zinc or aluminum coating according to 02420.10(d).

(d) Repair of Damaged Coating - In addition to the methods given in AASHTO M 36 (ASTM A760) the Contractor may repair damaged zinc or aluminum coating by removing all loose or cracked coating, removing all welding flux, wire brushing the damaged area, and applying two coats (minimum 2 mils total thickness) of a high zinc dust content paint conforming to the general requirements of ASTM A780.

Damaged zinc or aluminum coating within 3/8 inch of the ends of pipe sections caused by production cut-off of pipe need not be repaired. Coating damage on edges of connecting bands need not be repaired.

(e) Irrigation Pipe - In irrigation pipe installations, where Type D coating (AASHTO M 190) is not specified, the Contractor will be allowed to furnish pipe with Type D coating.

(1) Riveted Seams - If pipes are not furnished with Type D coating, do the following:

- Place a bead or strip of approved caulking compound, 1/8 inch minimum diameter or thickness, between the laps of all riveted seams.
- Rivet the annular seams of riveted pipe at spacings not greater than 3 inches. Rivet in a single row the longitudinal seams of pipes less than 42 inches in diameter. Place one rivet in each valley and one on each crest of the corrugations.
- Double rivet the longitudinal seams of pipes 42 inches and larger in diameter in each valley of the corrugations and place a single rivet on each crest of the corrugations.
- At the intersection of longitudinal and circumferential seams, close the gap caused by the three-sheet lap by special fabrication. Fabricate a special longitudinal seam at the ends of pipe sections for a sufficient distance to clear the coupling bands.

Spot welding of the seams of corrugated metal pipe used in irrigation pipe installations will not be allowed.

(2) Field Joints - Use connecting bands conforming to the details shown, and make the field joints watertight.

(f) Siphon Pipe - Fabricate corrugated steel pipe used in siphons with watertight seams.

Field joints shall provide circumferential and longitudinal strength to preserve the pipe alignment, prevent separation of pipe sections and provide a watertight joint. Attach the connecting bands so they lap a nearly equal portion of each pipe section to be connected.

(g) Sloped or Skewed Ends - If the ends of pipe culverts require sloped ends, skewed ends or both, fabricate the ends in a manner that provides good workmanship and a smooth finish. Restore zinc or aluminum coating as directed according to 02420.10(d), and bituminous protective coatings and linings when specified.

02420.11 Ductile Iron - Furnish ductile iron pipe conforming to the requirements of AWWA C151. Use Pressure Class 150 - 350 or Special Thickness Class 50 - 56, as directed.

02420.20 Protective Coatings - If specified or shown, furnish corrugated metal pipes with protective coatings as follows:

(a) Bituminous Protective Coatings - Provide corrugated metal pipe and connecting bands with bituminous coatings conforming to the requirements of AASHTO M 190 and the following:

- Before immersion, the metal shall be free of grease, dirt, dust, moisture or other contaminants.
- Apply the initial bituminous coating by one of the processes under 02420.20(a)(1) or 02420.20(a)(2).
- If a second dip is required to meet the coating thickness requirements of AASHTO M 190, the time and temperature requirements of 02420.20(a)(1) or 02420.20(a)(2) need not be followed for the second dip.

- The paved invert for both Type B and Type C coatings on either circular or arch type pipe shall fill the corrugations for at least 40 percent of the circumference of the pipe.

(1) Pipe Not Preheated - The temperature of the asphalt at the time of pipe immersion shall be 400 °F ± 5 °F and the duration of the immersion shall conform to the following schedule:

Metal Thickness (Inch) Steel	Aluminum	Minimum Immersion Time (Minutes)
0.064	0.060	2.5
0.079	0.075	3.0
0.109	0.105	5.0
0.138	0.135	6.5
0.168	0.164	8.0

(2) Pipe Preheated - At the time of pipe immersion the asphalt shall have a temperature of 380 °F ± 5 °F and the pipe shall be preheated to a temperature 300 °F to 350 °F.

(b) Type D, Fully-Bituminous Coated, Fully-Lined - The interior lining shall be smooth, uniform and free from sags and runs. Slight residual corrugations due to cooling and shrinkage of the lining will not be cause for rejection. At the three-sheet lap an interior nonuniformity equal to the thickness of the sheet will be allowed. Maintain the thickness of the lining to the ends of the pipe.

(c) Optional Paved Invert - If an asphalt coated pipe with a paved invert (Type C coating) is shown or specified, a centrifugally-applied interior lining conforming to Type D coating may be furnished as an alternate, providing the minimum thickness of bituminous coating over the crests of the corrugations is not less than 1/4 inch.

(d) Polymeric Coatings - If polymeric coating is shown on the pipe data sheet, use a coating from section 02420.20 of the QPL.

02420.30 Corrugated Steel Pipe for Underdrains - Furnish corrugated steel pipe for underdrains conforming to the requirements of AASHTO M 36 (ASTM A760) Type III - Underdrain Pipes, except as modified in 02420.10(c) and 02420.10(d), and as follows:

(a) Class IV - Semicircular pipe may be used only as an alternate with the 6 inch size of perforated full-circle drain pipe.

(b) Connecting Bands - Connecting bands for underdrain pipe field joints shall conform to the designs shown.

02420.40 Corrugated Aluminum Alloy Pipe - Furnish corrugated aluminum alloy pipe, helical rib pipe, pipe arches and special sections conforming to the requirements of AASHTO M 196 (ASTM B745), Types I, II and III, except as follows:

(a) Shapes - The shapes of the pipes to be furnished may include any of the shapes described in 02420.10(a).

(b) Connecting Bands - Use connecting bands conforming to the requirements of AASHTO M 196 (ASTM B745) and the details shown to make field joints for pipes and pipe arches not requiring watertight joints.

(c) Special Sections - Furnish special sections such as elbows, wyes, tees, crosses, bends, reducers and flared inlets as shown or as directed.

Generally, special sections shall conform to the requirements specified for the pipe with which they are used, and shall be connected to the pipe or to each other with connecting bands specified for use with the pipe to which they are connected.

For elbows of 30 degrees or greater total angle, use a three-piece section of approximately equal length and equal-angle segments or pieces.

(d) Irrigation Pipe - In irrigation pipe installations where Type D coating is not shown or specified, the Contractor will be allowed to furnish pipe with Type D coating.

If pipes are not furnished with Type D coating, all riveted seams shall conform to the applicable provisions of 02420.10(e)(1).

Use connecting bands conforming to AASHTO M 196 (ASTM B745) and the details shown, and make the field joints watertight for pipe installations used in irrigation.

(e) Siphon Pipe - Fabricate corrugated aluminum alloy pipe used in siphons with watertight seams.

Field joints shall provide circumferential and longitudinal strength to preserve the pipe alignment, prevent separation of pipe sections and provide a watertight joint. Fabricate the connecting bands from aluminum alloy conforming to AASHTO M 196 (ASTM B745). Attach the connecting bands so they lap a nearly equal portion of each pipe section to be connected.

(f) Sloped or Skewed Ends - If the ends of pipe culverts require sloped ends, skewed ends or both, fabricate the ends in a manner that provides good workmanship and a smooth finish. Repair bituminous protective coatings and linings when specified.

02420.50 Corrugated Aluminum Alloy Pipe for Underdrains - Furnish corrugated aluminum alloy pipe for underdrains conforming to the requirements of AASHTO M 196 (ASTM B745) Type III, except as follows:

(a) Special Sections - The provisions of 02420.40(c) apply.

(b) Connecting Bands - Connecting bands for field joints shall conform to the requirements of AASHTO M 196 (ASTM B745) and the details shown.

02420.60 Acceptance - Acceptance of pipes, underdrains, and protective coatings will be according to 00165.35 and this Section.

Section 02430 - Structural Plate Pipe

Description

02430.00 Scope - This Section includes the requirements for steel and aluminum alloy plates and hardware for structural plate pipe.

Materials

02430.10 Galvanized Steel Plates:

(a) General - Furnish galvanized steel plates for structural plate pipe conforming to the requirements of AASHTO M 167 (ASTM A761).

(b) Plates for Pipe Arches - The top plates shall form an arc between 180 and 155 degrees. The bottom plates shall form an arc between 50 and 10 degrees. Join the top plates at each end to the bottom plates with corner plates to form an arc with a radius between 16 inches and 21 inches or between 29 inches and 34 inches, as applicable, and forming an arc between 87.5 and 75 degrees.

(c) Forming and Punching Plates - Form plates to provide lap joints. Punch the bolt holes so that all plates with the same dimensions, curvature, thickness, and number of bolts per foot of seam are interchangeable. Curve each plate to the proper radius so that the cross-sectional dimensions of the finished Structure will be as shown or as specified.

Fabricate bolt holes according to AASHTO M 167. Provide additional bolt holes for special conditions of installation when specified or shown.

(d) Sloped and Skewed Ends - Cut plates for forming sloped ends, skewed ends or both, to give the angle of Slope or skew shown. Burnt edges shall be free from oxide and burrs. Legibly identify each cut plate to designate its proper position in the finished Structure.

02430.20 Aluminum Alloy Plates - Furnish aluminum alloy plates for structural plate pipe conforming to the requirements of AASHTO M 219 (ASTM B746). Fabricate according to 02430.10(b) through 02430.10(d).

02430.90 Bolts, Nuts, and Washers - Furnish bolts, nuts, and washers for use with galvanized steel structural plate pipe conforming to the requirements of AASHTO M 167 (ASTM A761) and galvanized according to AASHTO M 232 (ASTM A153).

Furnish bolts, nuts, and washers for use with aluminum alloy structural plate pipe conforming to the requirements of AASHTO M 219 (ASTM B746) and galvanized according to AASHTO M 232 (ASTM A153).

02430.95 Acceptance - Acceptance of structural plate pipe and hardware will be according to 00165.35 and this Section.

Section 02440 - Joint Materials

Description

02440.00 Scope - This Section includes the requirements for joint fillers, seals, gaskets and water stop for concrete pipe joints, manhole section joints, bridge joints, and miscellaneous concrete applications.

Materials

02440.10 Preformed Joint Fillers for Concrete - Furnish preformed joint fillers for concrete from the QPL conforming to the requirements of AASHTO M 153 or AASHTO M 213.

02440.11 Poured Joint Sealant - Furnish a two-component, low modulus, rapid-cure joint sealant from the QPL.

02440.14 Backer Rod - Furnish a closed-cell, non-gassing foam material backer rod from the QPL.

02440.15 Lubricant/Adhesive - Furnish a lubricant/adhesive conforming to ASTM D4070 and according to the recommendations of the seal manufacturer.

02440.19 Steel Bridging Plate - Furnish ASTM A36 steel bridging plate with a minimum thickness of 1/4 inch and a width of 8 inches, cut in lengths of 4 to 8 feet. Drill spike holes at 12 inch centers along the centerline of the plate.

02440.20 Strip Seals - Furnish strip seals from the QPL and conforming to ASTM D5973.

02440.21 Elastomeric Concrete - Furnish elastomeric concrete from the QPL.

02440.22 Preformed Compression Joint Seal - Furnish preformed compression joint seals from the QPL and conforming to the requirements of AASHTO M 297.

02440.23 Precompressed Foam Silicone Joint Seal - Furnish precompressed foam silicone joint seals from the QPL.

02440.30 Hot Applied Joint Sealant - Furnish hot applied joint sealant from the QPL.

02440.40 Gaskets for Concrete Pipe and Precast Manhole Section Joints:

(a) Preformed Flexible Joint Sealant - Furnish Materials for tongue and groove or key lock manhole joints conforming to the requirements of ASTM C990.

(b) Rubber Gaskets - Furnish Materials for O-ring manhole and concrete pipe joints conforming to ASTM C443.

02440.50 Joint Materials for Concrete Precast Manhole Section Joints:

(a) Mortar - Furnish mortar conforming to the requirements of ASTM C387, or proportioned one part Type II portland cement to two parts clean, well-graded sand passing a No. 6 screen. Admixtures may be used not exceeding the following percentages by weight of cement:

Hydrated lime 10%
Diatomaceous earth or other inert materials 5%

The consistency of the mortar shall be such that it will readily adhere to the precast concrete if using the standard tongue-and-groove type joint.

(b) Non-Epoxy (Non-Shrink) Grout - Furnish a non-epoxy (non-shrink) grout according to 02080.30. Place or pack non-epoxy (non-shrink) grouts only with the use of a non-epoxy bonding agent according to 02070.20, applied to all cured concrete surfaces being grouted. Use a bonding agent compatible with the grout used.

02440.60 Plastic Compound for Precast Manhole Section Joints - Furnish a plastic compound that is specifically manufactured for the intended use and:

- Has a putty-like, preformed homogeneous blend of hydrocarbon resins and rubber or plasticizing materials with not more than 50 percent by weight of inert mineral filler.
- Is pliable at temperatures between 32 °F and 135 °F. A specimen at 77 °F and 1/2 inch square in Cross Section shall stretch at least 1 1/2 inches before rupture when tested with the apparatus described in ASTM D113.
- Adheres firmly and cohesively to the precast manhole sections when the compound-sealed joint is flexed to its maximum extent.
- Includes a primer solution recommended by the compound manufacturer.
- Conforms with Federal Specification SS-S-00210 (GSA-FSS).

02440.70 Water Stop - Furnish either plastic or rubber water stop, as the Contractor elects, manufactured to the dimensions shown and meeting the following requirements:

(a) Plastic - Polyvinyl chloride water stop shall be manufactured from virgin polyvinyl chloride (PVC) compound. No reclaimed PVC will be allowed. The water stop shall have the following properties:

Test	ASTM Test Method	Specification (Minimum)
Tensile Strength, psi	D 412	1,800
Elongation, %	D 412	350
100% Modulus, psi	D 412	760
Low Brittle Temperature	D 746	- 50 °F
Cold Bend Test [1]		No Failures

[1] Samples maintained at -70 °F for 2 hours, then bent quickly around a 1/4 inch mandrel to 180 degrees.

(b) Rubber - Provide rubber water stops to the dimension shown and conforming to the requirements of ASTM C923, ASTM C1478, or ASTM F2510 as appropriate for the specific structure and pipe types.

02440.80 Acceptance - Acceptance of joint Materials will be according to 00165.35 and this Section.

Section 02450 - Manhole and Inlet Materials

Descriptions

02450.00 Scope - This Section includes the requirements for precast manhole sump sections, metal frames, covers, grates, and manhole steps.

Materials

02450.10 Precast Concrete Manhole Sections - Furnish precast risers, cones, and cover slabs for precast concrete manholes conforming to the requirements of AASHTO M 199 (ASTM C478).

02450.15 Precast Concrete Catch Basins and Inlets - Furnish precast concrete catch basins and inlet conforming to the requirements of ASTM C913.

02450.20 Precast Concrete Sump Sections - Furnish precast rings and lids for precast concrete sumps of portland cement concrete conforming to AASHTO M 199 (ASTM C478).

02450.30 Metal Frames, Covers, Grates, and Steps - Comply with the following:

Projects on State Highways

Item	AASHTO (ASTM) Designation	Grade
Manhole frames and covers	M 306	Class 35 B
Inlet frames and grates	M 306	Class 35 B
	M 227 (A663)	65
	M 270 (A709) (A36)	36
	M 103 (A27)	65 - 35

All Other Projects

Item	AASHTO (ASTM) Designation	Grade
Manhole frames and covers	M 105	Class 30 B
Inlet frames and grates	M 227 (A663)	65
	M 270 (A709) (A36)	36
	M 103 (A27)	65 - 35

Steps for manholes shall be steel-reinforced plastic conforming to AASHTO M 199 (ASTM C478) and AASHTO T 280 (ASTM C497). The steel shall be deformed reinforcing bar conforming to AASHTO M 31 (ASTM A615) Grade 60, No. 4 minimum. The plastic material surrounding the reinforcing steel bar shall be injection molded, with a textured, non-slip surface and a minimum thickness over the steel of 1/16 inch. Voids in the plastic will be cause for rejection of the step.

Welding shall conform to AWS D1.1. Frames, covers and grates for use one with another shall have even and uniform bearings. Miscellaneous metal items and hardware shall conform to the appropriate requirements of Section 00560.

Inlet frames and grates that are fabricated out of steel shall be galvanized according to the appropriate requirements of Section 02530.

02450.40 Damaged Zinc or Aluminum Coating - Repair damaged zinc or aluminum coating according to 02420.10(d).

02450.50 Acceptance - Acceptance of manholes and inlets will be according to 00165.35 and this Section.

Section 02470 - Potable Water Pipe Materials

Description

02470.00 Scope - This Section includes the requirements for ductile iron, steel, and polyvinyl chloride (PVC) pipe 16 inches in diameter and smaller, for potable water systems.

Materials

02470.10 General - Clearly mark all pipe with the type, class, thickness, and manufacturer's name, as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage. All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent, and ANSI/NSF Standard 372, Drinking Water System Components - Lead Content.

