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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 on the plans.

Materials

00810.10 General - Materials shall meet the requirements of the following:

Guardrail anchor hardware	02820.40
Guardrail hardware	02820.30
Metal beam rail	02820.10
Metal posts.....	02820.20
Wood guardrail posts.....	02110.10
Wood guardrail blocks	02110.20

Use guardrail terminals from the QPL conforming to the National Cooperative Highway Research Program (NCHRP) Report 350.

00810.11 Optional Posts - Posts, except as specified for use on bridges or otherwise shown or directed, may be of steel or wood, as the Contractor elects, conforming to the requirements of 00810.10. Once a type has been selected, use it throughout the Project.

The use of steel posts in guardrail transitions requires Bridge Section approval.

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.

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 - Wood posts shall be structurally sound, treated and free from damage that would affect their strength and durability. Do not incorporate into the work any post damaged to the extent that untreated wood is exposed.

(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

00810.15(b)

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 and 00310.82.

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, any materials that become fouled, at the Contractor's expense. 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 150 mm (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 the Contractor's expense. Dispose of excess materials according to 00330.41(a-5).

00810.42 Installation of Posts and Anchors - Place posts and anchors as shown. If directed, install 2.4 m (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 15 mm (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 02420.10(d), except add 45 g (1 1/2 ounces) of leafing aluminum powder to each liter of high zinc dust content paint.

Toe nail blocks to post with two 75 mm long (10d), galvanized, flat head nails to prevent rotation.

Draw tight all bolts, except adjustment 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 Metal Guardrail, Metal Median Barrier and Guardrail Anchors - Anchors will be measured on the unit basis, per each. The quantities of metal guardrail and metal median barrier will be the length of each type complete and in place as specified, measured by one of the following methods:

(a) Count Method - The number of standard sections will be counted and multiplied by 3.81 m (12 1/2 feet). For purposes of this subsection, a "standard section" is defined as 3.81 m (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, to the nearest 0.1 m (0.3 foot), 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, or as otherwise shown, along the line and grade of each run of each type.

Transitions and connections between guardrail and bridges will be measured on a unit basis according to 00810.82 and 00810.83.

00810.81 Guardrail End Pieces - Guardrail end pieces will be measured on the unit basis, per each, by actual count of units in place as specified.

00810.82 Guardrail Transitions - Guardrail transitions between Type 3 guardrail and bridge rail as shown, regardless of required length, will be measured on the unit basis per each by actual count of units in place as specified.

00810.83 Guardrail Connections - New guardrail connections to existing, new or retrofitted bridge rail or existing or new concrete barrier, not included in guardrail transitions, will be measured on the unit basis per each by actual count of units in place as specified.

00810.85 Guardrail Terminals - Slotted rail terminals will be measured on the unit basis per each by actual count of units in place as specified.

Payment

00810.90 General - The quantities accepted for payment will be paid for at the unit price per unit of measurement for the following items in the Contract Bid Schedule:

Pay Item	Unit of Measurement
(a) Guardrail, Type ____	m (Foot)
(b) Metal Median Barrier.....	m (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 2.4 m (8 foot) Posts	Each
(i) Guardrail Posts	Each

In item (a) the type of guardrail will be inserted with a separate pay item provided for each type.

Payment for items (a) and (b) will be payment in full for all costs involved in constructing the respective items except for:

- End pieces
- Anchors
- Transitions
- Extra costs involved in constructing guardrail connections to existing bridges

In item (c) the type of anchor will be inserted with a separate pay item provided for each type. Payment will be payment in full for all costs involved in constructing guardrail anchors.

In item (d) the type of guardrail end piece will be inserted with a separate pay item provided for each type. Payment will be payment in full for all costs involved in furnishing and installing guardrail end pieces.

Payment for item (e) will include payment in full for all costs involved in furnishing and constructing guardrail connections to existing, new or retrofitted bridge rail or existing or new concrete barrier, including any terminal connectors, connection plates, anchor bolts, etc. required to provide the connections and including any work necessary to prepare the bridge rail or concrete barrier for the connection and/or restore the guardrail.

Payment for item (f) will be payment in full for all costs involved in furnishing and constructing guardrail connections to existing, new or retrofitted bridge rail or existing or new concrete barrier, not included in guardrail transitions, including any section of guardrail not included in pay limits for guardrail, any terminal connections, connection plates, anchor bolts, and other materials required to provide the connections, and including any work necessary to prepare the bridge rail or concrete barrier for the connections.

In item (g) the type of terminal will be inserted in the blank. Payment for item (g) will be payment in full for furnishing and installing guardrail terminals, including posts, anchors, slotted rails, slot guards, end pieces, struts, soil tubes, and all necessary appurtenances and hardware to complete the work as specified.

Payment for item (h) is payment in full for any and all extra costs involved in furnishing and installing 2.4 m (8 foot) long posts instead of standard 1.8 m (6 foot) long posts, it being understood that such extra costs are those not covered and included in the unit price bid for some one or another of the other listed pay items.

There will be no separate payment for furnishing and placing steel posts, base plates or base plate concrete anchors as payment will be included in the pay item "Guardrail, Type _____".

Payment for the above items will be payment in full for furnishing and placing the materials, all necessary excavation and backfill work, and including all equipment, labor and incidentals necessary to complete the work, as specified or directed.

Section 00812 - Adjusting Guardrail

Description

00812.00 Scope - This work consists of adjusting existing guardrail by raising it to the proper height to conform to the applicable Standard Drawings.

Materials

00812.10 General - Replace rail members, posts or other materials that are damaged with material meeting the requirements of 00810.10. Replace materials damaged by the Contractor's operations at no additional cost to the Agency.

Construction

00812.40 General - Reinstall adjusted guardrail components during the same day they are removed. Repair minor damage to galvanizing by application of two coats of Formula 22-74 paint or approved equal.

Adjust the existing guardrail by one or both of the following methods:

(a) Posts Remain in Place - Remove the existing rail members and blocks in a manner that will not damage galvanizing; drill new bolt holes in posts (if needed); treat existing and new holes with a preservative from the QPL; reinstall the rail members and blocks; and perform such other incidental work as may be required (see detail in the plans).

(b) Raise Posts - Remove and reinstall posts at the proper height, or raise posts to the proper height and set firmly by working grout or other materials under the post in a manner satisfactory to the Engineer.

Measurement

00812.80 General - The quantities of adjusted guardrail will be the length, to the nearest meter, of existing guardrail adjusted according to these specifications. Measurement will be by one of the following methods:

(a) Count Method - The number of standard sections will be counted and multiplied by 3.81 m (12 1/2 feet). For purposes of this subsection, a "standard section" is defined as 3.81 m (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, to the nearest meter (foot), 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, or as otherwise shown, along the line and grade of each run of each type to the nearest meter.

Payment

00812.90 General - The accepted quantities of adjusted guardrail, measured as provided above, will be paid for at the Contract unit price per meter for the pay item "Adjusting Guardrail".

Payment will be payment in full for all materials, equipment, labor and incidentals necessary to complete the work as specified.

