OREGON DEPARTMENT OF EDUCATION | HIGHER EDUCATION COORDINATING COMMISSION

OREGON CAREER AND TECHNICAL EDUCATION STATEWIDE FRAMEWORKS

Automotive and Heavy Equipment Career Cluster

Resource Guide

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Well-designed career and technical education (CTE) programs help high school and college students make successful educational transitions and find employment in high-wage, high-skill, in-demand careers. **Oregon's State Plan for CTE: 2020–2024** lays out a comprehensive strategy for ensuring all Oregonians have equitable access to high-quality CTE programming. This entails designing instructional coursework that is sequenced within and across educational levels, grounded in rigorous academic knowledge and technical skills, and aligned with industry needs. It also requires creating quality relationships, experiences, and interactions among learners, educators, business partners, and community members.

OREGON'S VISION FOR CTE

Reimagine and transform learner experiences to enhance their future prospects, empower communities, and ensure equitable access to an inclusive, sustainable, innovation-based economy.

This document provides information and resources related to the ***Statewide Framework in Automotive and Heavy Equipment Career Cluster,*** which falls within the Industrial and Engineering Systems career area. Automotive and Heavy Equipment is one of 17 Career Clusters used to organize and deliver CTE programming in Oregon. The field includes a range of careers relating to the design, development, installation, operation, maintenance, and upgrade of physical systems. People in this cluster use academic and technological Knowledge and Skills to design, build, inspect, deliver, maintain, and repair automobiles, roads, bridges, and manufacturing machinery.

Oregon's new CTE state plan calls for the development of Statewide Frameworks to guide CTE program design. The goal is to *improve instructional quality* by aligning technical skills to the needs of employers in high-wage, high-skill, in-demand careers; *promote equity* by ensuring that all learners have access to consistent, high-quality programming; *strengthen career pathways* by intentionally connecting secondary and postsecondary coursework that culminates in an industry-recognized credential or certificate, or associate or baccalaureate degree; and *expand student access to dual and concurrent enrollment credits* to reduce tuition costs and the time required to earn a postsecondary credential.

While secondary and postsecondary CTE providers have considerable flexibility in designing curriculum and assessments, state approval is required to qualify programs for federal and/or state funding. This includes aligning offerings with labor market needs; meeting state-defined criteria for size, scope, and quality; addressing all of Oregon's five core elements of a Program of Study; and continuously improving CTE offerings through the use of the **High Quality CTE Program of Study Rubric.**

In Oregon, a CTE Program of Study is the primary vehicle for delivering coursework at the secondary and postsecondary levels. A CTE Program of Study is a progressive, nonduplicative sequence of courses, developed by a partnering secondary school district and postsecondary institution, designed to prepare students to seamlessly transition across education levels and into the workforce. Coursework integrates rigorous academic knowledge with industry-validated employability and technical skills, culminating in the award of an industry-recognized credential or certificate, or an associate or baccalaureate degree. High school students may also have options to earn college credit that may be applied toward their postsecondary studies.

Within each Career Cluster, CTE Programs of Study may be offered at the Career Cluster or Focus Area level. Career Cluster-level Programs of Study offer students broad exposure to multiple careers in the field, along with cross-cutting skills valued by all industry employers. Focus Area-level Programs of Study offer students more occupationally specific training with a higher level of statewide content standardization.

The new Statewide CTE Frameworks provide updated Knowledge and Skill statements to inform CTE program development. The updated Knowledge and Skill statements incorporate: 1) employability skills commonly found in all jobs in all Career Clusters; 2) cross-cutting technical skills applicable to all jobs in a specific Career Cluster; and 3) Focus Area skills applicable to a specific occupation. Each skill statement includes an optional set of Suggested Performance Indicators, which are intended to help educators develop curriculum and assessments to teach specific skills.

Projected Labor Market Demand

Labor projections published by the State of Oregon Employment Department indicate that while the Automotive and Heavy Equipment field will expand over the coming decade, a subset of high-wage, high-skill occupations will experience significant demand. These are defined as those paying more than the statewide median wage or having more than the statewide median number of total job openings. These occupational titles, projected demand, and wage and educational expectations of entry-level employees are provided in Table 1.

The largest growth in Oregon is projected for Industrial Machinery Mechanics, with demand expected to increase by 28 percent between 2020 and 2030. This will lead to 7,145 projected job openings, including new and replacement workers. Relatively large job openings are anticipated in several fields that are associated with programs of study commonly found in Oregon high schools and community colleges, including Automotive Service Technicians with 7,942 projected openings and Bus and Truck Mechanics and Diesel Engine Specialists (4,139 open positions).

Jobs in the Automotive and Heavy Equipment field typically pay modest wages. Median annual earnings in 2020 were approximately $45,344 for Automotive Service Technicians and Mechanics. Wages in other jobs fields range from $52,894 for Bus and Truck Mechanics and Diesel Engine Specialists to $74,298 for First-line Supervisors of Mechanics, Installers and Repairers. While some careers require a certificate for entry-level workers, a high school diploma is sufficient in many areas, making secondary CTE Programs of Study particularly relevant.

Table 1. Projections for High-Wage and High-Demand Occupations in Oregon, 2020-2030

Standard Occupational Classification (SOC)* code	Occupational title	Total job openings	Percent change 2020-2030	2021 median annual wage	Entry-level education
47-2073	**Operating Engineers and Other Construction Equipment Operators**	5,090	12.1%	$60,528	HS diploma
47-5022	**Excavating and Loading Machine and Dragline Operators, Surface Mining**	802	12.0%	$45,219	Less than HS
49-1011	**First-Line Supervisors of Mechanics, Installers, and Repairers**	5,002	13.3%	$74,298	HS diploma
49-3011	**Aircraft Mechanics and Service Technicians**	1,579	18.4%	$65,520	Certificate
49-3023	**Automotive Service Technicians and Mechanics**	7,942	7.8%	$45,344	Certificate
49-3031	**Bus and Truck Mechanics and Diesel Engine Specialists**	4,139	13.6%	$52,894	HS diploma
49-3041	**Farm Equipment Mechanics and Service Technicians**	1,058	14.3%	$53,040	HS diploma
49-3042	**Mobile Heavy Equipment Mechanics, Except Engines**	2,383	11.1%	$60,174	HS diploma
49-9041	**Industrial Machinery Mechanics**	7,145	28.0%	$60,278	HS diploma

Note: Adapted from ***State of Oregon Employment Department: High-Wage, High-Demand, and High-Skill Occupations (Projections 2020-2030)***

*SOC code = Standard Occupational Classification used to classify workers into job categories.

Statewide Program of Study Framework

Programs of study in the Automotive and Heavy Equipment Career Cluster prepare students for entry-level employment in the automotive field (e.g., careers as an automotive service technician) and/or to pursue advanced postsecondary educational studies. When proposing programming, secondary and postsecondary CTE providers collaborate to offer coursework leading to an industry recognized certificate and/or an associate's or baccalaureate degree. High school students also may be offered the opportunity to earn college credit that may be applied towards their certificate or degree objective.

In winter 2022, the Oregon Department of Education launched a statewide effort to update and revalidate the Knowledge and Skill statements used to define the Automotive and Heavy Equipment Career Cluster. The goal was to identify the employability and technical skills desired of entry-level workers. Work began with a review of labor market information compiled by the Oregon Employment Department to identify high-wage, high-skill occupations. An advisory group comprising Oregon employers and representatives reviewed and provided feedback on existing state skills, which are based on the 2021 Automotive Service Excellence (ASE) Education Foundation program standards in three fields: 1) Automobile, Maintenance & Light Repair; 2) Collision Repair and Refinish; and 3) Medium/Heavy Truck, Inspection, Maintenance & Minor Repair.

Based on their work, a statewide survey was developed and administered to community college faculty in all institutions offering a related CTE program. Individuals were asked to rate the importance of the Knowledge and Skill statements and Suggested Performance Indicators that were vetted with employers. Specifically, faculty were asked to rate the importance of each ASE Education Foundation standard as follows:

- **Critically important.** This skill would be expected of students entering a community college after having completed a CTE Program of Study at the high school level
- **Somewhat important.** This skill would be useful but not necessary for students entering a community college after having completed a CTE Program of Study at the high school level
- **Not important.** This skill would not be expected of students entering a community college after having completed a CTE Program of Study at the high school level (i.e., it will be taught at the college level)

To gather district perspectives, high school CTE instructors with approved programs in the cluster were administered a similar survey. Here educators were asked to rate the importance of high school graduates in related CTE programs of study mastering these skills upon completing their secondary CTE studies.

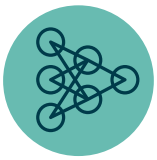
Feedback from survey respondents was analyzed to produce a core set of Knowledge and Skill statements and Suggested Performance Indicators that secondary educators should consider when designing CTE programs and formulating their CTE program approval applications.

Knowledge and Skill Statements

Knowledge and Skill statements describe the learning expectations of students in CTE programs. Ideally, skills marked as Foundational will be taught during a student's high school CTE Program of Study experience, with educators determining how and when instruction occurs. The CTE Statewide Framework for Automotive and Heavy Equipment is organized around three levels of skills.

Employability Knowledge and Skills – *Applicable to all Career Clusters—Foundational*

All learners are expected to master these basic skills to function in the workplace. These cross-cutting abilities, found in all jobs in all industries, encompass a broad range of communication, critical thinking, interpersonal, and organizational skills considered imperative for career success.



Career Cluster Knowledge and Skills – *Applicable to all careers in the Automotive and Heavy Equipment Cluster—Foundational*

All workers in the automotive industry are expected to have a broad understanding of the field. These cross-cutting skills prepare workers to succeed in a range of jobs. High school students mastering these skills are prepared to enter community college or the workforce with an understanding of their career options and training needs.

Focus Area Knowledge and Skills – *Applicable to a specific career*

Field-specific knowledge that an entry-level worker would be expected to possess. High school students mastering these skills are prepared to enter employment or enroll in a community college to pursue advanced training. Postsecondary graduates would be prepared to enter employment with a credential, certificate, or degree.

These skills have been classified based on their level of knowledge required for their mastery:

- ***Foundational Skills*** describe technical skills that all high school students completing a Program of Study would be expected to master. Ideally, these skills would be taught within a high school CTE Program of Study (or in collaboration with a postsecondary partner if it is not feasible within high school).
- ***Intermediate Skills*** describe more technically advanced skills that high school instructors are encouraged to teach, though some might be taught by community college faculty due to equipment or time constraints.
- ***Advanced Skills*** describe highly technical skills that high school instructors may choose to teach with the understanding that, due to their complexity, most will be taught by community college faculty as part of the postsecondary component of a CTE Program of Study.