02470.20 Ductile Iron Pipe:

(a) General - Use centrifugally cast ductile iron pipe meeting the requirements of AWWA C151. Ductile iron pipe shall have a cement-mortar lining and seal coating meeting the requirements of AWWA C104. Ductile iron pipe to be joined using bolted flanged joints shall be Special Thickness Class 53. All other ductile iron pipe shall be Special Thickness Class 50, unless otherwise shown or specified.

(b) Nonrestrained Joints - Nonrestrained joints shall be rubber gasket, push-on type, or mechanical type meeting the requirements of AWWA C111. Restrained joints shall conform to 02475.50.

02470.31 High Density Polyethylene (HDPE) Pipe - Use HDPE pipe meeting the requirements of ANSI/AWWA C906, Standard Code Designation of PE3408. Furnish all pipe with a minimum dimension ratio (DR) of 17. Join pipe using thermal butt fusion method that meets the requirements of ASTM D3261.

02470.40 Polyvinyl Chloride (PVC) Pipe 4 Inches and Larger:

(a) PVC Pipe Smaller Than 14 inch Diameter - PVC pipe 4 inches in diameter up to but not including 14 inches in diameter shall meet the requirements of AWWA C900, have the same outside dimensions as ductile iron pipe, and have a minimum dimension ratio (DR) of 18 or as specified or indicated.

(b) Large Diameter PVC Pipe - PVC pipe 14 inches in diameter to 16 inches in diameter shall meet the requirements of AWWA C905, have the same outside dimensions as ductile iron pipe, and have a minimum dimension ratio (DR) of 18 or as specified or indicated.

(c) Joints - Joints shall meet the requirements of ASTM D3139 using a restrained rubber gasket conforming to ASTM F477. Solvent-welded pipe joints are not allowed.

02470.45 Polyvinyl Chloride (PVC) Pipe Under 4 Inches - Polyvinyl chloride (PVC) under 4 inches in diameter shall meet the requirements of ASTM D2241. Pipe material shall be PVC 1120, PVC 1220, or PVC 2120, and shall have minimum wall thickness equal to or greater than a standard dimension ratio (SDR) of 21, or as specified or indicated. Joints shall meet the requirements of ASTM D3139 using a restrained rubber gasket meeting the requirements of ASTM F477. Solvent welded pipe joints will only be allowed when specified or indicated.

02470.50 Polyethylene Encasement - Polyethylene encasement shall conform to AWWA C105.

02470.60 Marking Tape and Wire:

(a) Marking Tape - Marking tape shall consist of inert polyethylene plastic impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the Soil. The width of the tape shall be as recommended by the manufacturer for the depth of installation. The tape shall be blue and imprinted continuously over its entire length in permanent black ink with the words "Caution - Water".

(b) Detectable Marking Wire - Furnish detectable marking wire with blue colored insulation and according to 00445.11. Furnish splice kits according to 00445.48.

02470.70 Acceptance - Ductile iron, HDPE, and PVC pipe will be accepted according to 00165.35 and this Section.

Section 02475 - Potable Water Fitting Materials

Description

02475.00 Scope - This Section includes the requirements for fittings, restrained joints, and couplings for ductile iron pipe, high density polyethylene (HDPE) pipe, and polyvinyl chloride (PVC) pipe for potable water systems.

Materials

02475.10 General - Bolts, nuts and washers used for securing fittings shall be of similar materials. Steel bolts shall meet the requirements of ASTM A307 for carbon steel, or ASTM F593 for stainless steel. Nuts shall meet the requirements of ASTM A563 for carbon steel and ASTM F594 for stainless steel. Iron bolts and nuts shall meet the requirements of ASTM A536, grade 65-45-12. Galvanize carbon steel bolts, nuts and washers according to 02560.40.

All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects or equivalent, and ANSI/NSF Standard 372, Drinking Water System Components - Lead Content.

02475.20 Ductile Iron Pipe Fittings - Fittings for ductile iron pipe shall meet the requirements of AWWA C110 or AWWA C153, and shall have a minimum working pressure rating of 250 psi. Joints shall meet the requirements of AWWA C111. Fittings shall be cement mortar lined and seal coated, meeting the requirements of AWWA C104. Provide gaskets for ductile iron flanged joints that are composed of synthetic rubber, full faced, 1/8-inch thick, and conform to ANSI/AWWA C111/A21.1. Ring gaskets will be permitted only where specified or shown. The type, material and identification mark for bolts and nuts shall be provided.

02475.31 High Density Polyethylene (HDPE) Pipe Fittings - Use HDPE pipe fittings meeting the requirements of ANSI/AWWA C906, Standard Code Designation of PE3408. Furnish all pipe fittings with a minimum dimension ratio (DR) of 17. Join pipe and fittings using a thermal butt fusion method that meets the requirements of ASTM D3261. Fittings shall be of the same class as the HDPE pipe.

02475.40 Fittings for Polyvinyl Chloride Pipe 4 Inches and Larger - Fittings for PVC pipe 4 inches in diameter and larger shall be the same as specified for ductile iron pipe.

02475.45 Fittings for Polyvinyl Chloride Pipe Under 4 Inches - Fittings for PVC pipe under 4 inches in diameter shall meet the requirements of ASTM D2466.

02475.50 Restrained Joints - Restrain pipe, fittings, and valves by using an approved bolted or boltless system. Design the restraint system to operate at a working pressure that is greater than the hydrostatic test pressure identified in 01140.51(a), unless otherwise shown. No device utilizing round point set screws will be allowed. Restraint systems provided for pipe bells shall be certified for use by the pipe manufacturer.

02475.60 Bolted, Sleeve-Type Couplings for Plain-End Pipe - Bolted, sleeve type couplings, reducing or transition couplings, and flanged coupling adapters used to join plain end pipe shall meet the requirements of AWWA C219. Buried couplings used for connecting ductile iron, gray cast iron, or PVC pipe shall be ductile iron.

02475.70 Acceptance - Acceptance of fittings, restrained joints and couplings will be according to 00165.35 and this Section.

Section 02480 - Potable Water Valve Materials

Description

02480.00 Scope - This Section includes the requirements for gate valves, butterfly valves, valve boxes, valve stem extensions, tapping sleeve and valve assemblies, check valves, combination air release/air vacuum valves, and backflow prevention devices for potable water systems.

Materials

02480.10 General - Provide valves with operating nuts or hand wheels as specified or shown. Furnish a standard 2 inch operating nut. All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent. When indicated, coat all interior and exterior ferrous surfaces of valves with a protective epoxy coating meeting the requirements of AWWA C550.

02480.20 Gate Valves:

(a) Minimum Pressure - Provide gate valves that meet the requirements of AWWA C500, AWWA C509, or AWWA C515. The minimum design working pressure shall be 200 psi for pipe 2 inches to 12 inches in diameter, and 150 psi for pipe 14 inches to 16 inches in diameter.

(b) Arrangement - For 16 inch diameter pipe, arrange gate valves for operation with gear case in the horizontal position. Equip valves with bypasses and gate valves of the sizes adopted in the AWWA Standards. Equip bypass gate valves with standard 2 inch operating nuts.

(c) Valves - Provide gate valves that are resilient seat, non-rising stem type, open counterclockwise, and are equipped with an O-ring stuffing box.

02480.22 Butterfly Valves:

(a) Seats and Seals - Provide butterfly valves that are rubber seated and meet the requirements of AWWA C504, Class 150B. Shaft seals shall be standard O-ring seals, designed for replacement under line pressure.

(b) Valve Operators - Provide valve operators of the traveling nut or worm gear type and that are sealed, gasketed, and permanently lubricated for buried service. Construct valve operators to the standard of the valve manufacturer to withstand all anticipated operating torques, and design to resist submergence in groundwater.

(c) Valves - Provide butterfly valves that are resilient seat, open counterclockwise, and are equipped with an O ring stuffing box.

02480.25 Valve Boxes - Install valve boxes on all buried valves. Boxes shall be of cast iron, two-piece, slip type standard design, with a base corresponding to the size of the valve. The cover shall have the word "WATER" cast in it.

02480.26 Valve Stem Extensions - Valve stem extensions shall have a 2 inch square operating nut and self-centering rockplate support. Valves with an operating nut more than 3 feet below grade shall have a valve stem extension to raise the operating nut to within 3 feet of the ground surface.

02480.30 Tapping Sleeve and Valve Assemblies:

(a) Valve Assemblies - Furnish tapping valves with flanged inlet end connections. The outlet ends shall conform in dimensions to the AWWA Standards for mechanical joint connections or

flange connections, except that the outside of the end connection shall have a large flange for attaching a drilling machine. The seat opening of the valve shall permit a diameter cut no less than 1/2 inch smaller than the valve size. Valves specifically designed for tapping meeting the requirements of AWWA C500, and valves meeting the requirements of AWWA C509, will be allowed. Tapping valves shall be of the same type as other valves on the Project.

(b) Sleeves - Tapping sleeves shall be cast iron, ductile iron, stainless steel, epoxy coated steel or other approved Material.

02480.40 Check Valves - Check valves shall conform to the following:

(a) Swing Check Valve - Swing check valves shall meet the requirements of AWWA C508, with rubber seat materials mating with metal seating surfaces. The minimum design working pressure shall be 175 psi for check valves with diameters of 12 inches and smaller, and 150 psi for check valves with diameters of 14 inches and 16 inches. Check valves shall be non-assisted, unless otherwise indicated.

(b) Spring-Loaded Plug or Disc Check Valves - Spring-loaded plug or disc check valves shall be bronze mounted with bronze, cast or ductile iron body, bronze plug or disc, stainless steel spring, and resilient seating suitable for potable water service. The valves shall provide drop-tight sealing. The plugs or discs shall be easily replaceable. The minimum design working pressure of the valves shall be 150 psi.

02480.60 Combination Air Release/Air Vacuum Valves - Furnish combination air release/air vacuum valves that meet the requirements of AWWA C512. The valve body shall have a minimum design working pressure of 300 psi. The body and cover shall be cast iron conforming to ASTM A48, Class 30. Floats shall be stainless steel conforming to ASTM A240 and designed to withstand 1,000 psi. Seats shall be Buna-N rubber. Internal parts shall be stainless steel or bronze.

02480.70 Backflow Prevention Devices - Backflow prevention devices shall be capable of withstanding a minimum design working pressure of 150 psi, and shall conform to the following:

(a) Reduced Pressure Backflow Prevention Assembly - Reduced pressure backflow prevention assemblies shall consist of a mechanical, independently operating, hydraulically dependent relief valve located between two independently operating, spring loaded check valves that are located between two tightly closing resilient seated shutoff valves, with four resilient seated test cocks, all meeting the requirements of AWWA C511 and the Oregon State Health Division.

(b) Double Detector Check Valve Backflow Prevention Assembly - Double detector check valve backflow prevention assemblies shall consist of two spring loaded, independently operating check valves, located between two tightly closing resilient seated shutoff valves, with four resilient seated test cocks, all meeting the requirements of AWWA C510 and the Oregon State Health Division.

02480.80 Acceptance - Valves and appurtenances will be accepted according to 00165.35 and this Section.

Section 02485 - Hydrant and Appurtenance Materials

Description

02485.00 Scope - This Section includes the requirements for hydrants and hydrant appurtenances for potable water systems.

Materials

02485.10 Hydrants - Furnish hydrants that are dry-barrel conforming to AWWA C502, of standard manufacture and of a pattern approved by the Agency. Hydrants shall be designed for a minimum working pressure of 150 psi.

All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent.

02485.20 End Connections - The end connections shall be mechanical joint or flanged, meeting the requirements of AWWA C110 and AWWA C111.

02485.30 Hydrant Dimensions and Nozzle Features:

(a) Hydrant Dimensions - Barrels shall have a 7 inch minimum inside diameter. Hydrant length, measured from the bottom of the hydrant to the sidewalk ring, shall provide proper cover at each installed location. Valve openings shall have a minimum diameter of 5 1/4 inches.

(b) Nozzle Features - Hydrants shall have two 2 1/2 inch diameter hose nozzles and one pumper nozzle to match the Agency's connection requirements.

Fit nozzles with cast iron threaded caps with operating nuts of the same design and proportions as the hydrant stem nuts. Thread caps to fit the corresponding nozzles and fit with suitable neoprene gaskets of positive water tightness under test pressures. The direction of opening shall be counterclockwise and shall be clearly marked on the operating nut or hydrant top. Hydrants shall have O-ring stem seals. Interior and exterior painting of the hydrant shall conform to AWWA C502.

02485.40 Hydrant Extensions - Hydrant extensions shall be gray cast iron or ductile iron with an inside diameter of at least 6 inches, and shall conform to the AWWA Standards for such castings. The drillings of the connecting flanges on the extensions shall match the drillings of the flanges on the hydrant.

Hydrant extensions shall also include the necessary hydrant operating stem extensions.

02485.50 Traffic Flange - Provide hydrants with a traffic flange. Hydrants shall be equipped with breaking devices at the traffic flange which will allow the hydrant barrel to separate at this point with a minimum breakage of hydrant parts in case of damage. Also provide, at this point, a safety stem coupling on the operating stem that will shear upon impact.

02485.60 Tie Rods - Tie rods shall be 3/4 inch diameter with threaded ends, galvanized according to 02560.40 and conforming to 02560.30.

02485.80 Acceptance - Acceptance of hydrants and hydrant appurtenances will be according to 00165.35 and this Section.

Section 02490 - Potable Water Service Connection Materials, 2 Inch and Smaller

Description

02490.00 Scope - This Section includes the requirements for potable water service connections 2 inches in diameter and smaller, and sampling stations.

Materials

02490.10 General - Service line materials shall conform to AWWA C800 and these Specifications. Provide service line materials that are designed for a working pressure of 100 psi. Where high pressure service materials are specified or shown, provide materials that are designed for a working pressure of 150 psi. Use high pressure service materials when service line is hydrostatically tested concurrent with the water main. All materials in contact with potable water shall conform to ANSI/NSF Standard 61, Drinking Water System Components - Health Effects, or equivalent.

02490.20 Saddles - Saddles shall be ductile iron, bronze or stainless steel. Saddles used for 3/4 inch and 1 inch services shall be single strap saddles and have either AWWA tapered thread or female iron pipe thread outlet. Saddles used for 1 1/2 inch and 2 inch services shall be double strap saddles with female iron pipe thread outlet. Saddles used on asbestos cement or on PVC pipe shall be formed for the pipe and have flat, stainless steel straps.

02490.30 Service Connection Valves:

(a) Corporation Stops - Corporation stops shall be constructed of bronze alloy. Corporation stops for direct tapping shall have AWWA tapered thread inlet and outlet connections compatible with either copper or polyethylene tubing.

(1) Less Than or Equal to 1 Inch - Corporation stops used with 3/4 inch and 1 inch outlet saddles shall have either AWWA tapered thread or male iron pipe thread inlets and outlet connections compatible with either copper or polyethylene tubing. Thread patterns for the saddle outlet and corporation stop inlet shall be the same.

(2) Greater Than 1 Inch - Corporation stops used with 1 1/2 inch and 2 inch outlet saddles shall have male iron pipe thread inlets and outlet connections compatible with connecting service pipes, or have male iron pipe thread outlets.

(b) Angle Meter Valves - Angle meter valves shall meet the requirements of ASTM B62. All angle meter valves shall have a lock wing.

(c) Customer Service Valves - Customer service valves shall be bronze straight gate valves or angled gate valves on all services smaller than 2 inch and shall be non-rising stem, solid disc type with screwed or union bonnet, threaded ends, and a have brass handle. Body, bonnet, operating handle, and disc shall be ASTM B62 bronze. Stems shall be copper silicon alloy, nickel plated steel, or other approved corrosion resistant materials with equal characteristics of strength and durability. The disc shall clear the port area completely in the fully opened position. Threaded ends shall meet the requirements of ANSI B2.1.

02490.40 Service Pipe and Fittings:

(a) Copper Tubing Service Pipe - Copper tubing service pipe shall be annealed, seamless tubing conforming to the requirements of ASTM B88, Type K.

(b) Polyethylene Tubing Service Pipe - Polyethylene tubing service pipe shall meet the requirements of AWWA C901. Tubing shall be high molecular mass with a 200 psi rating. Tubing

used for 3/4 inch and 1 inch shall be either SDR 7 (iron pipe size) or SDR 9 (copper tube size). Tubing used for 1 1/2 inch and 2 inch shall be SDR 9 (copper tube size).

(c) Service Fittings - Make fittings used for service connections of bronze alloy. Fittings used for copper tubing shall be either compression or flare type, insulated or noninsulated.

Fittings used for polyethylene tubing shall be either compression or stab type. Stab type fittings shall utilize an internal grip ring and O-ring seal. Use stainless steel liners when utilizing compression fittings on polyethylene tubing.

02490.50 Meter Setters - Meter setters shall be manufactured and tested according to all applicable parts of AWWA C800. Meter setters shall be 12 inches in height and shall have an angle meter stop with drilled padlock wing, an angle check valve, and inlet and outlet threads compatible with fittings connecting to service pipes.