Section 00815 - Bollards

Description

00815.00 Scope - This work consists of furnishing and installing bollards at locations shown or as directed.

Materials

00815.10 General - Provide materials meeting the following requirements:

- Granular drain backfill00430.11
- Commercial grade concrete00440
- Reflective sheeting.....02910.30

00815.11 Posts and Sleeves - Use Schedule 40 posts and sleeves conforming to ASTM A 53/A 53M.

00815.12 Plates, Shapes, Fasteners and Hardware - Use plates and shapes conforming to ASTM A 36/A 36M. Use fasteners and hardware conforming to ASTM A449.

00815.13 Galvanizing - Hot-dip galvanize all metal components after fabrication according to AASHTO M 111M/M 111 (ASTM A 123/A 123M) or AASHTO M 232M/M 232 (ASTM A 153/A 153M), as applicable.

00815.14 PVC Pipe - Use Schedule 40 PVC pipe.

Construction

00815.40 General - Install bollards as shown or as directed.

Measurement

00815.80 General - The quantities of bollards will be measured on a unit basis, per each, by actual count.

Payment

00815.90 General - The accepted quantities of bollards will be paid for at the Contract unit price per unit of measurement for the following item(s):

Pay Item	Unit of Measurement
(a) Bollards.....	Each
(b) Removable Bollards.....	Each

Payment will be payment in full for furnishing and placing materials, performing all excavation work, and for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

Section 00820 - Concrete Barrier

Description

00820.00 Scope - This work consists of constructing precast pin-and-loop and cast-in-place portland cement concrete barrier, to the lines and grades shown or established.

Materials

00820.10 General - Materials shall meet the following requirements:

Deformed bar reinforcement	02510.10
Concrete coating	02210
Portland cement grout	02080.40
Preformed joint filler	02440.10
Concrete	00440, except as provided in this Section

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(d) and (e). Test results shall be no more than one year old.

(2) Coarse Aggregate - Coarse aggregate shall meet the test requirements of 02690.20(c) and (d). Test results shall be no more than one year old.

(b) Hardware - Pins and dowels shall conform to ASTM A 449 and shall be hot-dip galvanized according to AASHTO M 232M/M 232 (ASTM A 153/A 153M).

(c) Loop Bars - Fabricate loop bars from ASTM A 36/A 36M, hot-rolled round bar and hot-dip galvanize according to AASHTO M 232M/M 232 (ASTM A 153/A 153M) and ASTM A 143.

(d) C-shape Connectors - Furnish perforated C-shape connectors fabricated from ASTM A 36/A 36M channel, hot-dip galvanized after fabrication according to AASHTO M232M/M 232 (ASTM A153/A 153M) 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.

(f) Barrier Markers - Provide concrete barrier markers from the QPL that are compatible with the selected reflective sheeting or provide integral plastic, prismatic, reflective units.

(g) Reflective Sheeting - Provide reflective sheeting for barrier markers from the QPL, of a color appropriate for the intended use.

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

00820.12(a)

- 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(c) 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 00165.61(a)
- 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(c) 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 expense to the Agency.

00820.15 Quality Control - Provide quality control according to Section 00165.

Labor

00820.30 Quality Control Personnel - Provide a certified Quality Control Technician (QCT).

Construction

00820.40 General - 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 for separately as Extra Work.

Place the barrier sections so that the joints offset no more than 6 mm (1/4 inch) transversely and no more than 12 mm (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 3.6 m (12 foot) straightedge is laid on the top or face of the barrier, the surface shall not vary more than 6 mm (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 seven 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 one hour.
- Apply first coat of latex paint approved for barrier use and meeting the requirements of Section 02210 at an application rate of 3.7 m²/L (150 square foot per gallon).
- Allow first coat to air dry for one hour.
- Apply second coat of latex paint at 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 seven 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% 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 10 m (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 C 403/C 403M. Continue steam curing until the barrier concrete reaches a minimum compressive strength of 14 MPa (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 10 mm

00820.45

(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 water-based coating material conforming to 02210.30(c). 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 Barrier Markers - Fasten markers to the top of the concrete barrier as recommended by the manufacturer or as directed. Install markers at 15 m (50 feet) nominal spacing or as shown or directed. Orient reflectors to face oncoming traffic.

00820.47 Replacement or Price Reduction - Remove and replace barrier represented by cylinders that fail to meet the minimum strength requirement, at no additional expense 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 expense to the Agency. The Contractor's payment for barrier will be reduced according to 00165.91.

Measurement

00820.80 General - Barrier will be measured by one of the following methods:

(a) Cast-In-Place Barriers - The quantities of cast-in-place barrier accepted will be the length in meters (feet) of barrier in place as specified, measured along the line and grade of each separate run, including terminal sections and transition sections.

(b) Precast Barriers - The quantity of precast barrier accepted will be 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 separately and added to the total length of standard sections.

Payment

00820.90 General - The accepted quantities will be paid for at the unit price per meter (foot) for the following items when in the Schedule of Items:

Pay Item	Unit of Measurement
(a) Concrete Barrier.....	m (Foot)
(b) Concrete Barrier, Reflectorized.....	m (Foot)
(c) Concrete Barrier, Tall.....	m (Foot)
(d) Concrete Barrier, Tall, Reflectorized.....	m (Foot)

Payment will be payment in full for furnishing all material, equipment, labor and incidentals required to construct shoulder barrier and median barrier, as specified.

No separate payment will be made for excavating and backfilling concrete barrier buried ends, as this work will be considered incidental to the appropriate concrete barrier pay item.

Section 00822 - Glare Shields

Description

00822.00 Scope - This work consists of furnishing and installing glare shields on concrete median barrier.

Materials

00822.10 Materials - The Contractor has the option of providing modular glare shields or individual glare shields as specified.

(a) Provide glare shields from the QPL.

(b) Provide steel base plate brackets fabricated from ASTM A 304 stainless steel or merchant quality mild carbon steel. Mild carbon steel brackets shall be hot-dip galvanized after fabrication according to AASHTO M 111M/M 111 (ASTM A 123/A 123M).

(c) Provide bolts, nuts, inserts, washers and other necessary assembly hardware made from ASTM A 304 stainless steel or mild carbon steel. Equip exposed hardware with vandal-resistant lock nuts or similar. Furnish mechanical inserts, if used, suitable for dynamic application. Galvanize carbon steel assembly hardware in accordance with AASHTO M 111M/M 111 (ASTM A 123/A 123M).

All base plate brackets and necessary assembly hardware installed in a continuous run shall be of the same material.

Construction

00822.40 Construction - Install the glare shields according to the following:

- Recess inserts at least 6 mm (1/4 inch) below the concrete barrier surface.
- Install all glare shield blades vertical and true to line.
- Place glare shields according to the manufacturer's recommendation.
- Install so that the angle of light coming through from the other side does not exceed 22°.
- Firmly attach the base plate anchor bolts to the concrete barrier to withstand a 4.4 kN (1,000 pounds) vertical pull and to prevent horizontal and rotational displacement. Do not exceed 760 mm (30 inches) spacing between anchor bolts on modular units.
- 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.

Measurement

00822.80 Measurement - Glare shields will be measured by the meter (foot) along the line and grade of each run.

Payment

00822.90 Payment - The accepted quantities will be paid for at the Contract unit price per meter (foot) for the pay item listed below:

Pay Item	Unit of Measurement
_____ mm (inch) Glare Shields.....m (Foot)

In the item above, the length of the blades in mm (inches) will be inserted with a separate pay item for each size.