Overarching descriptions of the Knowledge and Skill statements for new Statewide Frameworks in 1) Automotive Service Technology, 2) Collision Repair and Refinish, and 3) Heavy Equipment Service Technology are contained in Figure 1.

Each Knowledge and Skill statement includes a list of Suggested Performance Indicators that illustrate how students might demonstrate their understanding or abilities relating to each statement (see Appendix A). These examples are intended to provide educators with guidance in establishing program standards and assessments and designing curriculum and instructional activities. These skills also have been classified based on their level of difficulty, ranging from foundational to intermediate to advanced.

Suggested Performance Indicators are offered as optional, industry-suggested and community college faculty-vetted way to demonstrate the Knowledge and Skill Statements. ***They are not required.*** Educators may choose to design other means for students to show skill mastery in their Program of Study. It is anticipated that secondary and postsecondary educators will collaborate in selecting the number, type, and technical specificity of Suggested Performance Indicators, as well as the educational level at which they will be taught.

Figure 1. Knowledge and Skill Statements for the Statewide Framework for Automotive and Heavy Equipment

Automotive and Heavy Equipment Program of Study Knowledge and Skill Statements

EMPLOYABILITY

Cross-cutting, same for all Career Clusters

- Workplace practices
- Personal responsibility and accountability
- Teamwork and conflict resolution
- Communication
- Technology in the workplace
- Planning and organizing
- Career planning

CAREER CLUSTER

- Describe the individuals and organizations that collaborate to service and repair automotive vechicles
- Demonstrate an understanding of and adherence to safe working practices
- Demonstrate the safe use of tools
- Demonstrate knowledge of materials used in the automotive service industry
- Describe the types and purposes of governmental regulations and applicable laws and rules
- Demonstrate pre-task planning for vehicle service
- Demonstrate basic measuring practice
- Demonstrate an understanding of basic mathematics as used in the industry
- Describe the contribution that the automotive service industry has on society and the economy

FOCUS AREAS

Automotive Service Technology

- Engine repair
- Automotive transmission and transaxle
- Manual drive train and axles
- Suspension and steering
- Brakes
- Electrical/electronics systems
- Heating, ventilation, and air conditioning
- Engine performance

Collision Repair and Refinish

- Damage analysis, estimating, and customer service
- Painting and refinishing
- Non-structural analysis and damage repair
- Welding, cutting, and joining
- Structural analysis and damage repair
- Mechanical and electrical components

Heavy Equipment Service Technology

- Engine repair
- Drive train
- Brakes
- Suspension and steering systems
- Electrical/electronic systems
- Heating, ventilation, and air conditioning
- Cab
- Hydraulics

Program of Study Design Options

Educators have two options in designing a Program of Study using a Statewide Framework. They can pursue a Career Cluster-level Program of Study or a Focus Area-level Program of Study. The distinction between a Cluster and Focus Area Program of Study relates to the scope of Knowledge and Skill statements covered in the Program of Study and to the level of secondary to postsecondary alignment (nonduplicative sequence of courses leading to a certificate or degree).

There are two primary distinctions between the two options:

1. Educators choosing to offer a **Career Cluster Programs of Study** are required to cover all the employability skills and all the Cluster-level skills identified and may draw on skills included in one or more Focus Areas.
2. **Focus Area Programs of Study** are more occupationally specific with a higher level of content standardization. Focus Area Programs of Study are required to cover *all the employability skills, Cluster-level skills, and foundational skills identified within a Focus Area.*

Educators may choose to offer a Career Cluster-level Program of Study and/or Focus Area-level Program of Study. The options are not mutually exclusive. Providers with existing, well-developed Programs of Study may already fulfill many of the criteria of a Statewide Framework; others may build toward fulfillment of the Statewide Framework over time.

Career Cluster Program of Study Option

A Career Cluster-level Program of Study provides high school students with a broad overview of the Automotive and Heavy Equipment field to prepare them to specialize in an area of their choosing at the postsecondary level. With this option, educators may choose to offer a broad range of courses that address different aspects of the field, drawing from the Automotive Service Technology, Collision and Refinishing, and Heavy Equipment Service Technology programs.

To qualify as a concentrator at the Career Cluster-level, high school students must earn at least two credits in a state-approved Program of Study sequence, with one of these credits awarded as part of the second or third course in a sequence. High school graduates concentrating their studies in the Automotive and Heavy Equipment Career Cluster would have the option of continuing their studies at an affiliated community college, where they could pursue training (in one or more fields) that culminates in the award of a credential, certificate, or associate degree.

Focus Area Program of Study Option

Focus Area-level Programs of Study are intended to align with specific certificate and associate degree options offered at the postsecondary level. Where appropriate, districts and colleges can negotiate dual credit agreements so that high school students can earn college credit that may be applied toward a postsecondary certificate or degree, expediting the time it takes to complete.

The new statewide Program of Study option requires:

- Offering a minimum of three credits at the secondary level and 36 credits at the postsecondary level
- Covering all the employability, Career Cluster, and foundational Focus Area skills as part of the high school component of a CTE Program of Study or in collaboration with a postsecondary partner
- Concentrators to earn two credits in the Program of Study, including at least one credit awarded as part of the second or third course in a sequence
- Providing a sequenced, progressive set of courses, including an introductory or survey course, and two courses offering more technically advanced skills
- Exhibiting secondary-postsecondary standards alignment that is clearly defined and communicated to all stakeholders
- Offering or potentially offering dual credit opportunities
- Integrating career-related learning experiences, career-connected learning, and work-based learning in meaningful ways

High school graduates concentrating their studies in the Automotive and Heavy Equipment field would have the option of continuing their studies at an affiliated community college, where they could seek advanced training in the Focus Area or pursue training in another Automotive and Heavy Equipment field that culminates in the award of a credential, certificate, or associate degree.

Statewide Framework Programs of Study align course standards to industry-validated skills so that students throughout the state have access to consistent, high-quality CTE with opportunities to gain college credit and skills in in-demand occupations.

Course Scope and Sequence

Regardless of whether a district seeks approval for a Career Cluster- or Focus Area-level Program of Study, it is anticipated that CTE students will begin their course sequence with an introductory/survey course that opens a range of more technically advanced course options. An example of how an Automotive Service Technology or Heavy Equipment Service Technology Program of Study might be configured is provided in Table 2. *Note that course sequences and titles are provided for illustrative purposes only—it is up to secondary and postsecondary partners to determine course titles and sequences; course content, curriculum, and assessments, including when and how Knowledge and Skill statements are addressed; and whether dual credit or industry certifications may be awarded.*

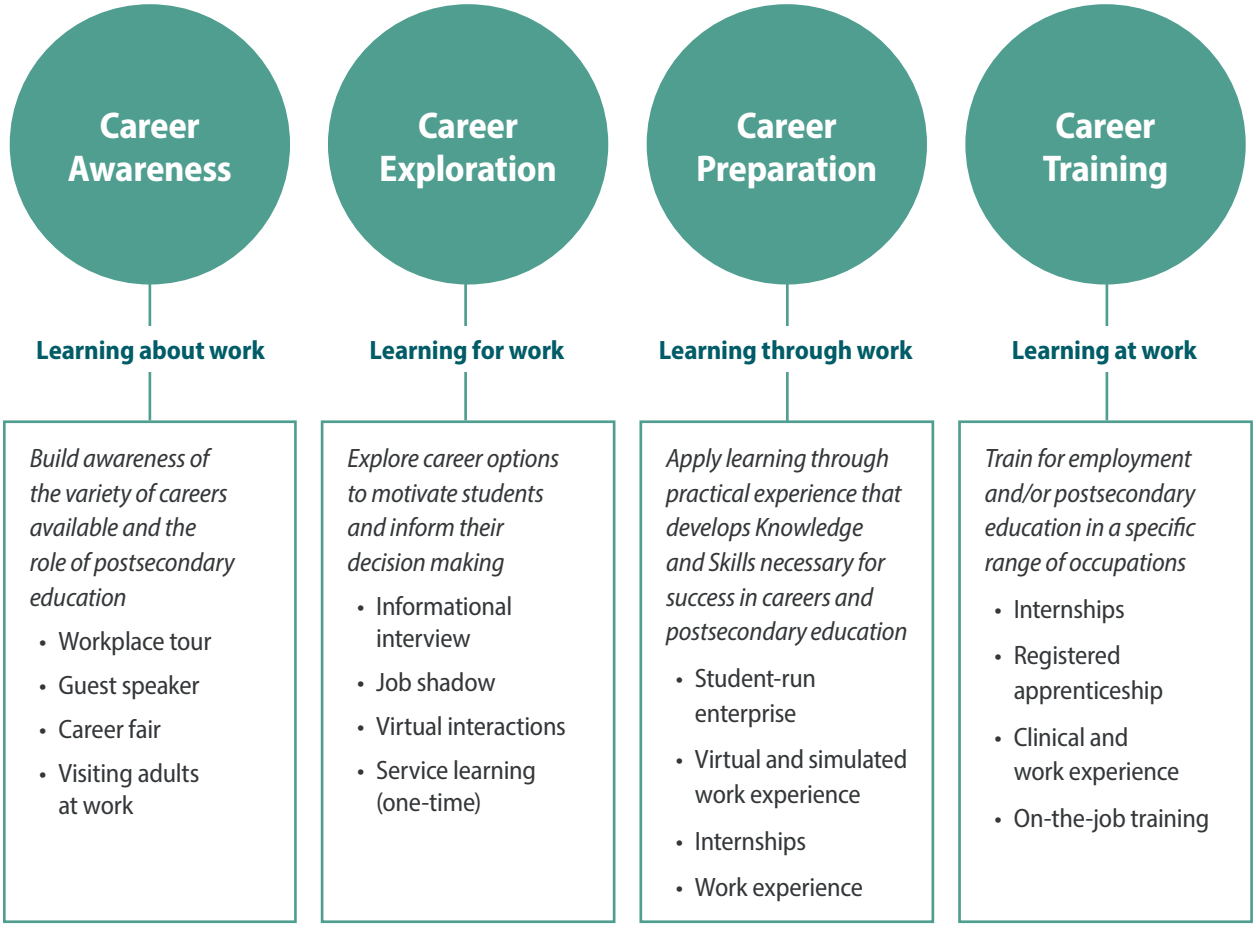
Table 2. Proposed Scope and Sequence for Automotive Service Technology and Heavy Equipment Service Technology

Course level	Grade	Course
Course 1	Grade 9 or 10	Introduction to Automotive Technology (survey course)
Course 2	Grade 10 or 11	Automotive Service Technology 1
		Collision Repair and Refinishing 1
		Diesel Technology 1
Course 3	Grade 11 or 12	Automotive Service Technology 2
		Collision Repair and Refinishing 2
		Diesel Technology 2
Capstone	Grade 12	Automotive Service Technology 3*
		Collision Repair and Refinishing 3*
		Diesel Service Technology 3*

*Or work-based learning experience

Additionally, all Programs of Study are expected to integrate a full range of **Career Connected Learning Experiences** that advance progressively, as indicated in Table 3.