Meter setters for 5/8 inch by 3/4 inch, 3/4 inch, and 1 inch services shall have meter saddle nuts for installation and removal of the meter. Meter setters for 1 1/2 inch and 2 inch services shall be equipped with a locking bypass.

02490.60 Bronze Nipples and Fittings - Bronze threaded nipples and fittings shall meet the requirements of ANSI B16.15, ASA 125 pound class.

02490.70 Meter Boxes:

(a) Nontraffic Areas - Construct meter boxes and covers located in the nontraffic areas of either reinforced concrete or high density polyethylene. High density polyethylene meter boxes and covers shall have a tensile strength conforming to ASTM D638. Meter box covers shall include a reading lid.

(b) Traffic Areas - Construct meter boxes located in traffic areas of either reinforced concrete, cast iron or ductile iron. Construct traffic covers of aluminum, steel, cast iron or ductile iron. Meter boxes and covers shall be designed for continuous H-20 traffic loading.

02490.80 Sampling Stations - Sampling stations shall have a 3/4 inch inlet with the depth of bury indicated, and a 3/4 inch unthreaded nozzle. Enclose the sampling station in a lockable, non-removable, cast aluminum housing. When opened, the station shall require no key for operation, and the water shall flow in an all-brass waterway. All working parts shall also be of brass and be removable from above ground with no digging. Exterior piping shall be brass. Include at each station a copper vent tube with a ball valve to enable the station to be pumped free of standing water to prevent freezing.

02490.90 Acceptance - Materials for potable water service connections will be accepted according to 00165.35 and this Section.

Structures

Section 02510 - Reinforcement

Description

02510.00 Scope - This Section includes the requirements for bars, dowels, and strand reinforcement and tendon ducts.

Materials

02510.10 Deformed Bar Reinforcement - Furnish deformed bar reinforcement from the QPL and conforming to the requirements of ASTM A706, AASHTO M 31 (ASTM A615), AASHTO M 334, or ASTM A1035. Unless otherwise specified or shown, all reinforcing bars shall be Grade 60.

02510.11 Epoxy Coated Reinforcement:

(a) Plant Certification - Epoxy coating shall be applied in a coating plant certified by the Concrete Reinforcing Steel Institute (CRSI).

(b) Handling - All systems for handling coated bars shall have padded contact areas for the bars wherever feasible. Pad all bundling bands. Lift all bundles with strong-backs, multiple supports, or platform bridges so as to prevent bar-to-bar abrasion from sags in the bar bundle.

(c) Coated Reinforcement Ties and Supports - Ties for coated reinforcement, including ties for coated-to-uncoated reinforcement connections, shall be nonmetallic coated.

(d) Epoxy Coating Repair - Repair damaged areas and visible voids according to 00530.45.

02510.20 Mechanical Splices - Furnish mechanical splices from the QPL. Where bars of different sizes or strengths are connected, the governing strength shall be the strength of the smaller or weaker bar.

- Type 1 Mechanical Splices - Furnish Type 1 Mechanical Splices that develop at least 125 percent of the specified minimum yield strength of the reinforcing bars. Type 1 Mechanical Splices are not allowed for column bars.
- Type 2 Mechanical Splices - Furnish Type 2 Mechanical Splices that develop at least 125 percent of the specified minimum yield strength of the reinforcing bars and 100 percent of the specified tensile strength of the reinforcing bars.
- Total slip displacement - Measure displacement after loading in tension to 30.0 ksi and relaxing to 3.0 ksi. The displacement for bars up to No. 14 shall not exceed 0.01 inches. The displacement for No. 18 bar shall not exceed 0.03 inches.

02510.25 Headed Bar Reinforcement - Furnish Class HA headed steel bar from the QPL for concrete reinforcement. The headed steel bar shall develop the specified minimum tensile strength of the reinforcing bars, according to ASTM A970. Ferrous-filler coupling sleeves and welded headed steel bars are not allowed for concrete reinforcement.

02510.30 Galvanized Reinforcement:

(a) General - Galvanized reinforcement shall conform to the requirements of ASTM A767, Class II, including Supplementary Requirement S3, and ASTM A143.

(b) Fabrication - The bars may be fabricated before or after galvanizing. If the bars are fabricated after galvanizing, Supplementary Requirements S1 and S2 of ASTM A767 shall apply.

(c) Handling - All systems for handling galvanized bars shall be according to 02510.11(c).

(d) Ties and Supports - Tie all mats of galvanized steel bars with galvanized ties. Precast concrete blocks that support galvanized reinforcement shall have galvanized ties.

02510.40 Welded Wire Reinforcement - Welded wire reinforcement and deformed welded wire reinforcement shall conform to the requirements of ASTM A1064.

02510.50 Dowels - Dowels shall conform to the requirements of AASHTO M 31 (ASTM A615), for Grades 40 and 60, or AASHTO M 227 (ASTM A663) for Grades 70, 75, and 80.

02510.60 Wire Reinforcement - Wire reinforcement and deformed wire reinforcement shall conform to the requirements of ASTM A1064.

02510.70 Acceptance - Acceptance of reinforcement will be according to 00165.35 and this Section.

Section 02513 - Stainless Steel Reinforcement

Description

02513.00 Scope - This Section includes the requirements for stainless steel reinforcement bars, mechanical splices, chairs and supports, inserts, dowels, and tie wire.

Materials

02513.10 Deformed Bar Reinforcement - Furnish deformed bar reinforcement meeting the requirements of ASTM A955 except for Section 6, Chemical Composition and Section 15, Finish. Acceptable alloys are listed by Uniform Numbering System for Metals and Alloys (UNS) designation in Table 02513-1. Finish the surface according to Table 02513-1 and the requirements of ASTM A380.

Table 02513-1
Stainless Steel Alloys for Reinforcing Bars and Dowels

UNS Designation	S31653		S31803		S20910		S24100		S32304	
AISI Type	316LN		2205		XM-19		XM-28		2304	
Common or Trade Name	Type 316 Low Carbon Nitrogen Added		Type 2205 Duplex		Nitronic 50		Nitronic 32 Enduramet 32 18-Cr-2Ni-12Mn		Type 2304 Duplex SAF 2304 Fe-23Cr-4Ni-0.1N	
Required Condition	As rolled		As rolled		As rolled		As rolled		As rolled	
Required Finish	Descaled and white pickled		Descaled and white pickled		Descaled and white pickled		Descaled and white pickled		Descaled and white pickled	
Grade	60	75	60	75	60	75	60	75	60	75
Minimum Tensile Strength (ksi)	90	95	90	95	90	95	90	95	90	95
Minimum Yield Strength (ksi)	60	75	60	75	60	75	60	75	60	75
Minimum Elongation in 2 inches (%)	25	20	25	20	25	20	25	20	25	20

02513.20 Mechanical Splices - Mechanical splices for reinforcing bars are systems which connect the bars without raising their temperature above 1,300 °F.

- Furnish mechanical splices which develop at least 90 percent of the specified minimum ultimate strength of the reinforcing bars in compression and in tension. Where bars of different sizes or strengths are connected, match the strength of the smaller or weaker bar.
- Do not allow the spliced reinforcing bars to slip more than 0.040 inch, measured between gauge points clear of the splice sleeve, when the reinforcing bars are loaded in tension to 67 percent of the specified minimum yield strength of the reinforcing bar.

- Fabricate the splice sleeve and connection hardware from an alloy listed in Table 02513-1. Finish the surface according to Table 02513-1 and the requirements of ASTM A380.

02513.30 Chairs and Supports - Furnish chairs and continuous supports fabricated from an alloy listed in Table 02513-1. Finish the surface according to Table 02513-1 and the requirements of ASTM A380.

02513.35 Concrete Inserts - Furnish concrete inserts fabricated from an alloy listed in Table 02513-1. Finish the surface according to Table 02513-1 and the requirements of ASTM A380. Furnish concrete inserts with closed-back ferrule threaded to receive UNC threaded bolts or rods of the size shown. Provide concrete inserts with the following minimum lengths and safe working loads:

Bolt or Rod Diameter (Inches)	Insert Length (Inches)	Safe Working Load in Shear or Tension (Pounds)
3/4	4 1/2	4,000
1	5 1/2	6,000
1 1/4	7 1/2	10,000
1 1/2	9 1/2	16,000

02513.50 Dowels - Furnish dowels meeting the requirements of ASTM A955 except for Section 6, Chemical Composition and Section 15, Finish. Acceptable alloys are listed by Uniform Numbering System for Metals and Alloys (UNS) designation in Table 02513-1. Finish the surface according to Table 02513-1 and the requirements of ASTM A380.

02513.60 Tie Wire - Furnish 16 gauge tie wire meeting the requirements of ASTM A555 and fabricated from an alloy listed in Table 02513-1, in dead soft annealed condition and passivated according to ASTM A380.

02513.70 Acceptance - Stainless steel reinforcement will be accepted according to 00165.35 and this Section.

Section 02515 - Prestressing Reinforcement

Description

02515.00 Scope - This Section includes the requirements for seven-wire strand, high tensile strength wire, high tensile strength steel alloy bars, tendon duct and couplings.

Materials

02515.10 Seven-Wire Strand - Seven-wire strand (bright wire) shall conform to the requirements of AASHTO M 203 (ASTM A416), Grade 270, supplement 1 (low relaxation strand), minimum ultimate strength, 270,000 psi.

02515.20 Wire, High Tensile Strength - High tensile strength wire shall conform to the requirements of AASHTO M 204 (ASTM A421).

02515.30 Bars, High Tensile Strength - High strength steel bars shall conform to the requirements of AASHTO M 275 (ASTM A722).

02515.40 Seven-Wire Strand Epoxy Coated Reinforcement - Epoxy coated reinforcement shall conform to the requirements of ASTM A882.

02515.50 Tendon Duct - Provide rigid galvanized steel ducts conforming to the requirements of ASTM A653 with a coating weight of G90 for post-tensioned Structures. Transition couplings connecting rigid ducts in anchoring devices need not be galvanized.

Rigid ducts may be fabricated with either welded or interlocking seams. Galvanizing of the welded seam is not required. Provide ducts with sufficient strength to maintain their correct alignment during placing of concrete and resist denting during construction.

Minimum wall thickness of ducts shall be 26 gauge for 2 5/8 inch diameter and smaller ducts, and 24 gauge for ducts that are larger than 2 5/8 inch diameter.

02515.60 Couplings - Provide couplings that develop at least 95 percent of the minimum specified ultimate strength of the prestressing steel without exceeding anticipated set. The coupling of tendons shall not reduce the elongation at rupture below the requirements of the tendon itself.

02515.70 Shipping Protection - Package prestressing steel to protect the steel against physical damage and corrosion. Place a corrosion inhibitor that prevents rust or other results of corrosion in the package, or use a corrosion inhibitor type packaging material, or when allowed, apply directly to the steel. Provide a corrosion inhibitor that has no deleterious effect on the steel or concrete or bond strength of steel to concrete. Immediately replace or restore damaged packaging.

Mark the shipping package with the type of corrosion inhibitor used, and the date packaged.

02515.80 Acceptance - Acceptance of pre-stressing reinforcement will be according to 00165.35 and this Section.

Section 02520 - Steel and Concrete Piles

Description

02520.00 Scope - This Section includes the requirements for steel pipe, steel H-beams, steel sheets, and pre-stressed concrete used for piling.

Materials

02520.10 Steel Piles:

(a) General - All steel piles, except steel pipe piles, shall meet the requirements for Camber and sweep specified in AASHTO M 160 (ASTM A6).

(b) Steel Pipe Piles - Steel pipe piles shall be either spirally welded or longitudinally welded, and shall be constant in section. Steel piles shall conform to ASTM A252 or API 5L and the grade shown.

(c) Steel H-Piles - Steel H-piles shall be rolled steel pile sections of the size and weight shown. Steel shall conform to the requirements of ASTM A36 or ASTM A572, Grade 50. The manufacturer's name, brand or trademark may be shown by die stamping in the web at intervals not exceeding 20 feet along the length of the pile.

(d) Steel Sheet Piles - Steel sheet piles shall conform to AASHTO M 202 (ASTM A328).

(e) Reinforced Pile Tips - Steel pile tip reinforcement includes H-pile points, pipe pile shoes or points or any other proprietary steel pile tip reinforcement. Legibly mark or tag each cast steel point or shoe delivered to the Project Site with the heat or lot number. Submit certified mill test reports showing the physical and chemical properties of each heat or lot number. If the heat or lot number cannot be read on the point or if the mark or tag is missing, the point or shoe will be rejected.

Provide reinforced tips for steel H-piles from the QPL. In addition, all cast steel points or shoes shall conform to the following:

ASTM A27, Grade 65 - 35
ASTM A27, Grade 70 - 36
ASTM A27, Grade 70 - 40
ASTM A148, all grades

For steel H-piles provide no less than a 5/16 inch fillet weld full width of each flange.

(f) Sampling and Field Testing Pile Tips - The Engineer may randomly sample from each heat or lot number, at least one pile tip or up to 10 percent of the tips for larger projects, of the pile tips delivered for incorporation into the Project.

The selected tips shall be tested as follows:

- Grind five smooth spots on each randomly selected tip. The Engineer will test each smooth spot on each tip with a portable hardness tester or in a laboratory. If three or more of the five spots tested have a reading below 74 on the "B" scale, the tested tip and the entire lot shall be rejected.
- For steel H-piles, determine the weight of the tips. Each cast steel H-pile point shall have a weight not less than 30 percent of the weight of a 1 foot section of the H-pile to which it will

be attached. If any of the tested tips fail to pass the minimum weight criteria the entire lot shall be rejected.

Pile tips that are supplied unattached to the pile may be selected for nondestructive testing as described above. Pile tips passing the field test may be incorporated into the Project. Pile tips selected for testing that are supplied already attached to the pile will be destructively tested as determined by the Engineer. Provide replacement tips for the tips that are destructively tested at no cost to the Agency. Replace rejected tips with new tips and rejected lots with new lots at no additional cost to the Agency. No time extension or other compensation will be granted for materials or Work required in testing pile tips, replacing rejected pile tips or for replacing tips that are destructively tested. New tips and new lots may also be tested according to the requirements above.

02520.20 Prestressed Concrete Piles:

(a) General - Prestressed concrete piles shall be manufactured according to Section 00550 and as shown.

(b) Concrete - Concrete in precast, prestressed piles shall be Class 5000 - 1 or 3/4. Minimum concrete strength at transfer of prestressing force shall be 4,000 psi. Concrete in pile extensions or "build-ups" shall be Class 3300 - 1 1/2, 1, or 3/4.

(c) Prestressing Reinforcement - Prestressing reinforcement steel shall consist of seven-wire, low-relaxation strands conforming to 02515.10.

(d) Mild Steel Reinforcement - Spiral reinforcement shall be plain reinforcing steel meeting the requirements of 02510.10 or cold-drawn wire meeting the requirements of 02510.60. All other mild reinforcing steel shall meet the requirements of AASHTO M 31 (ASTM A615), Grade 60.

(e) Forms - The use of steel forms on concrete founded casting beds is required. Forms shall enclose all except the top horizontal surface, and shall be mortar-tight. Forms for piles shall not cause the formation of fins at the intersection of surfaces.

(f) Tolerances - The maximum sweep (deviation of straightness measured along two perpendicular faces of the pile, while not subject to bending forces) shall not exceed 1/8 inch in any 10 feet of length, 3/8 inch in 40 feet, or 3/16 inch x total length in feet per 20 feet.

(g) Finish - The tops of concrete castings shall be given a uniformly smooth finish to match the finish surface of the formed sides.

02520.30 Acceptance - Material for piles will be accepted according to 00165.35 and this Section.

Section 02530 - Structural Steel

Description

02530.00 Scope - This Section includes the requirements for structural steel used in the fabrication of Bridges and non-Bridge Structures.

Materials

02530.10 Structural Steel for Bridges - Structural steel for Bridges shall conform to the following, as shown or specified:

- AASHTO M 270, Grade 36 (ASTM A709, Grade 36)
- AASHTO M 270, Grade 50 (ASTM A709, Grade 50)
- AASHTO M 270, Grade 50W (ASTM A709, Grade 50W)
- AASHTO M 270, Grade HPS 70 (ASTM A709 Grade HPS 70)
- AASHTO M 270, Grade HPS 70W (ASTM A709 Grade HPS 70W)

Supplementary Requirement S4 (AASHTO M 270 (ASTM A709)) Fracture-Critical, *F*, Material; Toughness Testing and Marking, is mandatory for all fracture critical steel. Toughness requirements for all areas of Oregon shall be according to Zone 2 requirements.

Supplementary Requirement S6, Limitation on Weld Repair, is mandatory for all fracture critical steel.

Supplementary Requirement S2, Product Analysis, of AASHTO M 160 (ASTM A6) is mandatory for all steel plate that will be welded. The product analysis shall be on a heat frequency. It shall include all elements listed in Table A of AASHTO M 160 (ASTM A6), regardless of the material specification, except that nitrogen need not be reported unless specified in the product specification. The product analysis shall be submitted to the Engineer immediately upon receipt of the steel.