Payment will be payment in full for providing all materials in final position, and including all equipment, labor and incidentals necessary to complete the work as specified.

Section 00830 - Impact Attenuators

Description

00830.00 Scope - This work consists of furnishing and installing impact attenuators for permanent installations.

00830.02 Required Submittals - Submit stamped shop drawings according to 00150.35(b), including concrete components, for approval.

Materials

00830.10 General - Provide impact attenuators from the QPL and as specified.

Concrete shall meet the requirements of Section 00440. Reinforcement shall conform to Section 00530.

Epoxy resin used in epoxy grout pads, where required, shall be a color similar to portland cement concrete pavement and shall conform to AASHTO M 200.

Aggregate used in epoxy grout pads shall be surface-dry when added to the epoxy mixture and shall conform to Section 02690.

00830.15 Acceptance - Provide a manufacturer's quality compliance certificate for impact attenuators according to 00165.35.

Construction

00830.40 General - Construct concrete according to 00440.40. Give exposed concrete surfaces a general surface finish according to 00440.41.

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 approved shop drawings.

00830.41 Sand-Filled Inertial Barrier Systems - Thoroughly mix dry sand filler, if required, with salt, 5% by volume. Outline the location of each module with paint for future reference. Paint, or otherwise denote, the mass (weight) of sand of each module within the module outline.

Measurement

00830.80 Unit Basis - Impact attenuator systems accepted for payment will be measured on the unit basis per each by actual count at each location a system is installed.

Payment

00830.90 Unit Basis - Payment for the impact attenuator installation will be made at the Contract unit price per each for the pay item "Impact Attenuator, _____".

The type of impact attenuator will be inserted in the blank, with a separate pay item for each type.

Payment will be payment in full for furnishing and installing all required materials, including the object marker, for each attenuator system as specified.

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 General - Materials shall meet the following requirements:

Flexible delineators	02850.30
Galvanized support posts.....	02850.10
Reflective sheeting for milepost markers	02910.30
Reflective sheeting for delineators	02850.40
Target members.....	02850.20

00840.11 Delineators at Guardrail Locations - Delineators installed at guardrail locations shall be guardrail-mounted (Type 4). Full-length ground-mounted delineators (Types 1 and 2) may be substituted if approved.

00840.12 Use of Salvaged Materials - Delineator components salvaged from existing or temporary delineators may be reused in new permanent delineator installations providing they are of the current design, conform to the Specifications and are free of damage that would impair their appearance or serviceability.

Suitability of salvaged materials proposed for reuse will be determined by the Engineer.

Construction

00840.40 Lines, Grades and Preparation Work - 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% in either direction and may deviate from line by 150 mm (6 inches) in either direction, as approved. Remove vegetative growth, litter and debris from the post sites.

00840.41 Installation of Posts - Post depths may vary from that recommended by the manufacturer. Posts set in sandy, gravelly or other unconsolidated material may need to be longer to provide adequate anchorage. Posts may be shortened to avoid unnecessary penetration in solid rock or in large rock fragments, as approved. If set in rock, drill a 230 mm (9 inch) deep hole, 25 mm (1 inch) greater in diameter than the large dimension of the post, and grout in place with a fine mortar grout. The posts shall be vertical and firm. Remove and discard posts that become split, cracked, twisted, or bent, or whose tops become badly misshapen during installation, and replace with undamaged posts.

Firmly attach guardrail-mounted delineators to guardrail posts as shown on Standard Drawing RD800.

00840.42 Target Members - Assemble, fasten, set and align target members and reflective material appropriate to the type and color of delineators involved as shown or directed. All fastenings shall be tight. Attach the reflective sheeting to the posts by an approved positive means, which has adequate strength to prevent loss of the reflective material during the life of the post or target.

Finishing and Clean Up

00840.70 General - Repair and restore exposed, damaged surfaces of installed delineators and milepost markers as directed. Replace parts of delineators showing damage beyond repair with new parts.

Remove and dispose of excess excavated materials, litter, and debris resulting from the operations according to 00310.43. Replace fouled stone bases with clean material of the same kind. Clean traveled surfaces, and finish areas disturbed by the Contractor's operations to the lines, slopes and conditions shown or specified.

Measurement

00840.80 Unit Basis - The quantities for delineators and milepost marker posts will be determined as follows:

(a) Delineators - The quantities will be the actual number of each type of delineator furnished, installed and accepted, regardless of color or number of reflectors.

(b) Milepost Marker Posts - The quantities will be the actual number of milepost marker posts furnished, installed and accepted.

Required preparation work, earthwork, grouting, backfilling, repair, restoration replacement and cleaning up are considered incidental to delineator or milepost marker post installation, and no separate measurement for this work will be made.

Payment

00840.90 Unit Basis - The accepted quantities will be paid for at the Contract unit price per each for the following pay items:

- (a) Delineators, Type ____
- (b) Milepost Marker Posts

Payment will be payment in full for furnishing and placing all materials, including all equipment, labor and incidentals necessary to complete the work.

In item (a) the type of delineator will be inserted, with a separate pay item provided for each type.

When "Delineators, Type 4" are shown or specified, and the Contractor substitutes ground-mounted delineators according to 00840.11, they will be paid for as "Delineators, Type 4".

Payment for milepost marker signs will be made according to 00940.90.

Section 00850 - Pavement Markings for Legends

Description

00850.00 Scope - This work consists of furnishing, preparing, placing and warranting pavement markings on surfaces to the lines shown or as directed.

00850.02 Definitions:

Type A - Liquid, Hot-Laid Thermoplastic - Liquid, hot-laid thermoplastic containing traffic paint beads with a separate application of additional traffic paint beads on the surface.

Type B - Preformed, Fused Thermoplastic Film - Preformed, fused thermoplastic film with intermixed traffic paint beads, and with or without a separate application of additional traffic paint beads on the surface.

Type C - Cold-Applied Plastic Film (Tape) - Cold applied plastic film (tape) with intermixed traffic paint beads.

Type D - Methyl Methacrylate - Methyl methacrylate including integral aggregate, and additional traffic paint beads on the surface.

Materials

00850.10 General - Use materials conforming to the requirements of the following:

Traffic Paint Beads.....	02840.20
Primer	02840.50

Use marking materials from the QPL.

Construction

00850.40 General - Place markings as shown, and according to the Manual on Uniform Traffic Control Devices and the current edition of ODOT's Traffic Line Manual. Apply the markings according to the manufacturer's recommendations. Furnish a copy of the manufacturer's instructions to the Engineer a minimum of seven days before placing markings.

Unless otherwise specified, apply pavement markings before public traffic is allowed on the freshly paved surface.

Remove and replace pavement markings not conforming to these Specifications or not properly installed, at no expense to the Agency, before continuing the operation.

Install pavement markings so that the completed markings have a uniform cross-section. Pre-formed markings 300 mm (12 inch) or wider may be fabricated from 300 mm (12 inch) or 150 mm (6 inch) wide material.