Figure 2. Career Connected Learning Experiences



Developing a CTE Program of Study for State Approval

To meet Oregon's definition of a High-Quality Program of Study, a CTE Program of Study must be built around five core elements. These elements and supporting components, which align to the Association for Career and Technical Education's (ACTE's) High-Quality CTE Program of Study Framework, are detailed in Table 4.

Table 3. Elements and Supporting Components of a High-Quality CTE Program of Study

Element	Components
Standards and Content	***Rigorous Integrated Content:*** Appropriately licensed secondary teachers and postsecondary instructors integrate rigorous technical and academic content.
	Engaged Learning: Students are engaged through instructional strategies that are relevant and authentic, and meet the needs and interests of all students.
	Coherent Curriculum: Aligned to industry-identified standards and sequenced to prepare students for their next steps.
Alignment and Articulation	***Partnerships:*** Actively engages employer and educator partners to develop, enhance and support the CTE program in a manner that is sustainable.
	Credentials: Links instruction to meaningful college credit or industry credentials that can lead to high-wage, high-skill, and in-demand occupations.
	Facilities and Equipment: Provides students with safe access to facilities and equipment appropriate to the type of instruction and reflective of workforce needs.
Accountability and Evaluation	***Continuous Improvement:*** Revisions to the Program of Study are based on student performance, economic demand, and employer requirements.
Student Support Services	***Equity and Access:*** Provides all students and their families with appropriate knowledge and experiences to help make informed education and career decisions.
	Career Connected Learning: Provides quality, accurate and timely information and support that will help students identify, pursue, transition to, and complete pathways to future careers. Career Connected Learning should include activities and opportunities within the four domains of Awareness, Exploration, Preparation and Training.
Professional Development	***Professional Development:*** Promotes instructional long-term growth that aligns with long-term program goals.

Educators are encouraged to consult the **High Quality CTE Program of Study Rubric** and accompanying **Quick Guide to Using the High Quality CTE Program of Study Rubric** to assess their existing CTE Programs of Study and create goals for continuous improvement.

CTE Licensure Requirements. Automotive and Heavy Equipment Career Cluster

Educators seeking to teach in the Automotive and Heavy Equipment Career Cluster must possess a valid Oregon CTE endorsement. See **CTE Licensure in Oregon** for an overview of licensing requirements and the steps to be taken to receive an endorsement. Contact Margaret Mahoney (**Margaret.Mahoney@ode.oregon.gov**) for more information.

Career and Technical Student Organizations

Learning is enhanced when students can apply academic, technical, and employability skills in an authentic setting. Career and Technical Student Organizations (CTSOs) are extracurricular groups that offer youth the ability to practice and enhance their classroom learning, while developing personal skills and leadership abilities, through participation in activities, events, and competitions.

In the Automotive and Heavy Equipment field, there is one active CTSO in Oregon:

SkillsUSA (https://www.skillsusa.org/) is an industrial and engineering CTSO preparing student learners for careers in trade, technical and skilled service occupations. Students learn about entry-level, technical, and professional careers in a range of fields, including careers in the Automotive and Heavy Equipment Career Cluster.

Appendix A. Automotive and Heavy Equipment Career Cluster Knowledge and Skill Statements and Suggested Performance Indicators

Overview

This document details the Knowledge and Skill Statements comprising the Programs of Study for: (1) Automotive Service Technology, (2) Collision Repair and Refinishing, and (3) Heavy Equipment Service Technology. These statements, developed with input by employers, define the career readiness expectations of entry-level workers.

Skill statements for each focus area are based on task lists contained in the 2021 Automotive Service Excellence (ASE) program standards, which are used by the Board of the National Institute for Automotive Service Excellence for accreditation purposes.

In some instances, ASE program standards are written for careers requiring differing levels of skills. For example, the Automotive Service Technology standards are written for three occupational certification levels: Maintenance & Light Repair, Automobile Service Technician, and Master Automobile Service Technician. Similarly, the Medium/Heavy Truck program standards define three skill levels: Inspection, Maintenance, & Minor Repair, Medium/Heavy Truck Service Technician, and Medium/Heavy Master Truck Service Technician. *For the purposes of CTE instruction at the high school level, the focus areas for Automotive Service Technology apply only to the Maintenance & Light Repair and for Medium/Heavy Truck, to the Inspection, Maintenance, & Minor Repair levels*.

The ASE program standards are written to provide instructors with flexibility when designing programs. Each task is assigned a priority rating that designates the proportion of skills that must be taught or, in the case of Collision Repair and Refinishing, how skills must be taught. These ratings are classified by ASE as follows:

Automotive Service Technology: Maintenance & Light Repair

- **Priority 1.** At least 90 percent of all Priority 1 (ASE–P1) tasks must be taught
- **Priority 2.** At least 75 percent of all Priority 2 (ASE–P2) tasks must be taught
- **Priority 3.** At least 50 percent of all Priority 3 (ASE–P3) tasks must be taught

Collision Repair and Refinish

- **High Priority – Individual.** Task that requires students to demonstrate hands-on competency—95 percent of all High Priority Individual (ASE–HP–I) tasks must be taught
- **High Priority – Group.** Task that may be taught via video, demonstration, or teams—95 percent of all High Priority – Group (ASE–HP-G) tasks must be taught

Medium/Heavy Truck: Inspection, Maintenance, & Minor Repair

- **Priority 1.** At least 95 percent of all Priority 1 (ASE–P1) tasks must be taught
- **Priority 2.** At least 70 percent of all Priority 2 (ASE–P2) tasks must be taught
- **Priority 3.** At least 25 percent of all Priority 3 (ASE–P3) tasks must be taught

Faculty in Oregon community colleges offering related automotive training were asked to rate the relative importance of each ASE task for high school graduates entering a community college after having completed a CTE Program of Study at the high school level. These ratings included:

- **Critically important.** This skill would be expected of students entering a community college after having completed a CTE Program of Study at the high school level
- **Somewhat important.** This skill would be useful but not necessary for students entering a community college after having completed a CTE Program of Study at the high school level
- **Not important.** This skill would NOT be expected of students entering a community college after having completed a CTE Program of Study at the high school level (i.e., it will be taught at the college level)

These examples are intended to provide educators with guidance in establishing program standards and assessments and designing curriculum and instructional activities. *These performance indicators are offered as suggestions, not requirements, for addressing the Knowledge and Skill Statements comprising a Program of Study.*

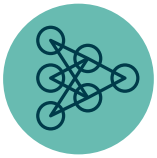
How to Use This Document

Educators offering a CTE Program of Study in the Automotive and Heavy Equipment Career Cluster should review the Knowledge and Skill statements and Suggested Performance Indicators in this document. Ideally, skills marked as Foundational will be taught during a student's high school CTE Program of Study experience, with educators determining how and when instruction occurs.

Three types of skills and indicators are provided:

Employability Knowledge and Skills – *Applicable to all Career Clusters—Foundational*

All learners are expected to master these basic skills to function in the workplace. These cross-cutting abilities, found in all jobs in all industries, encompass a broad range of communication, critical thinking, interpersonal, and organizational skills considered imperative for career success.



Career Cluster Knowledge and Skills – *Applicable to all careers in the Automotive and Heavy Equipment Cluster—Foundational*

All workers in the automotive industry are expected to have a broad understanding of the field. These cross-cutting skills prepare workers to succeed in a range of jobs. High school students mastering these skills are prepared to enter community college or the workforce with an understanding of their career options and training needs.

Focus Area Knowledge and Skills – *Applicable to a specific career*

Field-specific knowledge that an entry-level worker would be expected to possess. High school students mastering these skills are prepared to enter employment or enroll in a community college to pursue advanced training. Postsecondary graduates would be prepared to enter employment with a credential, certificate, or degree.

These skills have been classified based on their level of knowledge required for their mastery:

- ***Foundational Skills*** describe technical skills that all high school students completing a Program of Study would be expected to master. Ideally, these skills would be taught within a high school CTE Program of Study (or in collaboration with a postsecondary partner if it is not feasible within high school).
- ***Intermediate Skills*** describe more technically advanced skills that high school instructors are encouraged to teach, though some might be taught by community college faculty due to equipment or time constraints.

- ***Advanced Skills*** describe highly technical skills that high school instructors may choose to teach with the understanding that, due to their complexity, most will be taught by community college faculty as part of the postsecondary component of a CTE Program of Study.

Each Focus Area arrays the Knowledge and Skill statements and Suggested Performance Indicators that CTE educators should consider when planning their curriculum in Automotive Service Technology and Heavy Equipment Service Technology. Each statement and indicator include the level of skill master identified by community college instructors and priority rating assigned by the ASE Education Foundation for comparison purposes. Due to low survey response rates, skills could not be prioritized in Collision Repair and Refinish.

Each Knowledge and Skill statement includes a list of Suggested Performance Indicators that illustrate how students might demonstrate their understanding or abilities relating to each statement. Suggested Performance Indicators are offered as optional, industry-suggested and community college faculty-vetted way to demonstrate the Knowledge and Skill Statements. ***They are not required.*** It is anticipated that secondary and postsecondary educators will collaborate in selecting the number, type, and technical specificity of Suggested Performance Indicators, as well as the educational level at which they will be taught.

Automotive and Heavy Equipment Career Cluster Knowledge and Skill Statements

Employability Knowledge and Skills

These Knowledge and Skill statements apply to all Career Clusters in Oregon.