02530.20 Structural Steel for Non-Bridge Structures - Structural steel for metal sign Structures and other non-Bridge Structures shall conform to the following, or as shown or specified:

- AASHTO M 270, Grade 36 (ASTM A709, Grade 36)
- ASTM A36
- AASHTO M 270, Grade 50 (ASTM A709, Grade 50)
- ASTM A572

Notch toughness of all structural steel members and plates greater than 1/2 inch thick in load carrying members of sign Bridges and cantilever sign supports shall conform to Zone 2 requirements of AASHTO M 270.

02530.40 Ultrasonic Inspection of Plate - Ultrasonically inspect flanges 2 inches and thicker for welded plate girders before fabrication according to ASTM A578 except as follows:

- Section 7, Acceptance Standard - Level A, and Section 8, Acceptance Standard - Level B, do not apply. Use Supplementary Requirement S2.1 for acceptance standard.
- Inspection of flanges of rolled shapes with flanges thicker than 1 3/4 inches.

02530.50 Universal Mill Plate - Universal mill plate shall not be used.

02530.60 Rolled Shapes - With the approval of the Engineer, rolled shapes having equal or greater section properties and meeting minimum flange and web thickness requirements may be substituted for members specified on the Plans, at no additional cost to the Agency.

02530.70 Galvanizing - Galvanizing shall be by the hot-dip process according to the following, as applicable:

- AASHTO M 111 (ASTM A123)
- AASHTO M 232 (ASTM A153)

Steel that will be finished by hot-dip galvanizing for use as sign bridges, illumination poles, traffic signal poles, sign supports, bridge rail and items designated on the Plans as "Galvanize - Control Silicon" shall have controlled silicon content. The silicon content shall be in either of the ranges 0 - 0.06 percent or 0.13 percent - 0.25 percent. Before galvanizing, submit mill test certificates verifying silicon content to the Engineer and the galvanizer.

02530.71 Repair of Hot-Dip Galvanizing - Repair damaged hot-dip galvanizing according to ASTM A780 and ASTM A123. Furnish galvanizing repair Material from the QPL. Minimum dry film thickness is 3 mils. Minimum zinc content for Method A2 is 92 percent on the dry film.

02530.80 Acceptance - Acceptance of structural steel will be according to 00165.35 and this Section.

Section 02540 - Forgings, Shafting, Castings, and Nonferrous Materials

Description

02540.00 Scope - This Section includes the requirements for forgings, shafting, castings, and nonferrous materials except those used in potable water systems. For potable water system requirements, see Sections 02470, 02475, 02480, and 02490.

Materials

02540.10 Steel Forgings - Steel forgings shall conform to the following:

Carbon steel forgings ..... AASHTO M 102 (ASTM A668), Class C
Alloy steel forgings ..... AASHTO M 102 (ASTM A668), Class G

02540.20 Steel Shafting - Steel shafting shall be cold-finished and shall conform to AASHTO M 169 (ASTM A108), Grades 1016 - 1030, inclusive.

02540.30 Steel Castings - Steel castings shall conform to the following:

Carbon steel castings.....AASHTO M 103 (ASTM A27), Grade 70-36
Alloy steel castings.....AASHTO M 163 (ASTM A743), Grade CA-15

Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Allowance will be made in dimensions for reasonable pattern draft.

Castings shall be boldly filleted at angles and the arises shall be sharp and perfect.

Sandblast castings or otherwise effectively clean of scale and sand to present a smooth, clean and uniform surface.

02540.40 Iron Castings - Iron castings shall conform to the following:

- **Gray Iron Castings** - AASHTO M 306.
- **Ductile Iron Castings** - AASHTO M 306. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, shall be tested for castings weighing over 1,000 pounds.
- **Malleable Iron Castings** - ASTM A47, Grade 32510.

Finish iron castings according to 02540.30.

Clean iron castings according to 02540.30.

02540.50 Nonferrous Materials - Nonferrous Materials shall conform to the following:

Bronze castings.....AASHTO M 107 (ASTM B22) Copper Alloy UNS No. C91100
Copper alloy plates.....AASHTO M 108 (ASTM B100) Copper Alloy UNS No. C51000

02540.60 Acceptance - Acceptance of forgings, shafting, castings, and nonferrous Materials will be according to 00165.35 and this Section.

Section 02560 - Fasteners

Description

02560.00 Scope - This Section includes the requirements for fasteners.

02560.05 Geometry - Bolt or rod length used shall be such that the end of the bolt or rod extends beyond or is at least flush with the outer face of the nut when properly installed.

Materials

02560.10 Carbon Steel Fasteners:

(a) Bolts - Carbon steel bolts shall conform to ASTM A307, Grade A or B.

(b) Nuts - Nuts for carbon steel bolts shall conform to the requirements of the following, or equivalent:

Plain (Noncoated) Bolts:

- 1/4" - 1 1/2" - ASTM A563, Grade A, hex
- Over 1 1/2" - 4" - ASTM A563, Grade A, heavy hex

Galvanized Bolts:

- All - ASTM A563, Grade A, C, D, or DH, heavy hex

02560.20 High-Strength Fasteners:

(a) Bolts - High-strength bolts used in noncoated weathering steel connections shall be Type 3. High-strength bolts shall conform to the requirements of the following:

Heavy Hex Head:

- ASTM F3125, Grade A325

Twist-Off:

- ASTM F3125, Grade F1852

(b) Nuts - Nuts for high-strength bolts shall conform to the requirements of the following, or equivalent:

Type 1 Plain (Noncoated) Bolts:

- All - Heavy hex ASTM A563, Grade C, D, or DH

Type 1 Galvanized Bolts:

- All - Heavy hex ASTM A563, Grade DH

Type 3 Bolts:

- All - Heavy hex ASTM A563, Grade C3 or DH3

(c) Washers - Washers for high-strength bolts shall conform to ASTM F436. Use Type 3 washers with Type 3 bolts.

(d) Direct Tension Indicators - Direct tension indicators shall be the compressible-washer type, mechanically galvanized, conforming to ASTM F959. Adjust bolt lengths to accommodate both direct tension indicators and hardened washers.

(e) Markings - All bolts, nuts, washers and direct tension indicators shall be marked according to the appropriate AASHTO/ASTM specifications and with a symbol identifying the manufacturer.

02560.30 Tie Rods, Anchor Bolts, and Anchor Rods:

(a) Steel Tie Rods, Anchor Bolts, and Anchor Rods - Steel tie rods, anchor bolts, and anchor rods shall conform to: AASHTO M 314, Grade 36 or 55; ASTM F1554, Grade 36 or 55.

(b) High-Strength Tie Rods, Anchor Bolts, and Anchor Rods - High-strength tie rods, anchor bolts, and anchor rods shall conform to: AASHTO M 314, Grade 105; ASTM F1554, Grade 105; or ASTM A449, Type 1.

(c) Nuts - Nuts for tie rods, anchor bolts, and anchor rods shall conform to the requirements of the following, or equivalent:

Plain Steel Tie Rods, Anchor Bolts, and Anchor Rods:

- All - Heavy hex ASTM A563, Grade A

Galvanized Steel Tie Rods, Anchor Bolts, and Anchor Rods:

- All - Heavy hex ASTM A563, Grade A, C, D, or DH

Plain Or Galvanized High-Strength Tie Rods, Anchor Bolts, or Anchor Rods:

- All - Heavy hex ASTM A563, Grade DH

(d) Washers - Washers for anchor bolts shall conform to ASTM F436, Type 1.

02560.40 Galvanizing and Coating:

(a) High Strength Fasteners - When specified, hot-dip galvanize Grade A325 fasteners or mechanically deposit zinc to Grade F1852 fasteners according to ASTM F3125.

(b) Tie Rods, Anchor Bolts, Anchor Rods and Carbon Fasteners - Hot-dip galvanize tie rods, anchor bolts, anchor rods, nuts, washers and carbon fasteners according to ASTM F2329 as appropriate to the product.

Overtap nuts for galvanized fasteners, galvanized tie rods, galvanized anchor bolts, and galvanized anchor rods according to ASTM A563.

Measure the zinc thickness on the wrench flats or top of bolt head of galvanized bolts and on the wrench flats of galvanized nuts.

(c) Direct Tension Indicators - When specified, apply mechanically deposited zinc according to ASTM F959.

(d) Repair of Hot-Dip Galvanizing - Repair damaged hot-dip galvanizing according to ASTM A780. Minimum zinc content for Method A2 is 94 percent on the dry film.

Testing

02560.60 Testing:

(a) Rotational Capacity Test - Test all high-strength fasteners, except tie rods, anchor bolts, and anchor rods, according to Method 1 or 2 below, as applicable. Perform the test on coated or galvanized fasteners after coating, galvanizing, oversize tapping and lubricating. Use nuts from those supplied with the bolts for the job. Use washers for this testing. Repeat the rotational capacity test at the Project Site prior to installation to verify the effectiveness of the lubricant. The rotational capacity test is not required for lock-pin and collar fasteners. Use Method 1 for long bolts and Method 2 for short bolts.

Test each combination of bolt production lot, nut lot and washer lot as an assembly. Assign a rotational capacity lot number to each combination of lots tested. The minimum frequency of testing shall be two assemblies per rotational capacity lot. The test shall meet one of the following requirements:

(1) Method 1 - Place the lubricated fastener, including a washer, in a device capable of indicating direct bolt tension. Use spacers and/or washers with the hole size the same nominal diameter as the hole in the washer for the fastener to be tested. Allow three to five full threads of the bolt to be exposed between the bearing surfaces of the bolt head and the nut. Tighten the nut to a snug-tight condition to produce an initial load in the bolt equal to 10 percent of the tension required in Table 00560-1 of Section 00560. Mark the nut's position relative to the fixed bolt for this snug-tight position. Tighten the nut using a calibrated torque wrench and record the measured torque with the nut in motion to reach the tension required by Table 00560-1.

The above measured torque to produce the required bolt tensions shall not exceed the torque value calculated by the following equation:

$$T = 0.25\ PD$$

Where: T = Torque in foot pounds
P = Measured Bolt Tension in pounds
D = Nominal Bolt Diameter in feet

Reject assemblies with torque values exceeding the calculated value.

Continue to tighten the nut until the nut has turned twice the rotation shown in Table 00560-3 of Section 00560 from its snug-tight position mark. Record the measured bolt tension. The tension shall not be less than 1.15 times the tension shown in Table 00560-1. Reject assemblies not meeting this tension.

Loosen and remove the nut. Examine the threads on the nut and bolt. Reject assemblies showing evidence of thread shear failure, stripping or torsional failure of the bolt.

(2) Method 2 - Bolts that are too short to be tested in a direct bolt tension indicating device shall be tested in a steel joint.

Place the lubricated fastener including a washer in one or more flat structural steel plates. The total thickness including the washer shall be such that three to five full threads of the bolt are located between the bearing surfaces of the bolt head and the nut. The hole in the joint shall have the same nominal diameter as the hole in the washer. Using a calibrated torque wrench,

tighten the nut to a snug-tight condition to produce an initial torque in the bolt equal to approximately 10 percent of the torque calculated using the equation given in Method 1 above where P shall be the minimum tension in the bolt according to Table 00560-1 of Section 00560. Mark the nut's position relative to the fixed bolt for this snug tight position.

Using the calibrated torque wrench, further tighten the nut until the nut has turned the rotation shown in Table 00560-3 of Section 00560 from its snug-tight position mark. Prevent the bolt head from turning during the tightening process. Record the measured torque with the nut in motion. The measured torque shall not exceed 1.15 times the torque value calculated in the preceding step of Method 2. Reject assemblies with torque values exceeding the calculated value.

Tighten the nut further until the nut has turned twice the rotation shown in Table 00560-3 from its snug-tight position mark. Reject assemblies which fail this rotation either by stripping or fracture.

Loosen and remove the nut. Examine the threads on the nut and bolt. Reject assemblies showing evidence of thread shear failure, stripping or torsional failure of the bolt.

(3) Shipping - Ship bolts, nuts and washers from each rotational capacity test lot in the same container. If there is only one rotational capacity test lot for each size of bolt, the bolts, nuts and washers may be shipped in separate containers. Permanently mark each container with the rotational capacity test lot number to enable identification at any stage before installation.

(b) Other Test Requirements - Proof load testing on all high-strength bolts and nuts is mandatory. Test bolts according to ASTM F606, Method 1, and nuts according to ASTM F606, paragraph 4.2, with frequency of tests according to paragraph 9.3 of ASTM A563. Test galvanized bolts, rods, and nuts after galvanizing, overtapping and lubricating. Coated bolts, rods, and nuts may be tested before coating.

Wedge test all bolts according to ASTM F606, paragraph 3.5, with frequency of testing according to ASTM F3125, Grade A325 or Grade F1852. Test galvanized bolts after galvanizing. Coated bolts may be tested before coating.

Perform other tests called for on the Plans.

Provide certified test results for all tests required by the Specifications or the individual product specifications.

Provide three high-strength bolt assemblies per size per lot for check testing.

Provide one high-strength tie rod, one high-strength anchor bolt, and one high-strength anchor rod assembly per size per lot for check testing.

02560.70 Lubricating Fasteners - Furnish all galvanized and coated fasteners with a factory applied commercial water-soluble wax that contains a visible dye of a color that contrasts with the color of galvanizing or coating. Black fasteners shall be "oily" to the touch when installed.

Field lubricate galvanized bolts in tapped holes, galvanized anchor rods, and galvanized tie rods with a lubricant from the QPL. Apply lubricant to threads and to bearing surfaces that will turn during installation.

Protect fasteners from dirt and moisture at the Project Site.

Retest heavy hex head fasteners that do not pass the field rotational capacity test. Clean and relubricate heavy hex head fasteners with a lubricant from the QPL prior to retesting.

Relubrication of Twist-Off fasteners is not permitted.

02560.80 Acceptance - Acceptance of fasteners will be according to 00165.35 and this Section.

Section 02570 - Composite Bearings

Description

02570.00 Scope - This Section includes the requirements for composite bearings.

Materials

02570.10 Materials - Provide Materials meeting the following requirements:

Structural Steel 02530.20
Stainless Steel Sliding Surfaces ..... ASTM A240, Type 304 or Type 316
Flat Brass Rings for Pot Bearings .....ASTM B36, half hard
Cap Screws ..... ASTM A574 or ASTM F835
Bolts and Nuts .....Section 02560
Galvanized Bolts, Nuts, Washers, Cap screws,
Sole Plates and Base Plates .....02530.70 and 02560.40
Woven Polytetrafluoroethylene (PTFE)..... section 18 of the current AASHTO
.....*LRFD Bridge Construction Specifications*

Welded Stainless Steel Overlay - Produce welded stainless steel overlay for the convex rotational surface of spherical bearings using Type 309L electrodes.

Elastomer - Elastomer for elastomeric discs of pot bearings shall be 100 percent virgin natural polyisoprene (natural rubber) or 100 percent virgin chloroprene (neoprene) meeting the following requirements:

NATURAL POLYISOPRENE (Natural Rubber):

Physical Properties	**ASTM Test Method**	**Value**
Hardness, Durometer D	D 2240	50 ± 5
Tensile strength, minimum, psi	D 412	2,250
Ultimate elongation, minimum, %	D 412	450
Heat Resistance		
Change in durometer hardness, maximum points	D 573 70 hour at 158 °F	+ 10
Change in tensile strength, maximum, %		- 25
Change in ultimate elongation, maximum, %		- 25
Compression Set		
22 hours at 158 °F, maximum, %	D 395, Method B	25
Ozone		
25 pphm ozone in air by volume, 20% strain, 100 °F ± 2 °F 48 hours mounting Procedure D518, Procedure A	D 1149	No Cracks

Adhesion		
Bond made during vulcanization, lb/in	D 429 Method B	40
Low Temperature Test		
Brittleness at -40 °F	D 746 Procedure B	No Failure

VIRGIN CHLOROPRENE (Neoprene):

Physical Properties	**ASTM Test Method**	**Value**
Hardness, Durometer D	D 2240	50 ± 5
Tensile strength, minimum, psi	D 412	2,250
Ultimate elongation, minimum, %	D 412	400
Heat Resistance		
Change in durometer hardness, maximum points	D 573 70 hour at 212 °F	+ 15
Change in tensile strength, maximum, %		- 15
Change in ultimate elongation, maximum, %		- 40
Compression Set		
22 hours at 212 °F, maximum, %	D 395, Method B	35
Ozone		
100 pphm ozone in air by volume, 20% strain, 100 °F ± 2 °F 100 hours mounting Procedure D518, Procedure A	D 1149	No Cracks
Adhesion		
Bond made during vulcanization, lb/in	D 429 Method B	40
Low Temperature Test		
Brittleness at -40 °F	D 746, Procedure B	No Failure

When test specimens are cut from the finished product a 10 percent variation in physical properties will be allowed.