00850.41 Prepare and Prime Pavement - Completely remove, by approved methods, existing pavement markings (painted, thermoplastic, raised buttons or other durable materials) that are being replaced with new pavement markings, unless otherwise approved.

Clean the pavement before application of the marking material,. Remove contaminants such as curing compounds, and existing pavement markings by an approved mechanical means. Sweep and air blast

the pavement, as necessary, with an acceptable high-pressure system to remove extraneous or loose material.

After the pavement surface is clean and dry, apply a primer, if recommended by the manufacturer, to the area receiving the pavement markings. Apply primer in a continuous, solid film according to the recommendations of the primer manufacturer and the pavement markings manufacturer.

00850.42 Application of Pavement Marking Materials - Follow the manufacturer's recommendations for installing these marking materials. Provide manual or automatic application equipment as necessary for the job requirements.

(a) Type A: Liquid, Hot-Laid Thermoplastic Material - Apply the thermoplastic material to the pavement by a gravity and/or extrusion method, to the full width specified, in a single application. Place the pavement marking at least 3 mm (1/8 inch), but not more than 5 mm (3/16 inch), in thickness, exclusive of projecting surface-applied traffic paint beads, with a continuous and uniform cross-sectional configuration, and with the upper surface slightly arched.

Separately apply traffic paint beads to the material as it is placed. Locate the dispenser behind the pavement marking extrusion die and imbed the traffic paint beads in the pavement marking to a depth of at least one-half their diameters at a rate of 0.5 kg/m² (0.1 pound per square foot). Uniformly distribute the traffic paint beads over the entire width of the thermoplastic material.

(b) Type B: Preformed, Fused Thermoplastic Film - Longitudinal and transverse joints will be allowed with no overlap or gap permitted at the joint.

(c) Type C: Cold-Applied Plastic Film (Tape) - Longitudinal joints will be allowed with no overlap or gap permitted at the joint. On asphalt, position the tape on the fresh surface prior to final rolling of the mat.

(d) Type D: Methyl Methacrylate - Place the markings at least 3 mm (1/8 inch), but not more than 5 mm (3/16 inch), in thickness. In addition to the top dressing of traffic paint beads, provide intermixed traffic paint beads and an intermixed anti-skid aggregate.

00850.44 Public Safety and Convenience - Provide for the safety and convenience of the public as follows:

Protect applied markings from traffic until sufficiently dry so as not to be damaged or tracked by normal traffic movements. At a minimum, place tubular markers or conical markers next to all markings, and place barricades by all areas where cross traffic is anticipated. Additional protection, as required by the Engineer, may be necessary and will be considered incidental to the pavement markings.

- Immediately correct improper alignment, broken equipment, spilled product, or other striping problems that impair traffic, at no expense to the Agency, including appropriate traffic control. Provide documentation from DEQ indicating proper cleanup. Blacking out or covering up the lines will not be allowed, except in a short-term emergency, and when approved.
- Conduct work at all times so that there is the least possible interference with the traveling public, according to the requirements of Sections 00220 and 00225.
- Do not open any work area to traffic that is not adequately striped and cured.
- Do not perform any work, or close any lane to traffic, until the area is adequately signed and protected according to the Traffic Control Plan and when approved by the Engineer.

00850.46 Substrate Materials - Apply materials to a surface that is clean, dry, free of contaminants and meets the following requirements:

- (a) **New Asphalt Concrete** - Apply materials to new asphalt concrete that is sufficiently cured.
- (b) **Existing Asphalt Concrete** - Apply materials to existing asphalt concrete free of surface oils and existing road marking materials.
- (c) **Portland Cement Concrete** - Apply materials to concrete that has reached a minimum compressive strength of 20.7 MPa (3,000 psi), and is free of curing agents, laitance, surface oils and road marking materials.

00850.47 Disposal of Waste - Waste material is the property of the Contractor. Remove all waste materials, including grindings and old markings, from the jobsite and dispose of according to applicable state, federal and local regulations. Cost of disposal will be incidental to the work under this Section.

00850.75 Warranty - The warranty of 00170.85(b) applies to work under this Section. See the Special Provisions for details.

Measurement

00850.80 Existing Traffic Markings - Removal of existing pavement markings, preparation, cleaning, and priming the pavement will be on a lump sum basis and no separate measurement will be made.

00850.81 Pavement Markings - The measurement of accepted pavement markings, other than line markings, will be measured on the unit basis, per each, by the actual count of markings accepted and in place.

00850.82 Pavement Line - Pavement line for stop bars and crosswalks, complete and in place will be measured on the area basis, computed to the nearest m² (square foot).

Payment

00850.90 General - The accepted quantities will be paid for at the Contract unit price per unit of measurement for the pay items listed below when in the Schedule of Items:

Pay Item	Unit of Measurement
(a) Removal of Existing Pavement Markings.....	Lump Sum
(b) Pavement Legend, Type ____ : Arrows.....	Each
(c) Pavement Legend, Type ____ : "ONLY".....	Each
(d) Pavement Legend, Type ____ : "SCHOOL".....	Each
(e) Pavement Legend, Type ____ : "SCHOOL CROSSING".....	Each
(f) Pavement Legend, Type ____ : Railroad Crossing Markings.....	Each
(g) Pavement Legend, Type ____ : Bicycle Lane Symbols.....	Each
(h) Pavement Legend, Type ____ : Diamonds.....	Each
(i) Pavement Legend, Type ____ : _____.....	Each
(j) Pavement Line, Type ____.....	m ² (Square Foot)

Payment for item (a) will be payment for removal of existing pavement markings, preparation, cleaning and priming the pavement as specified.

In items (b) through (j), the designation for the type of pavement marking materials, listed in 00850.02, will be inserted in the first blank.

Payment for item (b) will include single or multiple headed arrows as required.

Payment for item (f) will include a R x R Symbol and three 600 mm (24 inch) wide white pavement bars as shown.

For item (i) the name of the legend will be inserted in the second blank.

Payment for item (j) will include the pavement lines for stop bars and crosswalks.

Payment for the items above will be payment in full for furnishing all materials, equipment, labor, and incidentals necessary to complete the work.

Section 00851 - Permanent Pavement Striping Tape

Description

00851.00 Scope - This work consists of furnishing and installing permanent pavement striping tape in reasonably close conformance to the dimensions and lines established. Permanent pavement striping tape will be referred to as "tape" in this Specification. Tape may be applied by rolling the material into a hot asphalt surface during the asphalt concrete placement, or by laying the material into a groove in existing asphalt or portland cement concrete.

Materials

00851.10 General - Furnish patterned and non-patterned preformed tape, as specified, from the QPL, consisting of white or yellow film with reflective elements incorporated to provide immediate and continuing retro-reflection.

Furnish tape capable of adhering to asphalt concrete or portland cement concrete. If the tape manufacturer recommends the use of a primer, use a type approved by the pavement marking manufacturer, and complying with applicable DEQ regulations.

Equipment

00851.20 General - Provide equipment acceptable to the tape manufacturer for the method specified.

00851.21 Equipment for Hot-Inlaid Installations - Provide applicators capable of applying single or double 100 mm (4 inch) lines simultaneously with variable spacing between double lines.