Code number	Knowledge and Skill Statement
E-01	Adhere to workplace practices
E-02	Exhibit personal responsibility and accountability
E-03	Practice cultural competence
E-04	Demonstrate teamwork and conflict resolution
E-05	Communicate clearly and effectively
E-06	Employ critical thinking to solve problems
E-07	Demonstrate creativity and innovative thinking
E-08	Demonstrate fluency in workplace technologies
E-09	Plan, organize, and manage work
E-10	Make informed career decisions

Career Cluster-Level Knowledge and Skills

These Knowledge and Skill statements apply to all Automotive and Heavy Equipment Programs of Study in Oregon.

Code number	Knowledge and Skill Statement
CC-AHE01	Describe the individuals and organizations that collaborate to service and repair automotive vehicles
CC-AHE02	Demonstrate an understanding of and adherence to safe working practices
CC-AHE03	Demonstrate the safe use of tools
CC-AHE04	Demonstrate knowledge of materials used in the automotive service industry
CC-AHE05	Describe the types and purposes of governmental regulations and applicable laws and rules
CC-AHE06	Demonstrate pre-task planning for vehicle service
CC-AHE07	Demonstrate basic measuring practice
CC-AHE08	Demonstrate an understanding of basic mathematics as used in the industry
CC-AHE09	Describe the contribution that the automotive service industry has on society and the economy

Focus Area Level Knowledge and Skills

These are updated Knowledge and Skill statements for the three Focus Area Programs of Study in the Automotive and Heavy Equipment Career Cluster.

AUTOMOTIVE SERVICE TECHNOLOGY

I. Engine Repair

Code number	Knowledge and Skill Statement
FA-AST01	**General.** Research vehicle history, assess engine status and operation, inspect for fluid leaks, and install engine covers as required
FA-AST02	**Cylinder head and valve train.** Identify cylinder head, and valve train components and configurations
FA-AST03	**Engine block assembly.** Identify engine block components and configurations
FA-AST04	**Lubrication and cooling systems.** Identify, inspect, adjust, and/or replace engine lubrication and cooling system components

II. Automatic Transmission and Transaxle

Code number	Knowledge and Skill Statement
FA-AST05	**General.** Identify, inspect, and demonstrate knowledge of transmission/transaxle components, configurations, and operation
FA-AST06	**In-Vehicle transmission/transaxle.** Inspect, demonstrate understanding of, and service in-vehicle transmission/transaxle
FA-AST07	**Off-Vehicle transmission/transaxle.** Describe the operational characteristics of a hybrid drive train and continuously variable transmission

III. Manual Drive Train and Axles

Code number	Knowledge and Skill Statement
FA-AST08	**General.** Identify components of manual transmission drive train check and service its components
FA-AST09	**Clutch.** Check and adjust clutch master cylinder
FA-AST10	**Transmission/transaxle.** Describe the operational characteristics of an electronically controlled manual transmission
FA-AST11	**Drive shaft, half shafts, universal joints, and constant velocity joints.** Inspect, remove, service, and/or replace shaft and joint components
FA-AST12	**Differential and drive axles – Ring and pinion gears and differential housing assembly.** Inspect, service, and/or replace differential housing fluids
FA-AST13	**Differential and drive axles.** Identify concerns related to tire circumference
FA-AST14	**Four-wheel drive/all-wheel drive.** Inspect and replace drive axle wheel studs

IV. Suspension and Steering

Code number	Knowledge and Skill Statement
FA-AST15	**General.** Identify, assess, and service suspension and steering components
FA-AST16	**Steering systems.** Inspect, remove, replace, and/or adjust steering system fluids and components
FA-AST17	**Suspension systems.** Inspect, remove, and/or replace suspension system components
FA-AST18	**Related suspension and steering service.** Inspect, remove, and/or replace, suspension and steering system components
FA-AST19	**Wheel alignment.** Describe and perform wheel alignment inspection
FA-AST20	**Wheels and tires.** Inspect, remove, repair and install tires and sensors

V. Brakes

Code number	Knowledge and Skill Statement
FA-AST21	**General.** Identify and describe procedures to check brake system components and configurations
FA-AST22	**Hydraulic system.** Describe hydraulic principals and identify, inspect, and service brake hydraulic systems
FA-AST23	**Drum brakes.** Remove, clean, inspect, and/or replace drum brakes
FA-AST24	**Disc brakes.** Remove, clean, inspect, and/or replace disc brakes
FA-AST25	**Power-assist units.** Identify components of brake power-assist and check brake travel
FA-AST26	**Related systems (i.e., wheel bearings, and parking brakes, electrical).** Remove, clean, inspect, and service wheel bearing and check parking brake operations and system components
FA-AST27	**Electronic brake control systems: Antilock brake (ABS), traction control (TCS) and electronic stability control (ESC) systems.** Identify and describe electronic brake control and regenerative braking systems

VI. Electrical/Electronic Systems

Code number	Knowledge and Skill Statement
FA-AST28	**General.** Identify and describe electrical/electronic system components and configurations and demonstrate ability to use tools and diagrams to inspect and test system
FA-AST29	**Batteries (conventional 12-volt).** Identify, inspect, clean, and perform operations related to battery maintenance
FA-AST30	**Starting system.** Inspect, test, remove and install starting system components
FA-AST31	**Charging system.** Inspect, test, adjust, and/or replace charging system components
FA-AST32	**Lighting systems.** Inspect operation of lighting systems
FA-AST33	**Instrument cluster and driver information systems.** Verify operation of instrument cluster and driver information systems
FA-AST34	**Body electrical systems.** Describe and demonstrate understanding of body electrical systems

VII. Heating, Ventilation, and Air Conditioning (HVAC)

Code number	Knowledge and Skill Statement
FA-AST35	**General.** Identify, inspect, and assess HVAC system components and configurations
FA-AST36	**Refrigeration system components.** Inspect refrigeration system components and/or replace belts, pulleys, and tensioners
FA-AST37	**Heating, ventilation and engine cooling systems.** Inspect engine cooling system components
FA-AST38	**Operating systems and related controls.** Inspect HVAC system air circulation components
FA-AST39	**Refrigerant recovery, recycling, and handling.** Demonstrate awareness of safe handling of refrigerants

VIII. Engine Performance

Code number	Knowledge and Skill Statement
FA-AST40	**General.** Research, record, and demonstrate understanding of engine cooling operations
FA-AST41	**Computerized controls.** Identify computerized control systems components and configuration
FA-AST42	**Ignition system.** Identify ignition system components and configuration
FA-AST43	**Fuel, air induction, and exhaust systems.** Identify, inspect, and replace fuel, air induction, and exhaust components as needed
FA-AST44	**Emissions control systems.** Identify, inspect, service, and/or replace system components as needed

COLLISION REPAIR AND REFINISH

I. Damage Analysis, Estimating, and Customer Service

Code number	Knowledge and Skill Statement
FA-CRR01	**Safety precautions.** Select proper safety equipment, locate vehicle procedures, and identify vehicle system precautions, and perform clean-up
FA-CRR02	**Damage analysis.** Identify and record pre-existing damage, analyze damage, and determine parts for removal and replacement
FA-CRR03	**Estimation.** Identify vehicle and options, apply appropriate estimating, determine necessary operations, determine charges, and document findings
FA-CRR04	**Vehicle construction and parts identification.** Identify components and repair/replacement procedures
FA-CRR05	**Customer relations and sales skills.** Demonstrate skills that support a positive customer relationship experience and provide information to support interaction

II. Painting and Refinishing

Code number	Knowledge and Skill Statement
FA-CRRL06	**Safety precautions.** Identify health hazards, inspect environment and select equipment, and perform clean-up
FA-CRRL07	**Surface preparation.** Inspect surface, identify finish, prepare surface, apply primer, paint, and sealer, and identify types of finishes
FA-CRRL08	**Spray gun and related equipment operation.** Inspect, select, test, and adjust spray gun and demonstrate understanding of its operation
FA-CRRL09	**Paint mixing, matching, and applying.** Identify color codes, prepare and apply refinish materials, and identify strategies for applying paints to address differing conditions
FA-CRRL10	**Paint defects – causes and cures.** Identify the types and causes of paint defects and how they can be corrected
FA-CRRL11	**Final detail.** Demonstrate how to remove defects and perform vehicle clean-up

III. Non-structural Analysis and Damage Repair (Body Components)

Code number	Knowledge and Skill Statement
FA-CRRL12	**Preparation.** Inspect remove, protect, label, store, inventory, and reinstall vehicle components
FA-CRRL13	**Outer body panel repairs, replacements, and adjustments.** Inspect remove, replace, and align vehicle components
FA-CRRL14	**Metal finishing and body filling.** Locate and repair surface irregularities and straighten contours using different types of fillers and techniques
FA-CRRL15	**Moveable glass and hardware.** Inspect, remove, repair, or replace window, roof panels, and related mechanisms and components
FA-CRRL16	**Plastics, adhesives, and welding.** Identify plastic types and repair using bonded and welding techniques

IV. Welding, Cutting, and Joining

Code number	Knowledge and Skill Statement
FA-CRRL17	**Metal welding, cutting, and joining.** Determine the correct GMAW welder type, set up and perform welds, and identify the causes of various welding defects

V. Structural Analysis and Damage Repair

Code number	Knowledge and Skill Statement
FA-CRRL18	**Frame inspection and repair.** Analyze, straighten, and align various types of vehicular structural damage
FA-CRRL19	**Unibody and unitized structure inspection, measurement, and repair.** Measure and diagnose unibody damage using differing measuring systems and straighten and repair vehicular components
FA-CRRL20	**Stationary glass.** Identify considerations for removal and remove, reinstall, or replace modular glass

VI. Mechanical and Electrical Components

Code	Knowledge and Skill Statement
FA-CRR21	**Suspension and steering.** Remove, replace, inspect, and replace suspension and steering components
FA-CRR22	**Electrical.** Check electrical systems and inspect, clean, repair, or replace fuses and battery components
FA-CRR23	**Brakes.** Inspect and replace brake lines, hoses, brake shoes or pads and check for damaged components
FA-CRR24	**Heating and air conditioning.** Identify, A/C system components, service A/C system fluids, and inspect, test, and replace A/C system components
FA-CRR25	**Cooling systems.** Inspect, test, remove, and/or replace cooling system components and fluids
FA-CRR26	**Drive train.** Inspect, remove, and/or replace drive train components
FA-CRR27	**Fuel, intake and exhaust systems.** Inspect, remove, and/or replace fuel, intake and exhaust components
FA-CRR28	**Restraint systems.** Inspect, remove, and/or replace seatbelt system and supplemental restraint system components