Polyether Urethane - The properties of polyether urethane for polyether urethane discs of disc bearings shall meet the values of the following tests:

Property	Test Method	Range of Values
Hardness, Durometer D	ASTM D2240	65 ± 5
Tensile stress, psi		
at 100% elongation	ASTM D412	2,300 min.
at 200% elongation		4,000 min.
Tensile strength	ASTM D412	6,000 min.
Ultimate elongation %	ASTM D412	220 min.
Compression set, 22 hrs.		
at 158 °F	ASTM D395	40 max.

Fabric Pads - Make preformed fabric pads for fabric pad bearings of multiple layers of duck, impregnated and bound with high quality oil resistant synthetic rubber compressed into resilient pads of uniform thickness according to the following:

- Cotton duck reinforcement shall be either a two-ply cotton yarn or a single-ply 50-50 blend cotton polyester with a minimum of 8 ounces per square yard.
- The fabric shall have a minimum tensile strength of 150 pounds per inch width when tested by the grab method.
- The filling count of the duck shall be 40 ± 2 threads per inch.
- The warp count of the duck shall be 50 ± 1 threads per inch.
- The number of plies shall produce the specified thickness after compression and vulcanizing.
- The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 psi without any sign of distress after the load is removed. The tested pad shall have a shape factor greater than 2.5. The preformed fabric pad shall have a Shore A hardness of 90 ± 5.

02570.20 Testing - Test all bearings except where lot testing is permitted. A lot is defined as 25 bearings per type and size. Where lot testing is required, previous test results on a typical bearing of equal or greater capacity is acceptable provided the data is no more than 2 years old. Test typical bearings either by an independent testing laboratory, or have the testing witnessed and attested to by an independent testing laboratory, for compliance with specified performance requirements as listed below. Provide a test results certificate according to 00165.35 with the submittal of shop drawings. Perform the following tests:

(a) Clearance Test - Move the components of the bearing through their design displacements or rotations to verify that the required clearances exist. If the test is conducted on a rotational component which is not under simultaneous full vertical load, make allowance for the displacements which would be caused by that load.

(b) Long-Term Deterioration Test - Conduct test on one full scale bearing per lot. Load the bearing in compression to a stress corresponding to 100 percent of the maximum dead plus live service load while subjected to plus and minus the design rotational displacement amplitude for 5,000 cycles. Flat sliding systems shall be displaced through at least 1,000 cycles with an amplitude of at least ± 1.0 inch (2.0 inch peak to peak). The sliding may take place at up to 10.0 inch per minute, except when readings of the coefficient of friction are taken, at which time the sliding speed shall be 2.5 inches per minute.

Bearings will be rejected when:

- There are visible cracks, splits, or excessive wear on disassembly of the bearing.
- The coefficient of friction exceeds two-thirds the value used in design.

(c) Friction Test - Conduct test on one full scale bearing per lot. The coefficient of friction between the sliding surfaces shall not be greater than 0.06 when the maximum working stress for the polytetrafluoroethylene (PTFE) surface is 2,000 psi. It shall not be greater than 0.045 when the maximum working stress for the PTFE surface is above 3,000 psi. Determine the coefficient of friction at 68 °F according to the requirements of section 18.3.4.3.2 of the AASHTO *LRFD Bridge Construction Specifications*.

(d) Proof Load Test:

(1) Vertical Proof Load Test - Apply a vertical load equal to 150 percent of the vertical design capacity of the tested bearing for 5 minutes, unload, then reapply for an additional 5 minutes. Place the bearing in a rotated position during the test. Rotation shall be 0.015 radians or the design rotation, whichever is greater. The test bearing shall show no indication of failure or other defects such as weld cracking, plate distortion, extrusion of the elastomer or bearing material, or displacement of the elastomer seal while under load or subsequently upon disassembly and inspection.

The successful test of a bearing with a vertical design capacity of 50 tons or less will be accepted as qualification for all bearings of a similar design with a lesser design capacity.

(2) Horizontal Proof Load Test - A horizontal proof load test is required when the design horizontal capacity exceeds 10 percent of the design vertical capacity and no engineer's calculations are submitted. Apply a horizontal load equal to 100 percent of the horizontal design capacity while also applying a vertical load equal to 100 percent of the dead load for a period of 2 minutes. The bearing does not need to be in the rotated position. The bearing shall show no indication of failure or other defects such as weld cracking, plate distortion, extrusion of the elastomer or bearing material, or displacement of the elastomer seal while under load or subsequently upon disassembly and inspection.

The bearing tested for horizontal proof load may be either a bearing specified for use on the Project or a similar type bearing with both a vertical design capacity and a horizontal design capacity within 10 percent of the design capacities of bearings specified for use on the Project.

02570.30 Acceptance - For each composite bearing used in the Structure, provide the manufacturer's quality compliance certificate according to 00165.35 that verifies the bearing has been manufactured according to the design of the tested bearing.

Section 02571 - Elastomeric Bearing Pads

Description

02571.00 Scope - This Section includes the requirements for plain and laminated elastomeric bearing pads.

Materials

02571.10 Elastomeric Compound - The elastomer portion of the elastomeric compound shall be 100 percent virgin polychloroprene (Neoprene) or natural rubber (polyisoprene) meeting the requirements of section 18 of the AASHTO *LRFD Bridge Construction Specifications* including the properties from the following table:

Table 02571-1

Properties	ASTM Test Method	Requirements
Hardness, Durometer D	D 2240	60 ± 5
Tensile strength, min., psi	D 412	2,250
Ultimate elongation, min., %	D 412	350
Heat Resistance:		
Change in durometer hardness max. points after 70 hr. at 212 °F	D 2240	+ 15
Change in tensile strength, max. % after 70 hr. at 212 °F	D 573	- 15
Change in ultimate elongation, max. % after 70 hr. at 212 °F	D 573	- 40
Compressive set, max. % after 22 hr. at 212 °F	D 395 Method B	35
Adhesion: Bond made during vulcanization, lb/in	D 429 Method B	40
Tear Resistance, (psi)	D 624 Die C	180

02571.15 Metal Reinforcement - Metal reinforcement shall be rolled, mild steel sheets 14 gauge thick and conforming to ASTM A1011, Grade 36 Type 1, or ASTM A1008, Grade 40.

02571.20 Manufacturing Requirements:

(a) Pads - Pads 1/2 inch thick shall be all elastomer. Pads over 1/2 inch thick shall consist of alternate laminations of elastomer and metal.

In metal reinforced pads, the top and bottom layers shall be elastomer 1/4 inch thick, and interior elastomer layers shall be 1/2 inch thick. The nominal thickness of the bearing shown reflects the thickness of the elastomer only. It does not include the steel laminates.

(b) Laminations - Laminations of elastomer shall be of uniform thickness and in no case shall the thickness of an individual lamination exceed 5/8 inch. Variations in thickness of an individual elastomer lamination shall not exceed 1/8 inch and the variation in thickness of all elastomer

laminations within a pad shall be such that each metal lamination shall not vary by more than 1/8 inch from a plane parallel to the top or bottom surface of the pad.

(c) Laminated Pads - Laminated pads shall be molded individually to the sizes required. No shearing to size or drilling of holes will be allowed. Cover all edges of metal laminations with a minimum of 1/8 inch, and a maximum of 1/4 inch, of elastomer except at laminate restraining devices and around holes that will be entirely closed when the pad is in place on the Structure.

Clean the exposed edge voids in the pads caused by the steel laminate restraining devices with a solvent. Shop seal with an appropriate caulking material before shipment.

Sandblast and clean the steel laminates of all surface coatings such as grease, oil, rust and mill scale before bonding. Free the laminates of sharp edges and burrs.

Pads 1/2 inch in thickness may be sheared. The shearing shall not heat the material and shall produce a smooth finish to 250 microinches with no tears or jagged areas.

(d) Dimensional Tolerances and Finishes - See section 18 of the AASHTO *LRFD Bridge Construction Specifications* for fabrication tolerances.

Fabricate pads to meet flash tolerance, finish and appearance requirements given in the current edition of the *Rubber Handbook*, published by the Rubber Manufacturers Association, Inc., RMA F3 and T.063 for molded bearings and RMA F2 for extruded bearings.

02571.30 Laminated Bearing Pad Tests and Acceptance Criteria:

(a) General - Comply with additional test requirements of this Subsection. Non-laminated bearing pads do not require these tests.

Independently test all completed bearings by compressive visual inspection according to 02571.30(b). Failure of individual bearings to pass the compressive visual inspection will be cause for rejection of those individual bearings.

Independently test five standard test specimens of laminated pads according to 02571.30(c). Failure of any individual specimen to meet the peel strength test requirements will be cause for rejection of the entire bearing production lot. A lot is defined as 50 or less bearings which are manufactured in a reasonably continuous manner from the same batch of elastomer, cured under the same conditions, and are all the same size and type.

Replace rejected bearings with new acceptable bearings at no additional cost to the Agency. Provide the sample pad and perform all testing at no additional cost to the Agency.

Mark all bearings in indelible ink or flexible paint with the Contract number, lot number, date of manufacturer, and bearing identification number. Place the marking on a side face visible after erection of the Bridge.

Clean and free the bearings of any foreign substances such as dust, grit and moisture before testing.

(b) Short-Duration Compression Test - Bring all bearings to a temperature of 73 °F ± 10 °F and proof load for a compressive loaded to 1.5 times the maximum design load. The load shall be held for 5 minutes, removed, then reapplied for a second period of 5 minutes. Maintain the load constant while the bearing is inspected for visual faults. The following will be cause for rejection:

- A bulging pattern or patterns implying lack of bond between the elastomer and the laminate or bulging patterns that imply improper laminate placement.

- Three separate surface cracks which are greater than 5/64 inch wide and 5/64 inch deep, or a single crack 3/16 inch deep or wider than 1/4 inch.

(c) Peel Strength Test - Perform a peel strength test according to ASTM D429 Method B, with the exception that the specimens shall be taken randomly and cut from a production bearing submitted for the Project. The bond between the elastomer and steel laminate in each specimen shall be not less than 40 pounds per inch.

(d) Long Duration Compression Test - Perform long term duration compression tests according to the requirements of AASHTO *LRFD Construction Specifications* when steel reinforced elastomeric bearings are designed using Method B, or when using Grade 4 elastomer.

02571.31 Acceptance - Provide a quality compliance certification according to 00165.35 that the bearing pads conform to the requirements for materials, fabrication and testing. Provide a test result certificate according to 00165.35 that includes the manufacturer's and independent test results according to 02571.30(a).

Aggregates

Section 02610 - Special Filter Material

Description

02610.00 Scope - This Section includes the requirements for special filter material for backfilling or filling trenches for perforated drains and other subsurface drains.

Materials

02610.10 Special Filter Materials - Furnish a specially graded filter Material of coarse sand, and crushed or uncrushed Rock that meets the following requirements:

(a) Grading - Sieve analysis shall be determined according to AASHTO T 27. The Material shall meet the following gradation requirements:

Sieve Size	Percent Passing (by Weight)
3/8"	100
No. 4	54 - 82
No. 10	34 - 56
No. 40	9 - 17
No. 100	0 - 3

(b) Sand Equivalent - Special filter material shall be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 25.

Section 02630 - Base Aggregate

Description

02630.00 Scope - This Section includes the requirements for Aggregates in Base.

Materials

02630.10 Dense-Graded Aggregate:

(a) Grading - Dense-graded base Aggregate shall be crushed Rock, including sand. Uniformly grade the Aggregates from coarse to fine. Sieve analysis shall be determined according to AASHTO T 27. The Aggregates shall conform to one of the grading requirements of Table 02630-1 as identified in the Special Provisions or indicated by the Pay Items in the Contract Schedule of Items.

Table 02630-1
Grading Requirements for Dense-Graded Aggregate
Separated Sizes

Sieve Size	2 1/2" - 0	2" - 0	1 1/2" - 0	1" - 0	3/4" - 0
	Percent Passing (by Weight)				
3"	100				
2 1/2"	95 - 100	100			
2"	–	95 - 100	100		
1 1/2"	–	–	95 - 100	100	
1 1/4"	55 - 75	–	–	–	
1"	–	55 - 75	–	90 - 100	100
3/4"	–	–	55 - 75	–	90 - 100
1/2"	–	–	–	55 - 75	–
3/8"	–	–	–	–	55 - 75
1/4"	30 - 45	30 - 45	35 - 50	40 - 55	40 - 60
No. 4 [1]	–	–	–	–	–
No. 10	[2]	[2]	[2]	[2]	[2]

[1] Report percent passing sieve when no grading requirements are listed
[2] Of the fraction passing the 1/4 inch sieve, 40 percent to 60 percent shall pass the No. 10 sieve

(b) Fracture Of Rounded Rock - Fracture of rounded Rock shall be determined according to AASHTO T 335. Provide at least one fractured face based on the following percentage of particles retained on the 1/4 inch sieve for the designated size:

Minimum Percent of Fractured Particles
(by Weight of Material)

Designated Size	Retained on 1/4 inch Sieve
1 1/2" - 0 and larger	50
Smaller than 1 1/2" - 0	70

(c) Durability - Dense-graded Aggregate shall meet the following durability requirements:

Test	Test Method	Requirements
Abrasion	AASHTO T 96	35.0% maximum
Degradation (coarse Aggregate)		
Passing No. 20 sieve	ODOT TM 208	30.0% maximum
Sediment Height	ODOT TM 208	3.0" maximum

(d) Sand Equivalent - Dense-graded Aggregate shall be tested according to AASHTO T 176, and shall have a sand equivalent of not less than 30.

02630.11 Open-Graded Aggregate:

(a) Grading - Open-graded Aggregate shall conform to the following grading requirements:

Table 02630-2
Aggregate Gradation for Open-Graded Aggregate

Sieve Size	Percent Passing (by Weight)
1"	100
3/4"	80 - 98
1/2"	60 - 85
3/8"	30 - 65
No. 10	5 - 20
No. 40	0 - 6
No. 100	0 - 3 (Dry Sieve)

(b) Fracture of Rounded Rock - Fracture of rounded Rock shall be determined according to AASHTO T 335. Open-graded Aggregate fracture requirements shall conform to the following:

Percentage of Fracture (by Weight)

Material Retained on 3/4", 1/2", and 1/4" Sieves (two fractured faces) 90
Material Retained on No. 10 Sieve (one fractured face) 75

(c) Durability - Open-graded Aggregate shall meet the durability requirements of 02630.10(c).

Section 02640 - Shoulder Aggregate

Description

02640.00 Scope - This Section includes the requirements for shoulder Aggregate.

Materials

02640.10 Aggregate:

(a) Grading - Shoulder Aggregate shall be crushed Rock, including sand. Sieve analysis shall be determined according to AASHTO T 27. Uniformly grade the Aggregates from coarse to fine. The Aggregates shall conform to one of the grading requirements of Table 02640-1 as identified in the Special Provisions or indicated by the Pay Item in the Contract Schedule of Items.

Table 02640-1
Grading Requirements - Shoulder Aggregates

	Separated Sizes	
	1" - 0	3/4" - 0
Sieve Size	Percent Passing (by Weight)	
1 1/2"	100	
1"	90 - 100	100
3/4"	–	90 - 100
1/4"	40 - 55	40 - 60

(b) Fracture of Rounded Rock - Fracture of rounded Rock shall be determined according to AASHTO T 335. Provide at least one fractured face based on the following percentage of particles retained on the 1/4 inch sieve for the designated size:

Minimum Percent of Fractured Particles
(by Weight of Material)

Designated Size	Retained on 1/4" Sieve
1 1/2" - 0 and larger	50
Smaller than 1 1/2" - 0	50

(c) Durability - The produced Aggregates shall meet the following requirements:

Test	Test Method	Requirements
Abrasion	AASHTO T 96	35.0% maximum
Degradation (Coarse Aggregate) Passing No. 20 sieve	ODOT TM 208	30.0% maximum
Sediment Height	ODOT TM 208	3.0" maximum

(d) Sand Equivalent - Shoulder Aggregate shall be tested according to AASHTO T 176, and shall have a sand equivalent of not less than 25.

Section 02690 - PCC Aggregates

Description

02690.00 Scope - This Section includes the requirements for coarse and fine Aggregates for portland cement concrete.

02690.01 Definitions:

Coating - Foreign or deleterious substances found adhering to the Aggregate particles.

Detrimental Materials - Materials that adversely affect concrete, including but not limited to clay, shale, mica, silt, bark, alkali, sticks, organic matter, soft and flaky particles.

Nominal Maximum Size Of Aggregate - One sieve larger than the first sieve that retains more than 10 percent of the material using an Agency specified set of sieves based on cumulative percent retained. Where large gaps in specification sieves exist, intermediate sieves may be inserted to determine nominal maximum size.

Materials

02690.10 Materials - PCC Aggregates shall consist of natural or crushed rock that is hard, strong, durable and free from adherent coatings or other detrimental materials.

Produce, handle and store the Aggregates in a way that will maintain passing material properties and avoid introducing deleterious materials or segregation prior to its use in portland cement concrete.