00851.25 Equipment for Grooved Installations - Provide grooving equipment utilizing diamond grinding heads, shot-blasting, or an approved alternate that makes a smooth, flat-bottomed cut of uniform depth.

Construction

00851.40 General - Apply the tape according to the Manual of Uniform Traffic Control Devices, the ODOT Traffic Line Manual, and the manufacturer's recommendations, or as specified.

Apply tape to clean, dry pavement surfaces, free of laitance, curing agents, surface oils, existing road markings, grinding debris, or other contaminants.

00851.41 Hot-Inlaid Installation - Apply all tape to the freshly paved asphalt surface before allowing public traffic on the pavement. Roll the tape into the fresh surface during the finish rolling of the mat. Closely monitor the temperature of the mat to ensure compliance with the manufacturer's recommendations.

00851.42 Grooved Installation - Place tape in grooves between 1.5 mm (1/16 inch) and 2.5 mm (3/32 inch) deep. Clean the groove by shot-blasting or other approved method to the satisfaction of the tape manufacturer's representative. Remove metal shot-blasting residue by magnetic sweeping or other approved method, and clean the area with high-pressure air immediately before placing the tape.

00851.45 Placement Tolerance - Place striping parallel and true to line. Make skip ends square and clean. Place skip stripes so that they are in cycle with at least one end of any adjacent project.

Allowable tolerances for installation are:

- **Side to side** - 12 mm (1/2 inch) on tangents; 25 mm (1 inch) on curves
- **Length of skips** - 3.00 m ± 50 mm (10 feet ± 2 inches)
- **End to end on skips** - 9.20 m ± 50 mm (30 feet ± 2 inches). Place skips on cycle to a tolerance of 50 mm (2 inches). A tolerance of 300 mm (12 inches) will be allowed on the first skip of a run, but it shall be on cycle in one skip.
- **Double lines** - Parallel, with a gap tolerance of ± 12 mm (1/2 inch)

00851.46 Quality Testing - On projects with more than 1500 m (5,000 feet) of tape, test the retro-reflectivity with a Miralux 12, a 30 m (100 foot) retro-reflectometer, or other approved device, every 300 m (1,000 feet) for each type and color of material. Perform this testing within one week of placement, and submit results to the Engineer within 48 hours of testing.

00851.47 Disposal of Waste - Waste material becomes the property of the Contractor. Remove all waste materials from the jobsite and dispose of according to applicable state, federal and local regulations, at no cost to the Agency. This includes all grindings or markings removed.

Finishing and Cleaning Up

00851.70 Removal or Repair of Unacceptable Work - Remove or repair all unacceptable work and dispose of according to 00851.47, at the Contractor's expense. Repair or replace unacceptable work immediately if it causes a safety problem. Remove unacceptable materials by an effective method, such as grinding if material has hardened. The removed material becomes the property of the Contractor. If additional traffic control is required for removal of unacceptable material, provide it as directed and at no cost to the Agency.

00851.75 Warranty - The warranty of 00170.85(b) applies to work done under this Section. See the Special Provisions for details.

Measurement

00851.80 Length Basis - Permanent pavement striping tape will be measured by the length of 100 mm (4 inch) striping placed and accepted. When lines other than 100 mm (4 inch) wide are specified, the linear measurement will be adjusted by converting it to an equivalent length of 100 mm (4 inch) line on a proportionate area basis.

Skip intervals will not be included in the measurement for payment.

The estimated quantities of each color and type of tape, and their intended locations, will be shown in the Special Provisions.

Payment

00851.90 General - The accepted quantities of striping tape will be paid for at the Contract unit price per unit of measurement for the pay items listed below:

Pay Item	Unit of Measurement
Permanent Pavement Striping Tape, Hot-Inlaid.....	m (Foot)
Permanent Pavement Striping Tape, Grooved	m (Foot)
Permanent Pavement Striping Tape, Patterned, Hot-Inlaid	m (Foot)
Permanent Pavement Striping Tape, Patterned, Grooved.....	m (Foot)

00851.90

Payment will be payment in full for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified.

Section 00860 - Pavement Markers

Description

00860.00 Scope - This work consists of furnishing and installing reflective and non-reflective pavement markers as shown or directed.

Materials

00860.10 General - Materials shall meet the following requirements:

Adhesive	02840.61
Pavement markers	02840.60

Construction

00860.40 Pavement Markers:

(a) General - Install reflective (Type I) and nonreflective (Type II) markers as shown. Place reflectorized markers so that future striping paint, if required, will not cover the marker.

(b) Surface Preparation - Prepare the surface by removing dirt, curing compound, paint, grease, oil, moisture, loose or unsound layers, and any other material which would adversely affect the bond of the adhesive.

Prepare by sandblasting or steel shot-blasting the pavement surface for a sufficient length of time to remove all surface contaminants but not so long as to expose buried aggregate. Use a blast of clean air to insure removal of all loose particles from the surface.

Apply pavement markers to a dry surface. Do not place markers on the pavement surface if visible moisture is present.

(c) Alignment - Install all markers on the established alignment, which will consist of either:

- Control points at 60 m (200 foot) intervals on tangent and at 15 m (50 foot) intervals on curves, or
- A temporary painted line.

One painted line or a line of points will be established for each direction of traffic on a divided highway. Perform all additional work necessary to establish satisfactory lines for markers, including correction of minor irregularities in the line established.

Do not install markers spanning a pavement joint or crack. Adjust spacing between the markers to avoid installation of markers across a joint or crack. Maintain the alignment.

Adjust alignment of a full pattern of markers away from existing lane lines to avoid installing markers that span a longitudinal construction joint or crack. For such deviation in the line of pavement markers, construct a gradual taper of pleasing appearance.

(d) Installation - If epoxy adhesive is used, thoroughly mix according to 02840.61(a). 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.

00860.40(d)

Place the marker in position and apply pressure until firm contact is made with the pavement. Visually inspect the installation to insure that a small bead approximately 3 mm (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.

The use of mineral spirits will be permitted for removing adhesive from the surfaces of nonreflective and reflective pavement markers. Cleaning shall effectively remove the adhesive so no loss in the reflective characteristic results. Protect the marker against impact until the adhesive hardens to the degree directed.

00860.41 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 00860.40.

(b) Installation - Install the pavement markers as shown and according to 00860.40(d).

Measurement

00860.80 Unit Basis - Pavement markers and recessed pavement markers will be measured on the unit basis by actual count of each type of marker furnished, installed and accepted. Constructing grooves, preparing pavement, adhesive and clean-up are considered incidental to the work and no separate measurement will be made.

Payment

00860.90 Pavement Markers - Payment for accepted quantities will be at the Contract unit price, per each, for the following items:

Pay Item	Unit of Measurement
(a) Mono-Directional Crystal Type I Markers	Each
(b) Bi-Directional Yellow Type I Markers	Each
(c) White Type II Markers	Each
(d) Yellow Type II Markers	Each
(e) Mono-Directional Crystal Type I Markers, Recessed	Each
(f) Bi-Directional Yellow Type I Markers, Recessed	Each

Payment for items (a) through (d) will be payment in full for all materials, equipment, labor and incidentals necessary to complete the work.