DIESEL AND HEAVY EQUIPMENT

I. Diesel Engines

Code number	Knowledge and Skill Statement
FA-DHE01	**General.** Research vehicle information, inspect engine fluid level and condition, perform diagnostics, and identify system components
FA-DHE02	**Cylinder head and valve train.** Inspect electronic wiring harness and brackets
FA-DHE03	**Engine block.** Inspect crankshaft and engine mounts
FA-DHE04	**Lubrication systems.** Test engine oil pressure and levels, and perform oil and filter service
FA-DHE05	**Cooling system.** Inspect coolant and coolant system components and replace as needed

Code number	Knowledge and Skill Statement
FA-DHE06	**Air induction and exhaust systems.** Inspect air induction and exhaust systems and replace or service components as needed
FA-DHE07	**Fuel system.** Check fluid levels and components and replace as needed
FA-DHE08	**Engine brakes.** Inspect engine compression and/or exhaust brake housing and components

II. Drive Train

Code number	Knowledge and Skill Statement
FA-DHE09	**General.** Identify drive train components
FA-DHE10	**Clutch.** Inspect and adjust clutch and clutch components and determine needed action
FA-DHE11	**Transmission.** Inspect transmission components, replace, covers, and determine needed action
FA-DHE12	**Driveshaft and universal joints.** Inspect, service and/or replace driveshaft and universal joint components
FA-DHE13	**Drive axles.** Check fluid levels and condition, inspect drive axel shafts, and remove and replace wheel assembly, determine needed action

III. Brakes

Code number	Knowledge and Skill Statement
FA-DHE14	**General.** Identify brake system components and configurations and identify performance problems
FA-DHE15	**Air brakes: Air supply and service systems.** Inspect air supply system components and verify gauge operation and readings
FA-DHE16	**Air brakes: Mechanical/foundation brake system.** Inspect brake system components and determine needed action
FA-DHE17	**Air brakes: Parking brake system.** Inspect and test parking brake components and determine needed action
FA-DHE18	**Hydraulic brakes: Hydraulic system.** Check master cylinder fluid level and condition, inspect hydraulic brake system components and operation
FA-DHE19	**Hydraulic brakes: Mechanical/foundation brake system.** Inspect and measure rotor, disk brake, and brake drum components
FA-DHE20	**Hydraulic brakes: Parking brake system.** Check parking brake operation
FA-DHE21	**Power assist systems.** Check brake assist/booster system components and emergency (back-up/reserve)

Code number	Knowledge and Skill Statement
FA-DHE22	**Vehicle dynamic brake systems (air and hydraulic); Antilock Brake System (ABS), Automatic Traction Control (ATC) system, and Electronic Stability Control (ESC) system.** Observe ABS and ATC and ESC warning light operations
FA-DHE23	**Wheel bearings.** Inspect, lubricate, and/or replace wheel bearings and hub bearing assemblies

IV. Suspension and Steering Systems

Code number	Knowledge and Skill Statement
FA-DHE24	**General.** Identify suspension and steering system components and configurations
FA-DHE25	**Steering column.** Check steering wheel operation and mounting
FA-DHE26	**Steering pump and gear units.** Check power steering pump and gear operations and flush and refill system
FA-DHE27	**Steering linkage.** Inspect steering linkage components
FA-DHE28	**Suspension systems.** Inspect suspension system components (e.g., shock absorbers, spring, and axles)
FA-DHE29	**Wheel alignment.** Demonstrate understanding of alignment angles
FA-DHE30	**Wheels and tires.** Inspect tire conditions and wheel mounting hardware and identify potential problems
FA-DHE31	**Frame and coupling devices.** Inspect frame components and configurations and service and/or adjust fifth wheel

V. Electrical/Electronic Systems

Code number	Knowledge and Skill Statement
FA-DHE32	**General.** Demonstrate knowledge of electrical/electronic principles, proper use of test equipment, and problems in electrical/electronic circuits
FA-DHE33	**Battery system.** Identify battery type and system configurations, and inspect, charge, and/or jump-start vehicles
FA-DHE34	**Starting system.** Demonstrate understanding of starter system operation, components, and configurations
FA-DHE35	**Charging system.** Identify, check, and inspect charging system components and configurations
FA-DHE36	**Lighting system.** Inspect lighting system components and configurations
FA-DHE37	**Instrument cluster and driver information systems.** Check indicator operation and identify components and configurations

VI. Heating, Ventilation, and Air Conditioning (HVAC)

Code number	Knowledge and Skill Statement
FA-DHE38	**General.** Identify HVAC components and configuration
FA-DHE39	**Refrigeration system components.** Inspect A/C system components and operation and determine needed action
FA-DHE40	**Heating, ventilation, and engine cooling systems.** Inspect engine cooling components and operation and identify A/C system odors
FA-DHE41	**Operating systems and related controls.** Verify blower operation, air distribution, and temperature controls and determine action

VII. Cab

Code number	Knowledge and Skill Statement
FA-DHE42	**General.** Use appropriate electronic service tools and procedures
FA-DHE43	**Instruments and controls.** Inspect ignition system components and understand operation of auxiliary and electric power units
FA-DHE44	**Safety equipment.** Check operation and condition of safety equipment
FA-DHE45	**Hardware.** Check operation of cab hardware (e.g., wipers, windshield), lubricate cab grease fittings, and inspect cab mountings and fender components

VIII. Hydraulics

Code number	Knowledge and Skill Statement
FA-DHE46	**General.** Identify and inspect hydraulic system components and check fluid level and condition

Employability Knowledge and Skill Statements with Suggested Performance Indicators

● **Foundational -** *Basic skills that **should be taught** within high school or, if not feasible, at a partnering college*

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational
E-01 ***Adhere to workplace practices***	A. Explain and follow workplace standards, rules, and regulations B. Show up on time and prepared to work C. Demonstrate the ability to take direction, be proactive, and work independently	●
E-02 ***Exhibit personal responsibility and accountability***	A. Apply professional and ethical standards of the industry to personal conduct B. Maintain integrity and promote personal and professional integrity in co-workers C. Take responsibility and carry out work assignments	●
E-03 ***Practice cultural competence***	A. Demonstrate awareness of issues related to diversity, equity, and inclusion B. Work effectively with colleagues of differing abilities, cultures, and backgrounds C. Describe issues relating to workplace harassment D. Model behaviors that are respectful and sensitive of others	●
E-04 ***Demonstrate teamwork and conflict resolution***	A. Demonstrate the ability to collaborate and contribute to the work of a diverse team B. Explain when it is appropriate to lead and when to follow another's lead C. Demonstrate strategies for resolving issues with coworkers	●
E-05 ***Communicate clearly and effectively***	A. Listen attentively, and speak and write clearly to convey information correctly B. Interpret information and instructions presented in verbal and written form C. Demonstrate effective communication with colleagues, supervisors, customers, and suppliers D. Demonstrate the ability to communicate verbally, in writing, and using electronic communication tools	●

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational
E-06 ***Employ critical thinking to solve problems***	A. Recognize problems in the workplace and diagnose their root causes B. Develop well-reasoned plans to solve identified challenges C. Apply and follow through on plans to ensure that problems are resolved	●
E-07 ***Demonstrate creativity and innovative thinking***	A. Develop ideas to solve problems in new and different ways B. Investigate one's own and others' ideas to find those with greatest applicability C. Develop and deploy plans to implement new ideas in the workplace	●
E-08 ***Demonstrate fluency in workplace technologies***	A. Demonstrate knowledge and application of general technology skills, including hardware and software commonly used in the industry B. Use online communication, networking tools and social networks to access, manage, evaluate, and create information to successfully function in a knowledge economy C. Describe and demonstrate a fundamental understanding of the ethical, legal, and security issues surrounding access to and use of information technologies	●
E-09 ***Plan, organize, and manage work***	A. Identify an intended project outcome including available inputs, materials, labor, timeline for producing work, and job-site obligations B. Effectively plan, monitor, and complete projects on time and within budget using available resources and materials C. Demonstrate ability to write coherent reports and project summaries to communicate the progress of project work and its adherence to schedule	●
E-10 ***Make informed career decisions***	A. Identify job and entrepreneurial opportunities in the industry and the required education and credentials to obtain employment B. Set short- and long-term career goals based on personal interests and aptitudes C. Maintain a project portfolio D. Develop a professional resume E. Explain and demonstrate how to cultivate and maintain a professional presence in an online environment, including the appropriate use of social media and networking platforms	●

Automotive and Heavy Equipment Career Cluster Knowledge and Skill Statements with Suggested Performance Indicators

● **Foundational -** *Basic skills that **should be taught** within high school or, if not feasible, at a partnering college*

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational
CC-AHE01 ***Describe the individuals and organizations that collaborate to service and repair automotive vehicles***	A. Identify the types of organizations that are engaged in the automotive service and repair industry (e.g., dealerships, aftermarket service and repair facilities) B. Identify the roles and responsibilities of employees in the automotive service industry (e.g., technicians, managers, marketing, customer service) C. Describe how individuals from different disciplines collaborate to deliver automotive services (e.g., insurance, parts suppliers) D. Describe the role and responsibilities of a technician within the automotive service and repair industry	●
CC-AHE02 ***Demonstrate an understanding of and adherence to safe working practices***	A. Describe general shop safety rules and procedures B. Demonstrate awareness of and take steps to redress common shop hazards C. Describe the types of injuries technicians are at greatest risk of experiencing (e.g., abrasions, burns, back, damage to eyes and fingers) and the treatments to address them D. Describe and demonstrate the use and care of personal protective equipment E. Identify vehicle systems that pose a safety hazard during repair (e.g., supplemental restraint systems, electronic brake control systems, stop/start systems) F. Describe safety considerations associated with the servicing of electric/hybrid vehicles G. Explain the purpose and use of Safety Data Sheets	●

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational
CC-AHE03 ***Demonstrate the safe use of tools***	A. Identify the hand and power tools commonly used in the field and describe their uses (e.g., wrenches, sockets, torque wrench, air tools) B. Demonstrate the use of hand and power tools commonly utilized in the industry in a safe manner C. Demonstrate how to maintain, clean, and store hand and power tools commonly used in the field	●
CC-AHE04 ***Demonstrate knowledge of materials used in the automotive service industry***	A. Identify the different types and grades of fluids, fuels, and lubricants and their uses B. Describe the different types of fasteners and connectors used in the automotive service industry and explain their uses C. Describe the types of batteries used in EV and hybrid vehicles and their uses D. Describe the types of parts commonly used in the automotive service industry (e.g., Original Equipment Manufacturer, aftermarket) E. Describe considerations in assessing parts for quality and safety	●
CC-AHE05 ***Describe the types and purposes of governmental regulations and applicable laws and rules***	A. Describe requirements related to handling and disposal of environmentally hazardous materials in accordance with the material safety data sheet (MSDS), the Occupational Safety and Health Administration (OSHA), and the Environmental Protection Agency (EPA) regulations B. State the purpose of regulations and certification requirements C. Explain the types of occupation-specific governmental regulations and federal, state, and local codes and regulations that apply in the industry and how the professions engage with them	●