02690.11 Alternate Grading - The Contractor may request approval to produce coarse and fine Aggregates in sizes other than those stated in 02690.20 and 02690.30. The request shall be in writing, and shall state the proposed target value and specified tolerances for each of the individual sieve sizes of the materials the Contractor proposes to produce.

02690.12 Acceptance of Aggregate - Acceptance of Aggregate will be according to Section 00165 and based on the Contractor's quality control testing, if verified, according to Section 00165.

(a) Aggregate Gradation - A stockpile contains specification Aggregate gradation when the quality level for each sieve size calculated according to 00165.40 is equal to or greater than the quality level in Table 00165-2 for a PF of 1.00. Each required sample represents a sublot. When the quality level in Table 00165-2 yields a PF of less than 1.00 for any constituent, the material is non-specification.

(b) Non-specification Aggregate Gradation - Stockpiled Aggregates that contain non-specification Aggregate gradation will be rejected by the Engineer unless non specification material is removed from the stockpile. Do not add additional material to the stockpile until enough non-specification material is removed so that the quality level for each constituent is equal to or greater than the quality level in Table 00165-2 for a 1.00 PF.

Reprocessing of non-conforming material and the testing required for acceptance will be at no additional cost to the Agency. Acceptance of reprocessed material will be based on passing test results or accepted visually by the Engineer.

02690.20 Coarse Aggregate:

(a) Harmful Substances - Harmful substances shall not exceed the following limits:

Test	Test Method ODOT	Test Method AASHTO	Percent (by Weight)
Lightweight Pieces	–	T 113	1.0
Material passing No. 200 sieve	–	T 11	1.0
Wood Particles	TM 225	–	0.05

(b) Soundness - Coarse Aggregates for concrete shall be tested for soundness using sodium sulfate salt, according to AASHTO T 104. The weighted percentage loss shall not exceed 12 percent by weight.

(c) Durability - Coarse Aggregates shall meet the following durability requirements:

Test	Test Method ODOT	Test Method AASHTO	Requirements
Abrasion	–	T 96	30.0% Max.
Oregon Air Aggregate Degradation:			
Passing No. 20 sieve	TM 208	–	30.0% Max.
Sediment Height	TM 208	–	3.0" Max.

(d) PCC Paving Aggregate - In addition to requirements above, comply with the following:

(1) Fracture - Provide Aggregate with at least two fractured faces on at least 50 percent of the particles retained on the 3/8 inch, 1/2 inch, 3/4 inch, 1 inch, and 1 1/2 inch sieves, as determined by AASHTO T 335.

(2) Elongated Pieces - Provide Aggregate with elongated pieces not exceeding 10 percent by weight of the material retained on the No. 4 sieve when tested according to ODOT TM 229 with the proportional caliper device set at a ratio of 5:1.

(e) Grading and Separation by Sizes for Prestressed Concrete - Sampling shall be according to AASHTO R 90 and sieve analysis shall be determined according to AASHTO T 27 and AASHTO T 11. PCC coarse Aggregate shall conform to grading and separated sizes as follows:

(1) Where specified in Table 02690-1, the coarse Aggregate shall be separated into two sizes and each separated size shall be measured into the batch in the quantity determined by the mix design.

For each of the specified maximum sizes of coarse Aggregates, the separated sizes shall be as specified in Table 02690-2:

Table 02690-1

Maximum Nominal Size of Aggregates	Separated Sizes
1"	1" - No. 4
3/4"	3/4" - No. 4
3/4"	3/4" - 1/2" and 1/2" - No. 4
3/4"	3/4" - 3/8" and 3/8" - No. 4

(2) The grading of each of the specified separated sizes of coarse Aggregate shall conform to the following:

Table 02690-2

Sieve Size	Separated Sizes 1" - No. 4	3/4" - No. 4	3/4" - 1/2"	3/4" - 3/8"	1/2" - No. 4	3/8" - No. 4
	Percent Passing (by Weight)					
1 1/2"	100					
1"	90 - 100	100	100	100		
3/4"	50 - 80	90 - 100	85 - 100	85 - 100	100	100
1/2"	–	–	0 - 15	–	85 - 100	–
3/8"	15 - 40	20 - 50	–	0 - 15	35 - 65	85 - 100
No. 4	0 - 10	0 - 10	–	–	0 - 15	0 - 15
No. 200	*	*	*	*	*	*

* See 02690.20(a). Do not evaluate material passing the No. 200 sieve according to 00165.40.

(f) Grading and Separation by Sizes for Other Concrete - Sampling shall be according to AASHTO T 2. Sieve analysis shall be according to AASHTO T 27 and AASHTO T 11. Provide Aggregates meeting the gradation requirements of Tables 02690-3 and 02690-4 for structural concrete. Provide a CAgT to perform sampling and testing when required.

Table 02690-3

Gradation of Coarse Aggregates

Sieve Size	Combined * Sizes 1 1/2" - No. 4	Separated Sizes 1 1/2" - 3/4"	Separated Sizes 1" - No. 4	Separated Sizes 3/4" - 1/2"
	Percent Passing (by Weight)			
2"	100	100		
1 1/2"	90 - 100	90 - 100	100	
1"	70 - 89	20 - 55	90 - 100	100
3/4"	35 - 70	0 - 15	–	85 - 100
1/2"	–	–	25 - 60	0 - 15
3/8"	10 - 30	0 - 5	–	–
No. 4	0 - 5	–	0 - 10	–
No. 8	–	–	0 - 5	–
No. 200	**	**	**	**

* For 1 1/2 inch coarse Aggregate use two or more separated sizes which when combined shall meet the gradation limits for 1 1/2" - No. 4

** See 02690.20(a). Do not evaluate material passing the No. 200 sieve according to 00165.40.

Table 02690-4
Gradation of Coarse Aggregates

Sieve Size	Separated Sizes 3/4" - 3/8"	Separated or Combined Sizes 3/4" - No. 4	Separated Sizes 1/2" - No. 4	Separated Sizes 3/8" - No. 8
		Percent Passing (by Weight)		
1"	100	100		
3/4"	90 - 100	90 - 100	100	
1/2"	20 - 55	–	90 - 100	100
3/8"	0 - 15	20 - 55	40 - 70	85 - 100
No. 4	0 - 5	0 - 10	0 - 15	10 - 30
No. 8	–	0 - 5	0 - 5	0 - 10
No. 16	–	–	–	0 - 5
No. 200	*	*	*	*

* See 02690.20(a). Do not evaluate material passing the No. 200 sieve according to 00165.40.

02690.30 Fine Aggregates:

(a) Different Sources - Do not mix fine Aggregates from different sources of supply, or store in the same pile. Do not use alternately in the same class of mix, without prior approval.

(b) Harmful Substances - The amount of harmful substances shall not exceed the following limits:

Test	Test Method (AASHTO)	Percent (by Weight)
Lightweight Pieces	T 113	2.0%
Material passing No. 200 sieve	T 11	3.0%

(c) Soundness - Fine Aggregate shall be tested for soundness using sodium sulfate salt, according to AASHTO T 104. The weighted percentage loss shall not exceed 10 percent by weight.

(d) Organic Impurities - All fine Aggregate shall meet the requirements of AASHTO M 6 for organic impurities.

(e) Sand Equivalent - Fine Aggregate shall be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 75.

(f) Sand For Mortar - Sand for mortar shall conform to the requirements of this Section.

(g) Grading - Sampling shall be according to AASHTO T 2. Sieve analysis shall be determined according to AASHTO T 27 and AASHTO T 11. Provide Aggregates meeting the gradation requirements of Table 02690-5 for structural concrete. Provide a CAgT to perform sampling and testing when required.

Table 02690-5
Gradation of Fine Aggregate *

Sieve Size	Percent Passing (by Weight)
3/8"	100
No. 4	90 - 100
No. 8	70 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	5 - 30
No. 100	0 - 10
No. 200	**

* Determine the fineness modulus according to AASHTO T 27 and AASHTO T 11. Maintain the fine Aggregate fineness modulus within plus or minus 0.20 from the fineness modulus used in the Contractor's mix design. Fine Aggregates in which the fineness modulus varies by more than 0.20 from the mix design target shall not be incorporated until an assessment is done to determine whether an adjustment in the Aggregate proportions is necessary. Proportion changes must be performed by a CCT according to the provisions of ACI 211. Submit analysis of FM and mix design adjustments to the Engineer for approval.

** See 02690.30(b). Do not evaluate material passing No. 200 sieve according to 00165.40.

Section 02695 - Reclaimed Glass (Mixed Waste Cullet)

Description

02695.00 Scope - This Section includes the requirements for reclaimed glass (mixed waste cullet) as a substitute for Aggregates.

Materials

02695.10 Mixed Waste Cullet - Cullet shall be 1/2" - 0. It shall be clean, hard, and durable. Not more than 5 percent by weight shall pass a No. 200 sieve.

The maximum debris level shall be 10 percent except as noted below. Debris is defined as any deleterious material that impacts the performance of the backfill. Percent of debris shall be estimated.

02695.20 Cullet Applications:

Use	Maximum Cullet Content (%)	Maximum Debris Level (%)	Minimum Compaction Level (%)
Nonstructural Fill	100	10	90

02695.41 Hauling and Placing - Transport the cullet to the Project Site, add water to obtain the proper moisture content, and place in the trench by means acceptable to the Engineer, in loose Lifts of 8 inches or less.

02695.43 Compacting and Shaping - Compact each layer of material by steel wheel vibratory rollers or as directed.

02695.50 Testing - The Engineer will check gradation and density by laboratory or field testing as deemed appropriate. Impurities will be checked visually by sampling a specimen of processed cullet with a weight of approximately 1/2 pound.

Railing and Guidance Devices

Section 02810 - Bridge Rail

Description

02810.00 Scope - This Section includes the requirements for the steel in railings for Bridges.

Materials

02810.10 Shapes, Plates, and Bars - Shapes, plates and bars shall conform to the following, or as shown or specified:

- ASTM A36
- ASTM A572 Grade 50
- ASTM F1554 Grade 105

The silicon content of all exposed shapes, plates and bars that are called out on drawings as "Galvanize - Control Silicon", shall be according to 02530.70.

02810.15 Anchor Adhesive - Use one of the following epoxy adhesive from the QPL:

- Hilti HIT-HY200-A
- Hilti HIT-RE 500v3, Red Head C6+
- Ultrabond HS-1CC

02810.20 Structural Steel Tubing - Structural steel rail members shall comply with ASTM A500, Grade B, or ASTM A501. Steel conforming to ASTM A513 or ASTM A618 may be substituted for ASTM A500 tubing subject to the following limitations:

- Provide chemical and tensile properties test results.
- Silicon content shall be according to 02530.70.
- Strength and elongation requirements of ASTM A513 tubing shall meet the requirements of ASTM A500 tubing.

02810.30 Steel Pipe - Metal parapet rail members shall be standard steel pipe complying with ASTM A53, Grade B or ASTM A500, Grade B.

02810.40 Cast Steel Posts - Cast steel posts shall be carbon steel castings complying with AASHTO M 103 (ASTM A27), Grade 65-35.

02810.50 Metal Thrie Beam Rail - Galvanize steel thrie beam rail according to AASHTO M 180, Class A rail, Type II coating after fabrication and subject to the single spot test. Backup plates will be accepted with ungalvanized edges and bolt holes, provided these areas are field-coated with an approved galvanizing substitute according to 02530.71. Metal posts and hardware shall meet the requirements of 02820.20 and 02820.30.

02810.60 Incidentals - Plates, caps and miscellaneous pieces necessary to complete the rail shall be as shown or specified.

02810.70 Acceptance - Bridge rail Materials will be accepted according to 00165.35 and this Section.

Section 02820 - Metal Guardrail

Description

02820.00 Scope - This Section includes the requirements for forming galvanized steel sheets into metal beam rail, and the manufacture of guardrail hardware.

Materials

02820.10 Metal Beam Rail - Form metal beam rail from galvanized steel. Galvanized steel beam rail shall conform to the requirements of AASHTO M 180, Class A. The zinc coating shall conform to the requirements of AASHTO M 180, Type II, applied after fabrication and subject to the single spot test. Backup plates will be accepted with ungalvanized edges and bolt holes, provided these areas are field-coated with an approved galvanizing substitute.

02820.20 Metal Guardrail and Median Barrier Posts - Metal posts shall be of structural steel conforming to the requirements of ASTM A36 and galvanized according to AASHTO M 111 (ASTM A123).

02820.30 Guardrail Hardware - All bolts, nuts, washers and other fittings for beam type guardrail shall be galvanized steel meeting the requirements of AASHTO M 180.

All bolts, nuts, and washers shall be as detailed, with nuts tapped oversize not to exceed 1/32 inch.

02820.40 Guardrail Anchor Hardware - Provide cable and fittings for guardrail anchors that conform to the requirements of AASHTO M 30, Class A, for Type II cable. Galvanize all fittings according to AASHTO M 111 (ASTM A123).

For steel anchors, the steel tubing shall meet the requirements of ASTM A500, Grade B, ASTM A501 or ASTM A618. The Soil plate shall meet the requirements of ASTM A36. After fabrication galvanize tubing and plate according to AASHTO M 111 (ASTM A123).

02820.50 Acceptance of Materials - Acceptance of metal guardrail Materials will be according to Section 00165.35.

Illumination and Traffic Control Materials

Section 02910 - Sign Materials

Description

02910.00 Scope - This Section includes the requirements for backing, sheeting, legend, reflectors, and hardware for sign installations. This Section also includes the requirements for anti-graffiti coating.

Materials

02910.10 Aluminum - The aluminum Materials shall be new and conform to the following requirements:

Aluminum Bars or Rods ..... ASTM B211
Aluminum Sand Castings ..... ASTM B26
Aluminum Sheet ..... ASTM B209
Extruded Aluminum Shapes ..... ASTM B221
Rolled or Extruded Structural Shapes ..... ASTM B308

Aluminum to be color coated shall be of an alloy which is compatible with the coating and the application process. The color-coated aluminum shall have a temper that, after coating and aging, provides an ultimate strength of 30,000 psi and a yield strength of 25,000 psi.

Fabricate sheet aluminum signs from aluminum alloy 6061-T6, 5052-H38, 5154-H38, or approved equal. Give a chromate treatment conforming to ASTM B449, Class 2 or a titanium-based coating according to ASTM B921. Provide certified test reports for all heats of aluminum products furnished to the Agency. Signs shall be of the thickness shown on Table 02910-1 unless otherwise indicated.

Table 02910-1

Sign Width (Horizontal Measure)	Sheet Aluminum Thickness
Less than 20"	0.063"
20" through 30"	0.080"
31" through 48"	0.100"
Over 48"	0.125"

02910.11 Plywood:

(a) General - Construct all plywood signs for permanent signing from 3/4 inch high-density overlay plywood. Construct plywood signs for temporary signs from either 3/4 inch high-density overlay plywood or 3/4 inch medium-density overlay plywood. Plywood shall be Douglas fir plywood, Grade B-B exterior or better, conforming to *Product Standard PS-1 for Douglas Fir Plywood* published by the U. S. Department of Commerce.

(b) Overlay - High-density and medium-density overlay shall be black or buff unless otherwise shown or specified. High-density and medium-density overlay shall conform to *Product Standard PS-1 for Douglas Fir Plywood*.

(c) Plywood Sealer - Fill all voids in top or sides of panel with caulking compound after cutting plywood to size. Apply an approved plywood edge sealer tinted to match the color of the panel overlay material. The sealer shall be a medium oil alkyd primer.

02910.20 Retroreflective Sheeting:

(a) General - Use retroreflective sheeting from the QPL and the following:

(1) Perforation - If required for application, the sheeting may be pre-perforated with holes not greater than 0.02 inch in diameter. The perforations shall be approximately 0.4 inch apart in rows approximately 1.5 inches apart.

(2) Surface - The sheeting and adhesive shall be compatible with non-reflective permanent cut-out legend.

(b) Acceptance - Furnish a quality compliance certification according to 00165.35, certifying that the reflective sheeting furnished meets the above requirements.

02910.21 Nonreflective Sheeting for Sign Background:

(a) General - The nonreflective sheeting shall be durable, weather resistant, gloss plastic film, and shall have a protected, precoated adhesive backing.

(b) Color - Color of the nonreflective sheeting shall conform to 00940.10. Submit for testing a 4 inch by 4 inch sample of the background color for each color of nonreflective sheeting shown.

(c) Adhesive - Adhere the nonreflective sheeting by a mildew and vandal resistant precoated adhesive that has no staining effect on the sheeting.

(d) Film:

(1) General - The nonreflective sheeting shall be flexible and easily cut to shape. The minimum tensile strength of the sheeting shall be 5 pounds per inch width.

(2) Surface - The sheeting surface shall be smooth and flat, to facilitate cleaning and wet performance. The sheeting surface shall be readily processed and compatible with recommended transparent and opaque process inks.

The sheeting shall permit cutting and color processing at minimum temperatures of 60 °F. The sheeting shall be heat resistant and shall permit force curing of applied sheeting at temperatures up to 150 °F. The sheeting surface shall be solvent resistant. Clean according to the manufacturer's recommendations.