Payment for items (e) and (f) will be payment in full for constructing pavement grooves, pavement preparation and furnishing and placing materials including equipment, labor and incidentals necessary to complete the work.

Section 00861 - Painted Permanent Pavement Striping

Description

00861.00 Scope - This work consists of permanently striping the top lift of pavement with paint within the limits of the Project as shown or as directed, and in accordance to the ODOT Traffic Line Manual.

Materials

00861.10 General - Use paint and traffic paint beads conforming to the requirements of Section 02840.

Equipment

00861.20 General - Use paint sprayers made specifically for the purpose of applying paint, containing traffic paint beads, to a uniform width and thickness on the roadway surface, using a three-gun system.

Construction

00861.40 General - Apply striping to the lines and locations shown in the plans, in the ODOT Traffic Line Manual or as directed. For overlays and shoulder widening projects, replace striping to match existing striping unless otherwise directed. If the roadway has changed significantly or is a new roadway, propose variations in standard layouts to handle unusual conditions, subject to approval.

Place permanent striping prior to traffic being allowed on the pavement, or if approved, the Contractor may install flexible pavement markers in conformance with Section 00225 prior to final striping.

00861.41 Alignment - Lay out a spot alignment for the striping consisting of control points every 15 m (50 feet) on tangent and every 7.5 m (25 feet) on a curve or as directed. Do not proceed with striping prior to receiving approval of the layout..

00861.42 Application - Apply painted stripes at a thickness of 380 μm (15 mils) (wet), equivalent to 40 L/km (17 gallons per mile) for a 100 mm (4 inch) wide solid stripe. Apply traffic paint beads at a rate of 0.6 kg/L (5 pounds per gallon) of paint. Embed the traffic paint beads in the paint to a depth of 40% to 60% of their diameter.

When striping over open-graded HMAC, apply two applications of pavement striping, the second retracing the first. Perform the second application approximately three weeks to a month after the initial striping is complete. Apply each application at a thickness of 380 μm (15 mils) (wet), and include traffic paint beads.

Immediately clean up paint dribbled beyond the cutoff. Avoid tracking of new paint. If more than one incident of tracking occurs in a 500 meter (1,500 foot) section, improve the level of traffic control and protection. All areas tracked through will be reviewed by the Engineer for possible cleanup and retracing at the Contractor's expense.

00861.45 Placement Tolerance - Place striping parallel and true to line. Make skip ends square and clean. Place skip stripes so that they are in cycle with at least one end of any adjacent project.

Allowable tolerances for installation are:

- **Side to side** - 12 mm (1/2 inch) on tangents; 25 mm (1 inch) on curves
- **Length of skips** - 3.00 m \pm 50 mm (10 feet \pm 2 inches)

00861.45

- **End to end on skips** - 9.20 m ± 50 mm (30 feet ± 2 inches). Place skips on cycle to a tolerance of 50 mm (2 inches). A tolerance of 300 mm (12 inches) will be allowed on the first skip of a run, but it shall be on cycle in one skip.
- **Double lines** - Parallel, with a gap tolerance of ± 12 mm (1/2 inch)

Finishing and Cleaning Up

00861.70 Removal or Repair of Unacceptable Work - Remove or repair all unacceptable work and dispose of at the Contractor's expense. Repair or replace unacceptable work immediately if it causes a safety problem. The removed material becomes the property of the Contractor. If additional traffic control is required for removal of unacceptable material, provide it as directed and at no cost to the Agency.

Measurement

00861.80 General - Painted permanent pavement striping will be measured on the length basis or the lump sum basis, according to the unit of measurement in the Bid Schedule.

00861.81 Length Basis - The quantity of painted permanent striping accepted will be the number of meters (feet) of striping placed, to the nearest meter (foot), complete and in place as specified. There will be no payment for the gap between skip stripes.

00861.82 Lump Sum Basis - No separate measurement of painted permanent pavement striping will be made.

Payment

00861.90 General - Painted permanent pavement striping - accepted for payment will be paid for on the by the meter (foot) or on the lump sum basis, as follows:

00861.91 Length Basis - Painted permanent pavement striping will be paid for at the Contract unit price per meter (foot) for the pay item "Painted Permanent Pavement Striping". The width of lines will be assumed to be 100 mm (4 inches). If lines other than 100 mm (4 inch) are specified, the length will be adjusted by converting it to an equivalent length of 100 mm (4 inch) line on a proportionate area basis.

Payment will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified, including layout work.

00861.92 Lump Sum Basis - Payment for painted permanent pavement striping will be made on the lump sum basis for the pay item "Painted Permanent Pavement Striping, Complete". Payment will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified, including layout work.

00861.93 Incidental Work - When required by construction staging, additional temporary flexible pavement markers will be paid for according to 00225.93. No payment will be made for temporary flexible pavement markers required by the Contractor's operations or placed for the Contractor's convenience.

No extra payment will be made for retracing the first application of striping; payment will be based on the total quantity of permanent striping provided as a finished product, complete and in place as specified.

Section 00862 - Durable Permanent Pavement Striping

Description

00862.00 Scope - This work consists of permanently striping the wearing surface with durable lines within the limits of the Project, as shown or according to the ODOT Traffic Line Manual, and the Manual of Uniform Traffic Control Devices (MUTCD).

For each Project, the striping contractor shall be certified by the marking materials manufacturer to perform the applicable work, prior to beginning the work.

00862.02 Pre-Striping Meeting - Prior to starting work, meet with the Engineer and striping subcontractor. At this meeting, do the following:

- Furnish a Traffic Control Plan for approval, including lane restriction time periods.
- Furnish a striping schedule showing areas and timing of work, and placing of materials.
- Discuss placement of materials, potential problems.
- Discuss work plan at off-ramps, on-ramps and any intersections.
- Discuss material handling procedures and procurement.
- Provide a copy of the manufacturer's installation instructions and copies of Material Safety Data Sheets (MSDS).
- Provide a spill recovery plan including:
 - Name, address and phone number of the Contractor's contact with the DEQ
 - Name, address and phone number of persons certified and on call to do cleanup

00862.08 Traffic Control - Provide temporary traffic control measures according to Section 00225.

Materials

00862.10 General - Use materials from the QPL. The Special Provisions will indicate the type of marking to be used for white lines, yellow lines and skip lines.

00862.11 Reflective Elements - Furnish traffic paint beads meeting the requirements of 02840.20.

Equipment

00862.20 Equipment - Use sprayers or extruders approved by the marking material manufacturer and made specifically for the purpose of applying beaded markings to a uniform width and thickness on the roadway surface. Hand units will not be allowed. Use automatic bead applicators that place a uniform layer of beads on the line.

Place double lines using equipment designed to place two parallel lines in one pass.

Construction

00862.40 General - Install the markings according to the manufacturer's recommendations and the Engineer's instructions.

Lay out a continuous guideline for each line, and receive approval of the layout from the Engineer prior to striping.

For overlays and shoulder widening projects, replace striping to match existing striping unless otherwise directed. If the roadway has been changed significantly by the Project, or is a new roadway, propose variations in standard layouts to handle changed or unusual conditions.

00862.40

Place lines wider than 100 mm (4 inches) with one pass.