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational
CC-AHE06 ***Demonstrate pre-task planning for vehicle service***	A. Describe the information needed to prepare a vehicle service repair order B. Describe the scope and sequence of activities needed to stage and perform the daily scope of work C. Identify and safely assemble the equipment required to conduct the daily scope of work D. Describe the existence and application of quality control and assurance procedures within the industry E. Estimate the time and materials needed to perform the daily scope of work F. Identify jobsite hazards related to the daily scope of work and take steps to mitigate them	●
CC-AHE07 ***Demonstrate basic measuring practice***	A. Describe and use imperial and metric units of length B. Identify and demonstrate the use of precision measuring tools (e.g., micrometer, dial-indicator, dial-caliper) C. Describe the types of measurements commonly performed on automotive parts and demonstrate how to make these measurements using tools used to conduct them (e.g., measurement cylinder walls, brake shoes, high-voltage battery readings)	●
CC-AHE08 ***Demonstrate an understanding of basic mathematics as used in the industry***	A. Add, subtract, multiply, and divide whole numbers, fractions, and decimals with and without a calculator B. Demonstrate an understanding of basic principles of density, pressure, and temperature C. Demonstrate how to determine area, volume, and length measurements using square feet, cubic feet, and yards D. Demonstrate an understanding of basic concepts of geometry (e.g., angles, diameters)	●
CC-AHE09 ***Describe the contribution that the automotive service industry has on society and the economy***	A. Describe the role that transportation plays in the American economy B. Explain the role of the automotive, collision, and heavy equipment service industry to the transportation sector C. Describe trends in the automotive service industry (e.g., transition to EV/hybrid vehicles, autonomous vehicles) and the potential effects on the field	●

Automotive Service Technology Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

- ● **Foundational -** *Basic skills that **should be taught** within high school or, if not feasible, at a partnering college*
- ■ **Intermediate -** *Advanced skills **encouraged to be taught** within high school, with some offered at a partnering college*
- ▲ **Advanced -** *Highly technical skills that **may be taught** within high school, with most offered at a partnering college*

I. Engine Repair

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST01. General ***Research vehicle history, assess engine status and operation, inspect for fluid leaks, and install engine covers as required***	A. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS) (ASE-P1) B. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed (ASE-P1) C. Verify operation of the instrument panel engine warning indicators (ASE-P1) D. Inspect engine assembly for fuel, oil, coolant, and other leaks (ASE-P1) E. Install engine covers using gaskets, seals, and sealers as required (ASE-P2) F. Demonstrate understanding of the procedure for verifying engine mechanical timing (ASE-P2) G. Identify service precautions related to service of the internal combustion engine of a hybrid electric vehicle (ASE-P2) H. Inspect engine mounts (ASE-P2)	A. ● B. ● C. ● D. ● E. ● F. ● G. ●	H. ■	
FA-AST02. Cylinder head and valve train ***Identify cylinder head, and valve train components and configurations***	A. Identify cylinder head and valve train components and configurations (ASE-P1)	A. ●		

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST03. Engine block assembly ***Identify engine block components and configurations***	A. Identify engine block assembly components and configurations (ASE-P1)	A. ●		
FA-AST04. Lubrication and cooling systems ***Identify, inspect, adjust, and/or replace engine lubrication and cooling system components***	A. Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required (ASE-P1) B. Inspect and test coolant; drain and recover coolant; flush and/or refill cooling system; use proper fluid type per manufacturer specification; bleed air as required (ASE-P1) C. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, heater core, and galley plugs (ASE-P1) D. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment (ASE-P1) E. Identify lubrication and cooling system components and configurations (ASE-P1) F. Identify causes of engine overheating (ASE-P2) G. Remove, inspect, and replace thermostat and gasket/seal (ASE-P1) H. Identify type of water pumps (belt driven, chain driven, and electric) (ASE-P3)	A. ● B. ● C. ● D. ●	E. ■ F. ■ G. ■	H. ▲

II. Automatic Transmission and Transaxle

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST05. General ***Identify, inspect, and demonstrate knowledge of transmission/transaxle components, configurations, and operation***	A. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick (ASE-P1) B. Identify automatic transmission and transaxle components and configurations (ASE-P1) C. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed (ASE-P1) D. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick (ASE-P3) E. Demonstrate knowledge of transmission/transaxle gear reduction/multiplication operation using driving, driven, and held member (power flow) principles (ASE-P3) F. Demonstrate knowledge of hydraulic principles (Pascal's Law) in a transmission/transaxle (ASE-P3)	A. ●	B. ■ C. ■ D. ■ E. ■ F. ■	
FA-AST06. In-vehicle transmission/transaxle ***Inspect, demonstrate understanding of, and service in-vehicle transmission/transaxle***	A. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification (ASE-P1) B. Inspect external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch (ASE-P2) C. Demonstrate understanding of relearn procedures (ASE-P2) D. Inspect, replace and/or align power train mounts (ASE-P3)	A. ●	B. ■ C. ■	D. ▲
FA-AST07. Cylinder head and valve train ***Identify cylinder head, and valve train components and configurations***	A. Describe the operational characteristics of a hybrid vehicle drive train (ASE-P2) B. Describe the operational characteristics of a continuously variable transmission (CVT) (ASE-P3)			A. ▲ B. ▲

III. Manual Drive Train and Axles

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST08. General ***Identify components of manual transmission drive train check and service its components***	A. Identify manual drive train and axle components and configurations (ASE-P1) B. Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification (ASE-P1) C. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed (ASE-P1) D. Check fluid condition; check for leaks (ASE-P2)	A. ● B. ●	C. ■ D. ■	
FA-AST09. Clutch ***Check and adjust clutch master cylinder***	A. Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification (ASE-P3)		A. ■	
FA-AST10. Transmission/ transaxle ***Describe the operational characteristics of an electronically controlled manual transmission***	A. Describe the operational characteristics of an electronically controlled manual transmission/transaxle (ASE-P2)		A. ■	
FA-AST11. Drive shaft, half shafts, universal joints, and constant velocity joints ***Inspect, remove, service, and/or replace shaft and joint components***	A. Inspect and/or remove/replace bearings, hubs, and seals (ASE-P2) B. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification (ASE-P2) C. Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints (ASE-P2)		A. ■ B. ■ C. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST12. Differential and drive axles – Ring and pinion gears and differential housing assembly ***Inspect, service, and/or replace differential housing fluids***	A. Inspect differential housing; check for leaks; inspect housing vent (ASE-P1) B. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification (ASE-P1) C. Drain and refill differential housing; using proper fluid type per manufacturer specification (ASE-P1)	A. ● B. ● C. ●		
FA-AST13. Differential and drive axles ***Identify concerns related to tire circumference***	A. Inspect and replace drive axle wheel studs (ASE-P2)		A. ■	
FA-AST14. Four-wheel drive/all-wheel drive ***Inspect and replace drive axle wheel studs***	A. Identify concerns related to variations in tire circumference and/or final drive ratios (ASE-P3)			A. ▲

IV. Suspension and Steering

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST15. General ***Identify, assess, and service suspension and steering components***	A. Identify suspension and steering system components and configurations (ASE-P1) B. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed (ASE-P1) C. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation (ASE-P2)		A. ■ B. ■ C. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST16. Steering systems ***Inspect, remove, replace, and/or adjust steering system fluids and components***	A. Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots (ASE-P1) B. Inspect power steering fluid level and condition (ASE-P2) C. Inspect for power steering fluid leakage (ASE-P2) D. Inspect pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, steering linkage damper (ASE-P2) E. Inspect tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion) (ASE-P2) F. Remove, inspect, replace, and/or adjust power steering pump drive belt (ASE-P2) G. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification (ASE-P2) H. Inspect electric power steering system (ASE-P2) I. Inspect, remove, and/or replace power steering hoses and fittings (ASE-P2)	A. ●	B. ■ C. ■ D. ■ E. ■ F. ■ G. ■ H. ■	I. ▲
FA-AST17. Suspension systems ***Inspect, remove, and/or replace suspension system components***	A. Inspect components of suspension systems (Coil, Leaf, and Torsion) (ASE-P1) B. Inspect upper and/or lower ball joints (with or without wear indicators) (ASE-P2) C. Inspect upper and/or lower control arms, bushings, and shafts (ASE-P2) D. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount (ASE-P2) E. Inspect track bar, strut rods/radius arms, and related mounts and bushings (ASE-P2) F. Inspect and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links (ASE-P2) G. Inspect components of electronically controlled suspension systems (ASE-P2) H. Inspect suspension system coil springs and spring insulators (ASE-P2) I. Inspect and replace rebound/jounce bumpers (ASE-P3) J. Inspect torsion bars and mounts (ASE-P3)	A. ●	B. ■ C. ■ D. ■ E. ■ F. ■ G. ■	H. ▲ I. ▲ J. ▲

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST18. Related suspension and steering service ***Inspect, remove, and/or replace, suspension and steering system components***	A. Inspect front and rear wheel bearings (ASE-P1) B. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings (ASE-P2) C. Describe the function of electronically controlled suspension and steering systems and components, (i.e., active suspension and stability control) (ASE-P2)	A. ●	B. ■ C. ■	
FA-AST19. Wheel alignment ***Describe and perform wheel alignment inspection***	A. Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling ire wear (ASE-P1) B. Perform pre-alignment inspection; measure vehicle ride height (ASE-P2)	A. ● B. ●		
FA-AST20. Wheels and tires ***Inspect, remove, repair and install tires and sensors***	A. Inspect tire condition/age; identify tire wear patterns; check for correct tire size, application (service-class, load, and speed ratings), and air pressure as listed on the tire information placard/label (ASE-P1) B. Rotate tires according to manufacturer's recommendations including vehicles equipped with tire pressure monitoring systems (TPMS) (ASE-P1) C. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly (ASE-P1) D. Inspect tire and wheel assembly for air loss; determine needed action (ASE-P1) E. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS) (ASE-P1) F. Repair tire following tire manufacturer approved procedure (ASE-P1) G. Identify indirect and direct tire pressure monitoring systems (TPMS); calibrate/relearn system; verify operation of instrument panel lamps (ASE-P1) H. Perform Road Force balance/match mounting (ASE-P3)	A. ● B. ● C. ● D. ● E. ●	F. ■ G. ■ H. ■	