(e) Durability - Process and apply according to the manufacturer's recommendations. The material shall be weather resistant, and following cleaning shall show no discoloration, cracking, crazing, blistering or dimensional change.

The sheeting surface shall be capable of being readily refurbished when cleaned and clear over-coated according to the manufacturer's recommendations.

(f) Acceptance - Furnish a quality compliance certificate according to 00165.35, certifying that the nonreflective sheeting furnished meets all the above requirements.

02910.32 Retroreflective Removable Legend:

(a) General - The letters and numerals for all removable legend shall conform to the design of the FHWA *Standard Rounded Capital Letter Alphabets*. The letters and numerals for removable legend for all freeway and expressway signs shall conform to the design of Series "E" modified from the FHWA *Standard Rounded Capital Letter Alphabets*.

Provide mounting holes within the frames to permit the use of the mounting hardware specified in the Specifications. Provide a sufficient number of mounting holes to ensure a firm attachment of the frames to the sign and meet the requirements of 00940.45(b). This requires a minimum of four mounting holes at each joint in the border.

(b) Retroreflective Sheeting Legend - Removable legend shall be fabricated with sheeting conforming to 02910.20 that is permanently adhered to a flat aluminum frame.

Letters, numerals, symbols and borders shall be a minimum of 0.032 inch thick aluminum conforming to ASTM B209, alloy 3003-H14. Degrease and etch the aluminum, or treat with a light, tight amorphous chromate type coating.

Apply the reflective sheeting to the prepared aluminum according to the sheeting manufacturer's recommendations.

The finished letters, numerals, symbols and borders shall be clean-cut and sharp, and shall have a nearly plane surface.

(c) Acceptance - Acceptance of retroreflective removable legend shall be a mill test certificate from the aluminum manufacturer attesting to the correct alloy, temper, and material thickness of the metal supplied. The Engineer may reject damaged or non-specification materials regardless of the test certification furnished.

02910.33 Permanent Legends:

(a) General - Permanent legends consist of silver-white retroreflective screened, red retroreflective screened, black screened or cut-out silver-white retroreflective sheeting. The letters and numerals of all permanent legends shall conform to the design of the FHWA *Standard Rounded Capital Letter Alphabets*.

(b) Retroreflective White Screened Legend - The transparent paste materials used for the reverse screening of retroreflective white legends and for the screening of retroreflective red legends shall conform to the recommendations of the manufacturer of the reflective sheeting.

(c) Retroreflective Cut-out Legend - The Material used for retroreflective cut-out legend shall conform to the requirements of 02910.20.

(d) Nonreflective Black Screened Legend - Furnish Material for nonreflective black screened legends that is compatible with the sign sheeting, as recommended by the sign sheeting manufacturer.

(e) Nonreflective Black Cut-out Legend - The Material used for nonreflective cut-out legend shall conform to 02910.21.

02910.40 Hardware - The bolts, nuts, and washers used to fabricate and erect signs shall be aluminum alloy, stainless steel, or hot-dip galvanized steel. Aluminum for bolts and nuts shall conform to ASTM B211, alloys 2024-T4 or 6061-T6 as the Contractor elects. Aluminum washers shall conform to ASTM B209, alloy Alclad 2024-T4. Stainless steel for bolts, nuts, and washers shall be Type 304 or Type 316. Galvanized steel bolts, nuts, and washers shall be medium carbon steel. Galvanize steel hardware according to AASHTO M 232 (ASTM A153).

Use nylon washers supplied by the sheeting manufacturer as shown or directed.

All mounting hardware shall be of the design and type shown, or if not shown shall be of such sizes and kinds as approved by the Engineer.

Blind rivets shall be 1/8 inch diameter, 1/4 inch head diameter, domed head, aluminum alloy conforming to ASTM B316. Aluminum alloys 5052 and 5056 are acceptable alloys. Blind rivets used to attach sign panels to closure strips or wind beams shall be anodized the same color as the sign background.

02910.60 Electronically Cuttable Films for Use on Retroreflective Sheeting:

(a) General - Electronically cuttable films shall consist of durable, transparent, colored films coated with a transparent pressure sensitive adhesive protected by a removable liner. The films shall be designed to be cut on knife-over-roll (sprocket fed or friction fed) and flat bed electronic cutting machines. The films shall be available in standard traffic colors, be dimensionally stable, and be designed to optimally cut, weed, lift and transfer. Use electronically cuttable films from the QPL.

(b) Acceptance - If requested, furnish with each lot or shipment a quality compliance certificate according to 00165.35, certifying that the Material supplied is an acceptable product on the QPL.

02910.70 Anti-Graffiti Coating for Signs:

(a) General - Use anti-graffiti coating from the QPL. Apply anti-graffiti coating over both the background and legend sheeting, per the manufacturer's recommendation.

(b) Acceptance - Furnish a quality compliance certificate according to 00165.35, certifying that the anti-graffiti coating used is an acceptable product on the QPL.

02910.75 Manufacturer Warranty - Furnish a manufacturer warranty that unconditionally warrants to the Agency the retroreflective sheeting products, sheeting with applied electronic cuttable film products, and installation under this Section against failure, according to this Subsection and 00170.85(c)(1). Use Agency-supplied warranty forms, available from the Engineer.

"Unconditionally warrant" means that the warranty covers all failures, regardless of the source or cause of the failure, including, without limitation, whether the source or cause is or may be related to workmanship, inspection, or choice of materials.

The Agency inspection of any portion of the Work during the Contract and during the product installation, the Agency acceptance of the Work, corrections under the warranty, or expiration of the warranty shall not relieve the obligations under this warranty.

(a) Warranty Period:

- For retroreflective ASTM Type III and Type IV sheeting used for permanent signs, the warranty period shall be for 10 years.
- For retroreflective ASTM Type IX and Type XI sheeting used for permanent signs, the warranty period shall be for 12 years.
- For retroreflective sheeting used for temporary signs, the warranty period shall be for 3 years.

(b) Failure - For purposes of the warranty, failure is defined as the deterioration of retroreflective sheeting, or sheeting with applied electronic cuttable film due to conditions inherent to the sheeting (including inks, overlay film, and electronic cuttable film) to the extent that:

- The sign shows discoloration, cracking, delamination, loss of adhesion, or
- The coefficient of retroreflection, as measured after signs are cleaned according to the manufacturer's recommendations, is less than the following:
  - 80 percent of minimum coefficient of retroreflection for designated sheeting or cuttable film according to ASTM D4956 for the first 7 years of the warranty period.
  - 70 percent of minimum coefficient of retroreflection for designated sheeting or cuttable film according to ASTM D4956 for the remaining 3 years of the warranty period for Type III and Type IV sheeting and remaining 5 years of the warranty period for Type IX and Type XI sheeting.

(c) Remedy - Upon notification by the Engineer of a failure, provide the following remedy at no additional cost to the Agency:

- Repair or replace the sheeting, or sheeting with applied electronic cuttable film, within 6 months of the written notification according to the following:
  - During the first 7 years, restore the sign panel to a condition that meets the Specifications.
  - For the remaining 3 years (5 years for ASTM Type IX and Type XI sheeting), furnish replacement sheeting required to restore the sign panel to a condition that meets the Specifications.
- Use Materials and procedures meeting the Specifications.
- Coordinate timing of repair Work with the Engineer.

(d) Agency's Right to Make Repairs - If, in the opinion of the Engineer, a failure causes or may cause a hazard, the failure may be temporarily corrected by Agency or other forces at no additional cost to the Agency. Replace temporary repairs with permanent repairs at no additional cost to the Agency and according to the Specifications and within the time specified in 02910.75(c).

Section 02926 - Highway Illumination Materials

Description

02926.00 Scope - In addition to all applicable portions of AASHTO *Roadway Lighting Design Guide* (2018) and *Recommended Practice for Lighting Roadway and Parking Facilities* (ANSI/IES, RP - 8, 2018), this Section includes the requirements for highway illumination installations.

Materials

02926.01 Materials - Hardware shall be furnished and installed with hot-dip galvanized or Type 304 or 316 stainless steel screws, bolts, nuts and washers. Bolts and screws shall have square or hex heads. Allen head fasteners will not be allowed.

Cabinets and Control Devices

02926.40 Cabinets - Construct all cabinets from 12 gauge Type 304 stainless steel, or 10 gauge sheet steel and hot-dip galvanize after fabrication according to 02530.70. Post mount cabinets shall be weatherproof, rated as NEMA type 3R, and constructed as shown.

With 3 phase electrical system and/or main circuit breaker of 200 amp or higher, pad-mount cabinet shall be installed as shown. It shall be NEMA type 3R, with hinged double door, 3 point lockable vault handles and stainless steel hardware. Cabinet size is 48 inches x 63 inches x 18 inches deep, or as shown.

The internal wiring of cabinets shall be done by a UL listed facility. Cabinets shall conform to one or more of the following standards where appropriate:

- UL 50, Cabinets and Boxes
- UL 67, Panelboards
- UL 869A, Service Equipment

Use a welded conduit hub to make conduit entrances into cabinets. Hubs shall be of the size required and shall be securely welded to the cabinet before galvanizing. Malleable iron screw-on hubs may be used as approved.

Power service cabinets with live parts exposed shall have a dead-front panel installed with cutouts for operating handles. Each dead-front panel shall have a minimum of two holding latches to maintain rigidity of the panel.

Construct the dead-front panels of stainless steel or code-gauge galvanized steel and treat all cut galvanized steel edges with zinc-rich paint. Prime galvanized steel dead-front panels with vinyl wash primer and finish with exterior polyurethane enamel. The finish color of galvanized steel shall be aluminum.

In all outdoor locations, mounting pans are required when circuit breakers, contactors, relays, switches, transformers or other types of electrical Equipment are to be mounted inside the cabinet.

Label circuit breakers and Equipment with an engraved permanent label on the dead-front panel to indicate the circuit controlled.

Provide each cabinet with a latching device for a standard Agency padlock.

Meter base shall be made from 16 gauge galvanized sheet steel (G90), and powder coated inside and out after fabrication, or from 16 gauge Type 304 stainless steel sheet.

02926.41 Circuit Control Devices:

(a) General - Install circuit breakers, the copper neutral block, and contactors as shown.

(b) Circuit Breakers - Circuit breakers shall have voltage rating and number of poles shown or specified. Circuit breaker's interrupting rating shall meet or exceed short circuit rating of the specified electrical system.

Circuit breakers shall be UL 489 conformed, thermal magnetic molded case circuit breakers and bolt-on type with individually insulated and protected terminals, suitable for surface mounting in the cabinet on a false back or bracket.

All 100 A frame breakers shall be Class 13a for single pole breakers, Class 18a for multiple pole breakers, and 225 A frame breakers shall be Class 20a in Federal Specification W-C-375B, table "Classification of ratings".

Install overcurrent protection and relay Equipment, as shown or specified, with materials and installation conforming to the NEC.

(c) Multiple Light Contactors - Contactors shall be lighting type specifically rated for high-intensity discharge type lamp loads, electrically held. The contactors shall have a 600 V rating. All multiple light contactors shall be unenclosed single-phase, two- or three-pole, open type lighting contactors of the rating shown or specified. Construct contactors for surface mounting on a false back or bracket within a weatherproof cabinet. The contactor coil shall operate on 120 V for 240 V circuits and 240 V, 208 V, and 277 V for 480 V circuits.

(d) Test Switch - Furnish and install a 277 V AC rated test switch in the control cabinets if shown. The test switch shall be a heavy-duty single-pole switch or circuit breaker rated at 15 A and shall be installed in the control cabinet as a roadway lighting test switch. The switch shall be wired to shunt the photoelectric relay power contactor and energize the lighting circuit contactors.

(e) Photoelectric Relay - The photoelectric relay shall attach to a three-pole locking receptacle by a twisting motion.

The unit shall have a built-in surge protective device for protection from induced high voltage and follow-through currents. The relay shall meet or exceed the requirements of ANSI C136.10. Factory set turn-on lights shall be 1.4 footcandle $\pm$ 0.2 footcandle at 120 V AC. When operated at 240 V AC, turn-on shall not change more than plus or minus 0.3 footcandle from the 120 V value. Maximum off-to-on ratio shall be 1.5:1.

The photoelectric relay shall be a cadmium-sulfide photocell encapsulated for humidity protection, or a silicon junction type photo-transistor.

Normal operation shall be designed for dual voltage operation of 105 V - 285 V, 60 Hz.

Power consumption shall be less than 1 W. At the designated voltage, the photoelectric relay shall be capable of controlling a minimum HID or LED luminaire load of 1000 W. Minimum operating temperature range shall be from -40 °F to 150 °F.

A time-delay control circuit shall prevent false turn-offs by transient light conditions. Provide a fail-safe circuit for the lighting load to remain on or become energized if any functional failure of the photoelectric control circuit occurs.

Lamps, Ballasts, and Luminaires

02926.50 Illumination Lamps - All high-pressure sodium lamps shall conform to ANSI Standards. All lamps of the same size and type, on a single project, shall be from the same manufacturer's lot number.

All lamp bases shall have a brass mogul base mounting with dating system.

Lamps shall have an average minimum initial lumen rating (after 100 burning hours) and an average minimum lamp life (based on 10 hours per start) as follows:

Lamp Watts	ANSI Code	Minimum Initial Lamp Lumens Vertical	Minimum Initial Lamp Lumens Horizontal	Minimum Average Lamp Life
		High-Pressure Sodium - Clear		
70	S62ME-70	6,300	6,300	24,000
100	S54SB-100	9,500	9,500	24,000
250	S50VA-250/S	29,000	29,000	24,000
400	S51WA-400	50,000	50,000	24,000
1,000	S52XB-1000	140,000	140,000	24,000

02926.52 Ballasts - High-pressure sodium ballasts shall be magnetic regulator (lag type regulator) with primary and secondary windings electrically isolated from each other.

Unless otherwise shown or specified, the ballast shall be an integral part of the luminaire unit. It shall be of the prewired, built-in type mounted in the luminaire.

Provide a manufacturer's nameplate on the ballast housing. The nameplate shall have the manufacturer's name, model number, serial number, hook-up diagram, power supply data, lamp type and operating wattage.

The ballast shall operate the lamp within the limits specified below throughout the rated life of the lamp:

- The lamp wattage shall not vary more than the allowable range shown in the table below over the line voltage variation shown.
- The lamp wattage shall not vary more than plus or minus 5 percent of nominal when the lamp is at its rated nominal voltage (high-pressure sodium lamps only).
- The minimum efficiency of the ballast (nominal lamp watts/line watts) shall not be less than shown below.
- The ballast shall not allow the lamp arc to extinguish when a line voltage dip as shown below occurs for several seconds.
- The power factor shall not drop below 90 percent for the line voltage variation shown below.
- The line starting current shall not exceed normal line operating current.
- The ballast shall start and operate the lamp in ambient temperatures down to -20 °F.
- The lamp current crest factor shall not exceed 1.8 for line voltage variation shown below.
- The ballast shall conform to all ANSI Standards.
- The ballast shall have capacity to operate dual-arc tube lamps as well as standard lamps without modification of the luminaire.

Submit for review ballast electrical data and lamp operating volt-watt traces for nominal and ± 10 percent rated line voltage for each type of high-pressure sodium lamp ballast.

Lamp Type	Lamp Wattage Range	Line Voltage Variation	Allowable Lamp Watt Variation	Minimum Efficiency	Allowable Line Voltage Dip
HPS	70 - 100	± 10%	± 10%	70%	40 - 50%
HPS	150 - 400	± 10%	± 10%	78%	40 - 50%
HPS	1,000	± 10%	± 10%	92%	40 - 50%

Unless otherwise shown or specified, operate ballasts on 240 V or 480 V. When 120 V operation is specified, the ballast shall be a multi-voltage type with taps to allow the ballast to be connected to 120 V, 208 V, 240 V, or 277 V.

02926.53 High-Intensity Discharge Luminaires:

(a) General - Furnish conventional roadway luminaires for horizontal slip fitter end mounting.

Luminaires shall have a cast-aluminum housing and shall attach to 2 inch pipe tenons on mast arms. The luminaire attachment fitting shall provide for a minimum of plus or minus 3 degree adjustment of the luminaire in the vertical direction. The reflector of all luminaires shall be of a snap-on or easily removed design manufactured of polished aluminum or molded from prismatically formed borosilicate glass. The refractor shall be mounted in a door frame assembly hinged to the luminaire and secured in the closed position by means of an automatic latch or a draw latch. The refractor and doorframe assembly, when closed, shall exert pressure against a gasket. Gaskets shall be composed of material capable of withstanding the temperatures encountered and shall be securely held in place. Glassware shall be of the refractor type with prisms.

Reflectors and refractors provided with the luminaire shall be stamped or labeled with a part number. The luminaire photometric submittal (isocandela diagrams) shall indicate the reflector and refractor part number used.

All luminaires shall have their components secured to the luminaire frame with corrosion-resistant mounting hardware. The housing, complete with integral ballast, shall be weather tight.