Place permanent striping prior to traffic being allowed on the pavement if the pavement has cured sufficiently. If not, install flexible pavement markers according to Section 00225 prior to final striping.

00862.41 Pavement Surface - Prepare the pavement surface as follows:

(a) New or Existing Asphalt Concrete - Apply material only when the surface is sufficiently dry, clean and free of contaminants such as surface oils and existing road marking materials. Some products require the asphalt to cure for several weeks prior to placement of certain striping materials.

(b) Portland Cement Concrete - Apply material to concrete that has reached a minimum compressive strength of 20.7 MPa (3,000 psi), and only when the surface is sufficiently dry, clean and free of contaminants such as curing agents, laitance, surface oils, and road marking materials.

Remove contaminants by approved mechanical means, such as turbo-blasting or grinding, and dispose of according to 00862.47.

00862.42 Application - Use the standard skip cycle of 3.0 m (10 foot) stripe, followed by 9.2 m (30 feet) with no markings until the next skip stripe. Match new skips to the pattern of existing markings on at least one end of the Project.

Monitor the bead application to ensure proper bead embedment and density. Apply reflective elements at a sufficient rate to obtain a minimum reflectivity reading of at least 300 mcd for white and 250 mcd for yellow.

Apply marking materials by one or more of the following methods, appropriate to the pay item(s) in the Schedule of Items:

(a) Method A: Profiled Markings - Apply profile markings as shown. Place lines and bumps straight and square.

(b) Method B: Non-Profiled Markings - Apply non-profile markings as shown. This method is designed to be done by an extrusion process. A ribbon type application will not be allowed.

(c) Method C: Inlaid Markings - Apply inlaid markings as shown. Overfill the slot as shown. Fill the slot edge to edge, and overfill the edges at the top by about 3 mm (120 mils) on each side, making the line flat or slightly convex on top, and about 100 mm (4 inches) wide.

(d) Method D: Inverted Profile Markings with Bumps - Apply inverted-profile markings (with bumps) as shown. Place lines and bumps straight and square.

(e) Method E: Inverted Profile Markings without Bumps - Apply inverted profile markings as shown.

(f) Method F: Spray Markings - Apply spray markings as shown. The actual thickness may vary slightly. At least two passes are required to obtain the thickness specified. Place additional passes squarely on top of the first pass, within ± 2 mm (1/16 inch).

00862.43 Quality of Work - Place markings and beads on the roadway in proper alignment with existing markings. Make skips parallel and true to line, with skip ends square and clean. Immediately clean up dribbling of markings beyond the cutoff.

(a) Test Stripe - Prior to starting, and in the presence of the Engineer, place a 50 m (150 feet) test stripe on roofing felt or other approved material or location, to demonstrate the pavement marking

application process. If the Project involves only inlay applications, this test stripe is not required. Do not place permanent materials without receiving the Engineer's approval of the test performance. Repeat the performance test until the Engineer is satisfied that the Contractor has suitable skills to place the materials accurately and properly. Any delay due to this test requirement will be at the Contractor's expense.

(b) Allowable Tolerances - Record the following readings, and the locations where they were taken, for evaluation by the Engineer:

- For inlay applications, record the depth of the slot every 100 m (300 feet) during the grinding operation.
- For all other applications, measure the thickness of the lines (above the pavement surface), at the time of application, at intervals not to exceed 100 m (300 feet).

Inspect the line initially, and again two weeks after placement, to ensure the material has cured properly. Remove all soft spots or abnormally darkened areas and replace with specification material.

Allowable tolerances for installation are:

- **Side-to-Side** - 12 mm (1/2 inch) maximum on tangent, 25 mm (1 inch) on curves
- **Space between parallel (double) lines** - \pm 10 mm (3/8 inch)
- **End-to-end on skips (for re-trace)** - 50 mm (2 inch) overlap
- **Length of Skip** - 3.00 m \pm 50 mm (10 feet \pm 2 inches)
- **Length of Gap** - 9.20 m \pm 50 mm (30 feet \pm 2 inches)
- **Width of lines** - 2 mm (1/16 inch), + 10 mm (3/8 inch)
- **Divergence of parallel double lines** - 10 mm (3/8 inch) maximum

If existing pavement markers are to be left in place, adjust skip spacing to place skips midway between pavement markers, or as directed.

If it is determined that the material is being placed too thin, or otherwise not to specification, make immediate adjustments to correct the problem. Do not allow the top of the line to be cupped, or lower than the wearing surface.

Durable permanent pavement markings applied by any method will be unacceptable if:

- The marking is not straight, not wide enough, or not true to line.
- The thickness of the line is inconsistent or less than specified.
- The top of the line is not smooth and uniform.
- Any lines or profile bumps are damaged prior to curing.
- Retro-reflectivity is too low.
- The material is uncured.
- The substrate is visible in the striped areas.
- Any profile bumps are missing or miss-shaped.
- Two or more profile bumps in a row are more than 3 mm (120 mils) deficient in height, measured above the wearing surface.
- Profile bump lead-in or lead-off is not present.
- The inlay slot is not ground deep enough.
- The inlay slot is not filled slightly over-full as specified.
- Grooves in inverted-profile lines are not square and properly shaped.
- Successive spray passes are not aligned over the previous pass.

(c) Retro-reflectivity - Measure the retro-reflectivity of each line, using a MiroLux 12, a 30 m (100 foot) retro-reflectometer, or similar device, mobile or hand-held, at intervals not exceeding 300 m (1,000 feet)

00862.43(c)

of road distance. Record the location of each test. Perform testing within 48 hours of curing. Make results available to the Engineer immediately.

Prior to acceptance of the Project, the initial retro-reflectivity may also be tested by the Engineer for compliance. This testing will take place at least two days, but not more than 90 days, after the Project is complete. Notify the Engineer as soon as possible when the lines are ready to measure.

If the retro-reflectivity is less than 250 mcd for white and 200 mcd for yellow, the affected materials will be considered unacceptable. The Engineer may elect to use the Contractor's retro-reflectivity readings for the initial retro-reflectivity.

(d) Repairs to the Work - Perform repairs using equipment similar to the equipment initially used to place the material. Do not perform repairs in a "patch-work" manner. If more than one repair is required in a single 100 m (300 foot) section, grind and repair the entire section.

00862.44 Public Safety and Convenience - Provide for the safety and convenience of the public according to Section 00220 and the following:

- Be responsible for protecting all applied markings from traffic until sufficiently dry to prevent damage or tracking by traffic movements. At a minimum, place cones or tubular markers by all skips, and barricades by all areas where cross traffic is anticipated. Additional protection may be necessary and will be considered Incidental.
- Immediately correct striping problems that impair traffic, such as improper alignment, broken equipment, or spilled product, at the Contractor's expense, including appropriate traffic control. Provide documentation from DEQ indicating proper cleanup. Blacking out or covering up lines will not be allowed, except in a short-term emergency when approved.
- Do not open up any work area to traffic that is not adequately striped and suitable for safe driving.

00862.47 Disposal of Waste - Waste material becomes the property of the Contractor. This includes all grindings and all removed marking material. Do not dispose of or store stripe removal waste material on Agency property. Dispose of waste material according to applicable State, federal and local regulations.