V. Brakes

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST21. General ***Identify and describe procedures to check brake system components and configurations***	A. Identify brake system components and configurations (ASE-P1) B. Install wheel and torque lug nuts (ASE-P1) C. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS) (ASE-P1) D. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed (ASE-P1)	A. ● B. ● C. ●	D. ■	
FA-AST22. Hydraulic system ***Describe hydraulic principals and identify, inspect, and service brake hydraulic systems***	A. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification (ASE-P1) B. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports (ASE-P1) C. Bleed and/or replace fluid in the brake system (ASE-P1) D. Describe proper brake pedal height, travel, and feel (ASE-P1) E. Demonstrate understanding of hydraulic principals (Pascal's law) (ASE-P1) F. Check master cylinder for proper operation (ASE-P1) G. Test brake fluid for contamination (ASE-P2) H. Identify components of hydraulic brake warning light system (ASE-P3)	A. ● B. ● C. ● D. ●	E. ■ F. ■ G. ■ H. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST23. Drum brakes ***Remove, clean, inspect, and/or replace drum brakes***	A. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability (ASE-P2) B. Remove, clean, inspect, and/or replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble (ASE-P3) C. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed (ASE-P3) D. Refinish brake drum and measure final drum diameter; compare with specification (ASE-P3) E. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments (ASE-P3)		A. ■ B. ■ C. ■ D. ■ E. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST24. Disc brakes ***Remove, clean, inspect, and/or replace disc brakes***	A. Inspect caliper mounting and slides/pins for proper operation, wear, and damage (ASE-P1) B. Remove and clean caliper assembly; inspect for leaks and damage, and wear (ASE-P1) C. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks (ASE-P1) D. Clean and inspect rotor and mounting surface, measure rotor thickness, thickness variation, and lateral runout (ASE-P1) E. Remove and reinstall/replace rotor (ASE-P1) F. Remove, inspect, and/or replace brake pads and retaining hardware (ASE-P1) G. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendation (ASE-P2) H. Refinish rotor on vehicle; measure final rotor thickness and compare with specification (ASE-P3) I. Retract and re-adjust caliper piston on an integrated parking brake system (ASE-P2) J. Refinish rotor off vehicle; measure final rotor thickness and compare with specification (ASE-P3)	A. ● B. ● C. ● D. ● E. ● F. ●	G. ■ H. ■ I. ■ J. ■	
FA-AST25. Power-assist units ***Identify components of brake power-assist and check brake travel***	A. Identify components of the brake power assist system (vacuum/ hydraulic/electric) (ASE-P2) B. Check brake pedal travel with and without engine running to verify proper power booster operation (ASE-P2)		A. ■ B. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST26. Related systems (i.e., wheel bearings, and parking brakes, electrical) ***Remove, clean, inspect, and service wheel bearing and check parking brake operations and system components***	A. Check operation of brake stop light system (ASE-P1) B. Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation (ASE-P2) C. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed (ASE-P2) D. Remove, clean, inspect, repack/replace, and install wheel bearings; remove and install bearing races; replace seals; install hub and adjust bearings (ASE-P3) E. Inspect and replace wheel studs (ASE-P2)	A. ● B. ●	C. ■ D. ■	E. ▲
FA-AST27. Electronic brake control systems: Antilock brake (ABS), traction control (TCS) and electronic stability control (ESC) systems ***Identify and describe electronic brake control and regenerative braking systems***	A. Identify electronic brake control system components and describe function (ABS, TCS, ESC) (ASE-P2) B. Describe the operation of a regenerative braking system (ASE-P3)		A. ■	B. ▲

VI. Electrical/Electronic Systems

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST28. General ***Identify and describe electrical/electronic system components and configurations and demonstrate ability to use tools and diagrams to inspect and test system***	A. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits (ASE-P1) B. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance (ASE-P1) C. Use wiring diagrams to trace electrical/electronic circuits (ASE-P1) D. Inspect and test fusible links, circuit breakers, and fuses (ASE-P1) E. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law) (ASE-P1) F. Identify electrical/electronic system components and configurations (ASE-P1) G. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed (ASE-P1) H. Describe types of test lights; use appropriate test light to check operation of electrical circuits per service information (ASE-P2) I. Measure key-off battery drain (parasitic draw) (ASE-P2) J. Use fused jumper wires to check operation of electrical circuits per service information (ASE-P2) K. Repair and/or replace connectors, terminal ends, and wiring of electrical/electronic systems (including solder repair) (ASE-P2)	A. ● B. ● C. ● D. ● E. ● F. ●	G. ■ H. ■ I. ■ J. ■	K. ▲

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST29. Batteries (conventional 12-volt) ***Identify, inspect, clean, and perform operations related to battery maintenance***	A. Perform battery state-of-charge test; determine needed action (ASE-P1) B. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply (ASE-P1) C. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test (ASE-P1) D. Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold downs (ASE-P1) E. Perform battery charging according to manufacturer's recommendations (ASE-P1) F. Maintain or restore electronic memory functions as recommended by manufacturer (ASE-P2) G. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery (ASE-P2)	A. ● B. ● C. ● D. ● E. ●	F. ■ G. ■	
FA-AST30. Starting system ***Inspect, test, remove and install starting system components***	A. Perform starter circuit voltage drop tests (ASE-P1) B. Perform starter current draw test (ASE-P1) C. Inspect and test starter relays and solenoids (ASE-P2) D. Inspect and test switches, connectors, and wires of starter control circuits (ASE-P2) E. Demonstrate knowledge of an automatic idle-stop/start-stop system (ASE-P2) F. Remove and install starter in a vehicle (ASE-P3)	A. ● B. ●	C. ■ D. ■	E. ▲ F. ▲
FA-AST31. Charging system ***Inspect, test, adjust, and/or replace charging system components***	A. Perform charging system output test (ASE-P1) B. Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment (ASE-P1) C. Perform charging circuit voltage drop tests (ASE-P2) D. Remove, inspect, and/or replace generator (alternator) (ASE-P3)	A. ● B. ● C. ●		D. ▲

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST32. Lighting systems ***Inspect operation of lighting systems***	A. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed (ASE-P1) B. Aim headlights (ASE-P2)	A. ●		B. ▲
FA-AST33. Instrument cluster and driver information systems ***Verify operation of instrument cluster and driver information systems***	A. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required (ASE-P1)	A. ●		
FA-AST34. Body electrical systems ***Describe and demonstrate understanding of body electrical systems***	A. Verify windshield wiper and washer operation; replace wiper blades (ASE-P1) B. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation (ASE-P2) C. Demonstrate understanding of vehicle comfort, convenience, access, safety, and related systems operation (ASE-P3) D. Remove and reinstall door panel (ASE-P2) E. Describe the operation of keyless entry/remote-start systems (ASE-P3)		A. ■ B. ■ C. ■	D. ▲ E. ▲

VII. Heating, Ventilation, and Air Conditioning (HVAC)

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST35. General ***Identify, inspect, and assess HVAC system components and configurations***	A. Visually inspect A/C system for signs of leaks (ASE-P1) B. Identify heating, ventilation, and air conditioning (HVAC) components and configurations (ASE-P1) C. Identify and interpret heating and air conditioning problems (ASE-P1) D. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed (ASE-P1) E. Identify steps of an A/C performance test (ASE-P2) F. Identify abnormal operating noises in the A/C system (ASE-P3)	A. ●	B. ■ C. ■ D. ■ E. ■	F. ▲
FA-AST36. Refrigeration system components ***Inspect refrigeration system components and/or replace belts, pulleys, and tensioners***	A. Inspect evaporator housing condensation drain (ASE-P1) B. Inspect and/or replace A/C compressor drive belts, pulleys, and tensioners (ASE-P1) C. Inspect for proper A/C condenser airflow (ASE-P2)		A. ■ B. ■ C. ■	
FA-AST37. Heating, ventilation and engine cooling systems ***Inspect engine cooling system components***	A. Inspect engine cooling and heater systems hoses and pipes (ASE-P1)	A. ●		
FA-AST38. Operating systems and related controls ***Inspect HVAC system air circulation components***	A. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets (ASE-P1) B. Identify the source of HVAC system odors (ASE-P2)		A. ■	B. ▲

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST39. Refrigerant recovery, recycling, and handling *Demonstrate awareness of safe handling of refrigerants*	A. Demonstrate awareness of the need to recover, recycle, and handle refrigerants using proper equipment and procedures (ASE-P1)	A. ●		

VIII. Engine Performance

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST40. General *Research, record, and demonstrate understanding of engine cooling operations*	A. Demonstrate understanding of proper engine cooling system operation (ASE-P1) B. Demonstrate understanding of camshaft timing including engines equipped with variable valve timing (VVT) systems (ASE-P1) C. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed (ASE-P1)	A. ●	B. ■ C. ■	
FA-AST41. Computerized controls *Identify computerized control systems components and configuration*	A. Identify computerized control system components and configurations (ASE-P1)		A. ■	
FA-AST42. Ignition system *Identify ignition system components and configuration*	A. Identify ignition system components and configurations (ASE-P1) B. Remove and replace spark plugs; inspect secondary ignition components for wear and damage (ASE-P2)	A. ●	B. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-AST43. Fuel, air induction, and exhaust systems ***Identify, inspect, and replace fuel, air induction, and exhaust components as needed***	A. Identify fuel, air induction, and exhaust system components and configurations (ASE-P1) B. Inspect, service, or replace air filters, filter housings, and intake duct work (ASE-P1) C. Replace fuel filter(s) where applicable (ASE-P2) D. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields (ASE-P1) E. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields (ASE-P1) F. Check and refill diesel exhaust fluid (DEF) (ASE-P3)	A. ●	B. ■ C. ■ D. ■ E. ■	F. ▲
FA-AST44. Emissions control systems ***Identify, inspect, service, and/or replace system components as needed***	A. Identify emission control system components and configurations (ASE-P1) B. Inspect, test, and service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses (ASE-P2)	A. ●	B. ■	

Collision Repair and Refinish Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