If sand-cast, the aluminum housing shall be left in its natural finish. If die-cast, the housing shall be given a coat of aluminum paint.

Refractors shall be formed from heat-resistant, high-impact, molded borosilicate glass.

Lamp sockets shall be adjustable to obtain the light distribution shown or specified.

Socket opening shall be sealed with a heat-resistant filter or filtering gasket to prevent the entry of dirt, insects or moisture into the optical system.

The socket mounting mechanism shall be sufficiently rigid that upon application of a 2 pound load in any direction on the light source center, the light source center shall not deflect more than 1/16 inch.

(b) Classification of Luminaire Light Distribution - Furnish the following distribution types as shown or specified. The classifications listed shall conform to ANSI definitions.

(1) Vertical Light Distributions - Divide vertical light distributions into three groups: short (S), medium (M), and long (L). Classification of the three groups depends on the maximum candle power point within a grid area according to the ANSI/IES RP-8 (2018) publication.

(2) Lateral Light Distributions - Lateral light distribution patterns shall have the following designations:

Type I
Type II
Type III
Type IV
Type V

The type designations listed above shall conform to ANSI definitions.

(3) Distribution Above Maximum Candle Power - This classification shall be used to control the candle power in the upper portion of the beam above the maximum candle power. The following three classifications shall be used:

Cutoff
Semi cutoff
Noncutoff

The classifications listed above shall conform to ANSI definitions.

02926.54 LED Luminaires:

(a) General Performance Requirements:

(1) General - Furnish each LED luminaire as a complete lighting unit manufactured according to ANSI C136.37-2011 and utilizing high-power LEDs as the light source.

All internal components shall be assembled and pre-wired using modular electrical connections. Wiring, grounding, and terminal block installation shall be according to ANSI C136.37. Luminaires shall accept a designated voltage range of 50 to 60 Hz, and operate normally with an input voltage that is within 10 percent of the specified voltage.

(2) Finished Surface - Furnish LED luminaires with a gray or silver housing. The surface of the luminaire housing shall be UL listed for wet locations (UL 1598). After 1000 hours of salt chamber exposure, according to ASTM B117, luminaire surface shall exceed a rating of 6 for rust creepage for scribed specimens according to ASTM D1654.

(3) Thermal Management - The luminaire shall start and operate in the ambient temperature range specified. Mechanical design of heat sink fins shall facilitate hose-down cleaning and discourage debris accumulation.

Liquids or moving parts (such as fans) shall be clearly indicated in submittals, consistent with product testing, and subject to approval by the Engineer.

(4) LED Driver Requirements - The LED driver shall meet the following minimum requirements:

- Rated to operate in -40 °C to 40 °C ambient temperature
- Total Harmonic Distortion (THD) to be less than 20 percent

- Have minimum power factor of 90 percent
- Comply with requirements of UL, CSA, and FCC regulations in 47 CRF Part 15
- Rated for outdoor operation and have an ANSI/IEC rating of IP66

Furnish a dimmable driver for each high-mast, highway/street lighting luminaire, including ornamental lighting and intersection lighting on signal systems, with two leads to accept standard 0-10 V (DC), except on the luminaires of 100 watts or less. The dimming control shall be compatible with IEC 60929. If the control leads are open or the analog control signal is lost, the circuit shall default to 100 percent power. Conductors and terminals shall be identified.

(5) Electrical Parts and Safety Testing - For each luminaire, except ornamental, underdeck, and wall-mount luminaires, provide an ANSI C136.41compliant, 7-pin receptacle that is fully prewire for the LED driver's control. For 0-10 V dimmable LED drivers, connect control wires to the receptacle pads as specified in ANSI C136.41.

When the photo control is required, furnish and install a specified photo control unit with the specified driver on each LED luminaire. If the photo control is not required, install a shorting cap on each luminaire, as directed by the Engineer.

Luminaires shall conform to ANSI C136.2 for electrical immunity, using the combination wave test level of 6 kV/3 kA. Luminaires shall comply with interference criteria for Class A digital devices according to FCC regulations in 47 CFR Part 15.

(6) Identification and Labeling - Luminaires shall have internal and external labels according to ANSI C136.15 and ANSI C136.22.

(7) Surge Protection - Provide a surge protection device (SPD) to protect LED drivers and LED lighting arrays from electrical transients. The SPD shall be recognized according to UL1449 and rated for 10 kV/5 kA combination wave surges according to ANSI/IEEE C62.41.2. The SPD shall comply with FCC regulations in 47 CFR Part 15, Subpart B for the emission of electronic noise.

(8) Maximum Power Consumption - For the control of trespassing light and glare, the following maximum power consumption values are allowed on ODOT Standard Pole mounting for State Highways:

Mounting Height (ft.)	Maximum Wattage in LED Luminaire
25.0 to < 30.0	100
30.0 to < 35.0, or when replacing 150 watt HPS	120
35.0 to < 40.0, or when replacing 200/250 watt HPS	200
40.0 to 55.0, or when replacing 310/400 watt HPS	300
Each LED luminaire in high mast tower	500

(b) LED Luminaire Types - For each type of LED luminaire shown, furnish luminaires according to the general performance requirements in 02926.54(a) and the following:

(1) LED Luminaires on Traffic Signal Supports - When furnishing an LED luminaire model that is not specified as approved, the luminaire shall meet the following general requirements:

Minimum luminaire efficacy: ..... 115 lumens/watt (LPW)
Nominal input power: ..... 110 - 136 watts
Nominal input voltage: ..... 240 volts
Minimum lumen output: ..... 14,000 lumens
Minimum lumen maintenance at 50,000 hrs.: .... 86% of initial lumens
Nominal CCT (Correlated color temp.):..... 4000 ± 250 °K
Color Rendering Index (CRI) ..... ≥ 70
BUG rating: B3-U0-G3
Nominal type of output pattern: ..... Type 3 Medium
Maximum luminaire weight: ..... 30 lb.
EPA: ..... 0.5 – 0.9 sq. ft.
Mounting method: ..... 2 inch tenon as shown
Vibration: ..... 3G vibration test
Thermal: ..... -40 – 40 °C operation
Photo control receptacle: ..... ANSI C136.41, 7-pin
LED driver: ..... 0-10 V dimmable

(2) LED Luminaires on Freeway Interchange Lighting Systems - When furnishing an LED luminaire model that is not specified as approved, the luminaire shall meet the following general requirements:

Minimum luminaire efficacy: ..... 117 lumens/watt (LPW)
Nominal input power: ..... 180 - 214 watts
Nominal input voltage: ..... 240 volts
Minimum lumen output: ..... 24,000 lumens
Minimum lumen maintenance at 50000 hrs.: ..... 86% of initial lumens
Nominal CCT (Correlated color temp.):..... 4000 ± 250 °K
Color Rendering Index (CRI): ..... ≥ 70
BUG rating:..... B3-U0-G3
Nominal type of output pattern:..... Type 3 Medium
Maximum luminaire weight: ..... 30 lb.
Maximum EPA:..... 1.0 sq. ft.
Mounting method:..... 2 inch tenon, as shown
Vibration:..... 3G vibration test certified (ANSI C136.31)
Thermal:..... -40 – 40 °C operation
Photo control receptacle:..... ANSI C136.41, 7-pin
LED driver:..... 0-10 V dimmable

(c) Submittals - Before beginning LED luminaire installation, submit the following according to 00150.37 for review by the Engineer:

- Four copies of LED luminaire manufacturer's data sheets, including light source, drivers, surge protection device, and installation instructions.
- For the dimmable LED driver specified, diagrams illustrating light output and input power as a function of control signal.
- IES LM-79 luminaire photometric reports produced by the test laboratory, that satisfy LED Lighting Facts accreditation requirements. Reports shall include the name of the laboratory, report number, date, luminaire catalog number, luminaire description, and Backlight-Uplight-Glare (BUG) ratings.

  Lumen maintenance calculations and supporting data shall be in accordance with LED Lighting Facts guidance. Computer generated photometric analysis and calculation of maintained light levels shall be in accordance with IES RP-8, Roadway Lighting. Use a Light Loss Factor (LLF) of 0.8 or less, according to the individual luminaire test report data. Do not use the Mesopic multipliers of effective luminance factors for calculation.
- IES format electronic file containing luminous intensity data associated with submitted LM-79 reports and used for point-by-point calculations.

Within 21 Calendar Days after receipt of submittals, the Engineer will review the submittals and designate them in writing as “approved”, “approved as noted”, or “returned for correction”. Do not begin LED luminaire installation before receiving written approval of submittals from the Engineer.

PART 03000 - MATERIALS

Section 03010 - Fencing Materials

Description

03010.00 Scope - This Section includes the requirements for barbed wire, woven wire fabric, chain link fabric, wildlife wire fabric, metal posts, braces, hardware, and gates.

Materials

03010.10 Barbed Wire - The barbed wire shall be two-strand and either 12 1/2 gauge or 15 1/2 gauge with four-point barbs spaced at 5 inch intervals conforming to the requirements of AASHTO M 280 (ASTM A121). Galvanizing shall be Class 3.

All barbed wire installed on the Project shall be new or like new, and the same diameter unless otherwise approved.

03010.20 Woven Wire Fabric - The woven wire fabric shall be 12 1/2 gauge galvanized steel wire conforming to the requirements of AASHTO M 279 (ASTM A116), Class 3 coating or 11 gauge or 12 1/2 gauge aluminum coated steel wire conforming to the applicable requirements of ASTM A116. The 12 1/2 gauge aluminum coated steel wire shall have the same coating thickness required for 11 gauge steel wire in Table 2 of ASTM A116.

03010.21 Wildlife Wire Fabric - The wildlife wire fabric shall be 12 1/2 gauge galvanized steel wire conforming to the requirements of ASTM A116, Design Number 2096-6-12 1/2.

03010.30 Chain Link Fabric, Ties, and Tension Wire - Chain link fabric, ties, and tension wire shall conform to the requirements of AASHTO M 181 supplemented and modified as follows:

- Fabric may be zinc-coated steel meeting Type I, Class D coating requirement, aluminum-coated steel, or aluminum alloy. Use only one type on the Project.
- Wire fabric ties, wire ties, and hog rings may be zinc-coated steel wire, aluminum-coated steel, or aluminum alloy as elected, regardless of the type of wire fabric used.
- Use ductile, zinc-coated steel meeting the coating requirements of ASTM A641, Class 1 for wire fabric ties, wire ties, and hog rings. Aluminum-coated steel wire fabric ties, wire ties and hog rings shall be coated with at least 0.30 ounce per square foot.
- Tension wire shall have a Class 2 coating.
- Fabric for the fence to be installed with pickets shall be 9 gauge wire woven in 3 1/2 inch by 5 1/2 inch diamond mesh. Top and bottom selvage shall be knuckled finish.

03010.31 Pickets - Pickets shall be either standard Grade A redwood or cedar pickets, 3/8 inch x 2 1/2 inch x 6 feet, or industry standard metal, or plastic pickets as shown or approved.

03010.40 Vinyl Clad Fabric - Vinyl clad chain link fabric shall conform to AASHTO M 181, Type IV. The color of the PVC coating shall be either medium or dark green.

03010.50 Metal Fence Posts, Braces, and Appurtenances - Metal fence posts, braces and appurtenances shall conform to the requirements indicated on the Plans and the following:

(a) Painted Metal Posts - All painted metal posts shall be of the same kind and color.

(b) Posts, Braces, and Appurtenances for Chain Link Fence - Posts, braces, and appurtenances for chain link fence shall conform to the requirements of AASHTO M 181.

Posts, braces, and appurtenances for bridge protective fence shall conform to the requirements of AASHTO M 181, Grade 1, ASTM F1083 and ASTM F1043, Group IA-2.

(c) Posts, Braces, and Appurtenances for Barbed Wire and Woven Wire Fence:

(1) Tubular Steel Posts - Tubular steel posts, braces and appurtenances shall conform to the requirements of AASHTO M 181. Tubular posts shall be fitted with a snug-fitting, galvanized metal cap.

(2) Other Shapes - Metal posts and braces, other than tubular shape, for barbed wire and woven wire fences, shall conform to AASHTO M 281 (ASTM A702), except that galvanizing may conform to the requirements of AASHTO M 111 (ASTM A123). The posts and braces may be either galvanized or painted, as elected. Wire fasteners shall meet the coating requirements of ASTM A641, Class 1.

(3) Fence Stays, Brace Guys, and Wire Loops - Metal fence stays, brace guy wires, wire loops for gateways and other miscellaneous wire used in barbed and woven wire fences shall be furnished with Class 1 coating as required by ASTM A641. Either 9 1/2 gauge or 10 gauge wire is acceptable for fence stays.

(d) Concrete In Footings - Concrete for footings shall conform to Section 00440.

(e) Grounding Rod - 5/8 inch by 8 feet, nonrusting, copper covered steel rod with a bronze grounding wire clamp.

(f) Grounding Wire - AWG 4/0 Solid Copper or No. 6 bare aluminum wire with clamps.

(g) Posts, Braces, and Appurtenances for Wildlife Fence - Posts, braces, and appurtenances for wildlife fence shall conform to the requirements of AASHTO M 181.

03010.60 Fence Gates:

(a) General - Tubular steel gate frames shall conform to AASHTO M 181. Fabric in gates used with chain link fence shall be chain link of the same gauge and conforming to applicable requirements of 03010.30. Fabric in gates used with woven wire fence shall be woven wire fabric conforming to 03010.20 or chain link fabric conforming to the applicable requirements of 03010.30, except that the zinc coating may be either Class C or Class D. Fabric in gates used with wildlife fence shall be wildlife fence fabric conforming to 03010.21.

(b) Hardware - All fence and gate hardware shall conform to the requirements of AASHTO M 181, except that the thickness of galvanizing shall be according to AASHTO M 232 (ASTM A153).

03010.75 Protective Fence Materials, On and Off Structures - Provide certification according to the requirements of 00165.35 that the anchor system selected conforms to requirements shown on the Plans.

- **Resin Bonded Anchor System** - The resin bonded anchor system used to install the fence post anchor rods in the concrete bridge rail shall be from the QPL and be installed according to the manufacturer's recommendations.
- **Posts** - Modify posts to attach to the Structure as shown.

- **Steel Plates, Angles, and Bolts** - Steel plates, angles, and bolts shall meet the applicable requirements of Section 02530 and galvanized according to 02530.70.
- **Chain Link Fabric, Ties, and Tension Wire** - Chain link fabric, ties, and tension wire shall conform to the requirements of 03010.30.
- **Pickets** - Pickets shall meet the requirements of 03010.31.

03010.80 Acceptance - Acceptance of fencing Materials will be according to 00165.35 and this Section.

Section 03020 - Erosion Materials

Description

03020.00 Scope - This Section includes the requirements for erosion control Materials.

Materials

03020.10 Commercially Manufactured Compost - Furnish commercially manufactured compost that:

- Is processed through thermophilic composting meeting the EPA's definition of "Process to Further Reduce Pathogens".
- Is from a commercial compost facility that holds a current DEQ composting permit or is registered with DEQ as a composting facility.
- Meets the requirements of the US Composting Council (USCC) and its Seal of Testing Assurance (STA) program.
- Contains a minimum 65 percent by volume of the following recycled plant waste:
  - Source-separated yard and garden wastes
  - Wood wastes
  - Agricultural crop residues
  - Wax-coated cardboard
  - Preconsumer vegetative food wastes
  - Other similar source-separated materials that the DEQ has determined to have a comparable low level of risk in hazardous substances, human pathogens, and physical contaminants.
  - Manure or biosolids based composts when approved.
- Meets the following compost particle size and media parameters:

Compost Particle Size

	Compost Type		
Sieve Size	**Fine***	**Medium***	**Coarse****
	Percent Passing (By Dry Weight)		
3"	100	100	100
1"	99-100	95-100	90-100
3/4"	99-100	95-100	70-100
5/8"	95-100	90-100	70-100
1/2"	80-100	70-100	60-100
1/4"	75-100	70-90	30-60

* maximum 3 inch particle length
** maximum 6 inch particle length

Media Parameters

Test	Test Method	Requirements		
Physical Contaminants*	TMECC** 03.08-A	Less than 1.0%		
Organic Matter	TMECC** 05.07-A	35% (Minimum)		
pH	TMECC** 04.11-A	6.0 to 8.5		
Soluble Salt Concentration	TMECC** 04.10-A	5 dS/m (Maximum)		
Total Carbon Total Nitrogen	TMECC** 04.02-D TMECC** 04.02-D	Carbon/Nitrogen Ratio		
		Fine	Medium	Coarse
		<25:1	<30:1	<35:1
Stability	TMECC** 05.08-B	≤8		
Maturity	TMECC** 05.05-A	80% or Greater		
Moisture Content	TMECC** 03.09-A	35-60% (Wet Weight)		

* Man-made Inert
** Test Methods for Evaluation of Compost and Composting

03020.90 Acceptance - Acceptance of commercially manufactured compost Material will be the following:

- Copies of STA lab analysis.
- Copy of DEQ permit or registration of the compost producer.

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