Finishing and Cleaning Up

00862.70 Removal or Repair of Unacceptable Work - Remove or repair all unacceptable work and dispose of according to 00862.47, at no expense to the Agency. Repair or replace unacceptable work immediately if it causes a safety problem. Remove unacceptable materials by an effective method, such as grinding if material has hardened. The removed material becomes the property of the Contractor (see 00862.47). If additional traffic control is required for removal of unacceptable material, provide it as directed and at no cost to the Agency.

00862.75 Warranty - The warranty of 00170.85(b) applies to work under this Section. See the Special Provisions for details.

Measurement

00862.80 General - The quantity of durable permanent pavement striping will be the length, to the nearest meter (foot), complete and in place as specified. For skip stripes, measurement will be for the actual stripe, excluding the gap between skip stripes. The standard application width is considered to be 100 mm (4 inches). If wider lines are specified, the length of those lines will be adjusted by converting them to an equivalent length of 100 mm (4 inch) line on a proportionate area basis.

Thickness will be measured from the top of the 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.

Temporary flexible pavement markers required by 00862.40 will be measured on the unit basis when a pay item is included in the Schedule of Items. When no pay item is provided, there will be no separate measurement of temporary flexible pavement markers.

Payment

00862.90 General - The accepted quantities will be paid for at the Contract unit price per meter (foot) for the pay items listed below when in the Schedule of Items:

- | | |
|---|---|
| Method A (Profile): | (a) Methyl Methacrylate, Profile, 2.3 mm (90 mils), Extruded |
| | (b) Methyl Methacrylate, Profile, 3.0 mm (120 mils), Extruded |
| | (c) Thermoplastic, Profile, 2.3 mm (90 mils), Extruded |
| | (d) Thermoplastic, Profile, 3.0 mm (120 mils), Extruded |
| Method B (Non-Profile): | (e) Methyl Methacrylate, Non-Profile, 2.3 mm (90 mils), Extruded |
| | (f) Methyl Methacrylate, Non-Profile, 3.0 mm (120 mils), Extruded |
| | (g) Thermoplastic, Non-Profile, 2.3 mm (90 mils), Extruded |
| | (h) Thermoplastic, Non-Profile, 3.0 mm (120 mils), Extruded |
| Method C (Inlaid): | (i) Methyl Methacrylate, Inlaid |
| Method D (Inverted Profile with Bumps): | (j) Thermoplastic, Inverted Profile w/ Bumps |
| Method E (Inverted Profile): | (k) Thermoplastic, Inverted Profile |
| Method F (Spray): | (l) Methyl Methacrylate, Non-Profile, 2.3 mm (90 mils), Sprayed |
| | (m) Methyl Methacrylate, Non-Profile, 3.0 mm (120 mils), Sprayed |
| | (n) Thermoplastic, Non-Profile, 2.3 mm (90 mils), Sprayed |
| | (o) Thermoplastic, Non-Profile, 3.0 mm (120 mils), Sprayed |

Payment for items (a) through (o) will be payment in full for furnishing all materials, equipment, labor, and incidentals necessary to complete the work as specified, and includes payment for the following:

- Laying out the alignment
- Checking dimensional tolerance
- Removing and disposing of unacceptable materials
- Furnishing a striping schedule
- Placing a test stripe
- Removing existing pavement markings and other waste materials
- Testing retro-reflectivity

There will be no separate or additional payment for the following:

- Over-runs of material caused by the variation of the gradation of the asphalt
- Additional material required to apply markings on open-graded pavement
- Additional material placed at the top of inlay slots, for item inlaid markings
- Disposal of stripe removal waste material

Temporary flexible pavement markers required by 00862.40 will be paid for according to Section 00225, if a pay item is provided. If no pay item for temporary flexible pavement markers is in the Schedule of

00862.90

Items, payment will be incidental to the permanent pavement striping pay item(s) and no separate payment will be made.

Section 00863 - Pavement Marking Removal

Description

00863.00 Scope - This work consists of removing painted markings from the pavement surface within the limits of the Project.

Construction

00863.40 Construction - Remove pavement markings by an approved method as necessary to remove the markings, but without damaging the pavement surface. Repair any damaged surface at no additional compensation, and to the satisfaction of the Engineer.

Coordinate all removal work with construction activity. Remove pavement markings the same day permanent striping is applied, unless otherwise directed. Use vacuum shrouded equipment or other equally effective containment procedures. Properly dispose of all waste materials in accordance with DEQ regulations, where applicable.

Measurement

00863.80 Measurement - The quantities of pavement line removed will be measured on the length basis, to the nearest meter (foot). Pavement line removal will be based on a nominal width of 100 mm (4 inches). If the width of the line is other than 100 mm (4 inch), measurement will be adjusted by converting to an equivalent length of nominal 100 mm (4 inch) line on a proportionate area basis.

The quantities of legends removed will be measured on the unit basis, per each, by actual count of legends removed. One legend is considered to include all letters, characters, etc. associated with the particular pavement legend.

Payment

00863.90 General - The accepted quantities of work performed under this Section will be paid for at the Contract unit price per unit of measure for the following items:

Pay Item	Unit of Measurement
Pavement Line Removal.....	m (Foot)
Pavement Legend Removal.....	Each

Payment will be payment in full for furnishing all equipment, labor and incidentals necessary to complete the work as specified.

Section 00865 - Rumble Strips

Description

00865.00 Scope - This work consists of forming rumble strips by constructing indentations in the surfacing of shoulders as shown.

Equipment

00865.20 Equipment - Form rumble strips using a rotary type cutting head with a maximum outside diameter of 600 mm (24 inches) and at least 400 mm (16 inches) long. The cutting head shall have the cutting tips arranged in such a pattern as to provide a relatively smooth cut (approximately 2 mm (1/16 inch) between peaks and valleys). The cutting heads shall be attached the power unit in a manner that allows the tool to self-align with the slope of the shoulder and any irregularities in the shoulder surface. The cutting equipment shall be capable of cutting rumble strips while moving in the same direction as the flow of traffic.

Obtain approval of the equipment prior to use.

Construction

00865.40 Construction - Do not construct rumble strips on bridge decks, bridge approach slabs, in poor pavement sections (as documented by the Agency), in ramp openings, or on the right shoulder (in the direction of travel) where the shoulder is 1200 mm (48 inches), or less.

In shoulder areas where monuments, manholes, catch basins, electronic monitoring equipment, cables, loops or other features prevent the rumble strips from being constructed as detailed, relocate the strips as approved to avoid these features.

All cuttings and other debris resulting from the rumble strip operation shall become the property of the Contractor. Dispose of on the roadway slope or outside the Project limits according to 00330.41(a-5). After removal of the debris, thoroughly clean the pavement by sweeping to remove dust and other foreign matter.

Measurement

00865.80 Length Basis - Rumble strips will be measured by the kilometer (mile), to the nearest 0.01 km (0.01 mile). Measurement will be made along each shoulder on which the rumble strips are constructed.

Payment

00865.90 General - The accepted quantity of rumble strips will be paid for at the Contract unit price per kilometer (mile) for the pay item "Rumble Strips".

Payment will be payment in full for furnishing all materials, equipment, labor and incidentals necessary to complete the work as specified.