I. Damage Analysis, Estimating, and Customer Service

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRR01. Safety precautions ***Select proper safety equipment, locate vehicle procedures, and identify vehicle system precautions, and perform clean-up***	A. Select and use proper personal safety equipment; take necessary precautions with hazardous operations and materials in accordance with federal, state, and local regulations (ASE-HP-I) B. Locate OEM procedures to identify material and composition of the vehicle being repaired (mild steel, high strength steel, ultra-high strength steel, aluminum, etc.) (ASE-HP-I) C. Locate procedures and precautions that may apply to the vehicle being repaired (ASE-HP-I) D. Identify vehicle system precautions and/or inspections to include but not limited to supplemental restraint system (SRS), advanced driver assistance systems (ADAS), hybrid/electric/alternative fuel vehicles, locations and recommended procedures before inspecting or replacing components (ASE-HP-I) E. Perform vehicle clean-up; complete quality control using a checklist on operations performed (ASE-HP-I)
FA-CRR02. Damage analysis ***Identify and record pre-existing damage, analyze damage, and determine parts for removal and replacement***	A. Position the vehicle for inspection under proper lighting; take photos to identify the vehicle and document damage (ASE-HP-I) B. Identify components to be removed to gain access to damaged areas (ASE-HP-G) C. Analyze damage to determine appropriate methods for overall repairs (ASE-HP-G) D. Determine the direction, point(s) of impact, and extent of direct, indirect, and inertia damage (ASE-HP-G) E. Gather details of the incident/accident necessary to determine the full extent of vehicle damage (ASE-HP-G) F. Identify and record pre-existing damage (ASE-HP-G) G. Identify and record prior repairs (ASE-HP-G) H. Perform visual inspection of structural components (ASE-HP-G) I. Identify structural damage using measuring tools and equipment (ASE-HP-I) J. Perform visual inspection of non-structural components (ASE-HP-I) K. Determine parts, components, material type(s) and procedures necessary for proper repair (ASE-HP-I) L. Identify type and condition of finish; determine refinish labor operations as required (ASE-HP-I) M. Identify suspension, electrical, and mechanical component physical damage (ASE-HP-G) N. Identify safety systems physical damage (ASE-HP-G) O. Identify interior component damage (ASE-HP-G) P. Identify add-on accessories and modifications (ASE-HP-G)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
	Q. Identify single (one time) use components (ASE-HP-G) R. Identify and document illuminated dash malfunction indicator lamp(s) (MIL) (ASE-HP-I) S. Perform a pre-repair inspection of the vehicle with the customer T. Record fit and finish concerns (color mismatch, factory gaps, unrelated prior damage, and prior repairs) (ASE-HP-G)
FA-CRR03. Estimation ***Identify vehicle and options, apply appropriate estimating, determine necessary operations, determine charges, and document findings***	A. Determine and record customer/vehicle owner information (ASE-HP-I) B. Identify and record vehicle identification number (VIN) information, including nation of origin, make, model, restraint system, body type, production date, engine type, build data, and assembly plant (ASE-HP-I) C. Identify and record vehicle mileage and options, including trim level, paint code, transmission, accessories, and modifications (ASE-HP-I) D. Identify safety systems; determine precautions, inspections and replacement items as required (ASE-HP-G) E. Apply appropriate estimating and parts nomenclature (terminology) (ASE-HP-I) F. Determine and apply appropriate estimating sequence (ASE-HP-I) G. Utilize estimating procedure pages (ASE-HP-I) H. Apply estimating footnotes, headnotes, and line notes as needed (ASE-HP-I) I. Identify operations requiring labor value judgment (ASE-HP-G) J. Select appropriate labor code for each operation (structural, non-structural, mechanical, and refinish) (ASE-HP-I) K. Select and price OEM parts; optional OEM parts, aftermarket parts, recyclable/used parts, remanufactured, rebuilt, and reconditioned parts; verify availability, compatibility, and condition (ASE-HP-G) L. Determine necessary sublet operations (ASE-HP-G) M. Determine included and non-included operations and miscellaneous items (ASE-HP-G) N. Recognize and apply overlap deductions (ASE-HP-I) O. Determine additional material and charges (ASE-HP-G) P. Determine refinishing material and charges (ASE-HP-I) Q. Apply math skills to establish charges and totals (ASE-HP-I) R. Identify differences between computer generated and manually written estimates (ASE-HP-G) S. Identify procedures to restore corrosion protection; establish labor values, and material charges (ASE-HP-G) T. Recognize the cost effectiveness of the repair and determine the approximate vehicle retail, and repair value (ASE-HP-G) U. Recognize the differences in estimating platforms when using different information provider systems (ASE-HP-G)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
	V. Verify accuracy of estimate compared to the actual repair and replacement operations (ASE-HP-G) W. Determine telematic/connectivity of the vehicle and place vehicle in service mode (ASE-HP-G) X. Identify vehicle safety recalls using the vehicle identification number (VIN) (ASE-HP-I) Y. Review damage report and analyze damage to determine appropriate methods for overall repair; communicate with team members to verify accuracy and resolve discrepancies (ASE-HP-G)
FA-CRR04. Vehicle construction and parts identification ***Identify components and repair/replacement procedures***	A. Identify type of vehicle construction (unibody, body-over-frame) (ASE-HP-G) B. Recognize the different collision damage between unibody and body-over-frame vehicles (ASE-HP-G) C. Identify impact energy absorbing components (ASE-HP-G) D. Identify different types of substrates (steel types, aluminum, magnesium, plastic, composites, etc.); determine repairability (ASE-HP-G) E. Identify vehicle glass components and repair/replacement procedures (ASE-HP-G) F. Identify add-on accessories (ASE-HP-G)
FA-CRR05. Customer relations and sales skills ***Demonstrate skills that support a positive customer relationship experience and provide information to support interaction***	A. Introduce yourself, acknowledge and greet customer/client/visitor; offer assistance (ASE-HP-I) B. Listen to customer/client; collect information and identify customers/client's concerns, needs and expectations (ASE-HP-I) C. Establish cooperative attitude with customer/client (ASE-HP-I) D. Deal with dissatisfied customer/client; seek resolution (ASE-HP-I) E. Identify customer/client preferred communication method; follow up to keep customer/client informed about parts and the repair process (ASE-HP-G) F. Recognize basic claims handling procedures; explain to customer/client (ASE-HP-G) G. Project positive attitude and professional appearance (ASE-HP-I) H. Provide and review warranty information (ASE-HP-G) I. Provide and review technical and consumer protection information (ASE-HP-G) J. Estimate and explain duration of out-of-service time (ASE-HP-G) K. Demonstrate negotiation skills to obtain a mutual agreement (ASE-HP-G) L. Interpret and explain estimate to customer/client (ASE-HP-I)

II. Painting and Refinishing

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRRL06. Safety precautions ***Identify health hazards, inspect environment and select equipment, and perform clean-up***	A. Select and use the proper personal safety equipment for surface preparation, spray gun and related equipment operation, paint mixing, matching and application, paint defects, and detailing (gloves, suits, hoods, eye and ear protection, etc.); take necessary precautions with hazardous operations and materials according to federal, state, and local regulations (ASE-HP-I) B. Identify safety and personal health hazards according to OSHA guidelines and the "Right to Know Law" (ASE-HP-I) C. Inspect spray environment and equipment to ensure compliance with federal, state and local regulations, and for safety and cleanliness hazards (ASE-HP-I) D. Select and use a NIOSH approved supplied air (Fresh Air Make-up) respirator system E. Perform proper maintenance in accordance with OSHA Regulation 1910 134 and applicable state and local regulation (ASE-HP-I) F. Perform vehicle clean-up; complete quality control using a checklist on operations performed (ASE-HP-I)
FA-CRRL07. Surface preparation ***Inspect surface, identify finish, prepare surface, apply primer, paint, and sealer, and identify types of finishes***	A. Inspect, remove, store, protect, and replace exterior trim and components necessary for proper surface preparation (ASE-HP-I) B. Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants (ASE-HP-I) C. Inspect and identify type of finish, surface condition, and film thickness; develop and document a plan for refinishing using a total product system (ASE-HP-I) D. Remove paint finish as needed (ASE-HP-I) E. Properly sand areas to be refinished (ASE-HP-I) F. Identify and select appropriate sandpaper to featheredge areas to be refinished (ASE-HP-I) G. Apply suitable metal treatment or primer according to total product systems (ASE-HP-I) H. Mask and protect other areas that will not be refinished (ASE-HP-I) I. Demonstrate different masking techniques (recess/back masking, foam door type, etc.) (ASE-HP-I) J. Mix primer, primer-surfacer and primer-sealer following paint manufacturers technical data sheet instructions (ASE-HP-I) K. Identify a complimentary color or shade of undercoat to improve coverage (ASE-HP-G) L. Apply primer onto surface of repaired area; demonstrating control of primer application by keeping the areas small as possible (ASE-HP-I) M. Apply two-component finishing filler to minor surface imperfections (ASE-HP-I) N. Guide coat and block sand area with correct grade/grit sandpaper to which primer-surfacer has been applied (ASE-HP-I) O. Dry sand area to which two-component finishing filler has been applied (ASE-HP-I)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
	P. Remove dust from area to be refinished, including cracks or moldings of adjacent areas (ASE-HP-I) Q. Clean area to be refinished using a recommended final cleaning solution (ASE-HP-I) R. Remove, with a tack rag, any dust or lint particles from the area to be refinished (ASE-HP-I) S. Apply suitable primer sealer to the area being refinished (ASE-HP-I) T. Scuff sand to remove nibs or imperfections from a sealer (ASE-HP-I) U. Apply stone chip resistant coating (ASE-HP-G) V. Restore caulking and seam sealers to repaired areas and replacement panels as required (ASE-HP-G) W. Prepare adjacent panels for blending using paint manufacturers procedures (ASE-HP-I) X. Identify the types of rigid, semi-rigid or flexible plastic parts to be refinished; determine the materials needed, preparation, and refinishing procedures (ASE-HP-I) Y. Identify metal parts to be refinished; determine the materials needed, preparation, and refinishing procedures (ASE-HP-I) Z. Identify chip resistant coatings and texture match (ASE-HP-G) AA. Identify caulking and seal sealers that may need replacement (ASE-HP-G) AB. Identify refinishing guidelines for stationary glass flange areas to be refinished (ASE-HP-I)
FA-CRRL08. Spray gun and related equipment operation ***Inspect, select, test, and adjust spray gun and demonstrate understanding of its operation***	A. Inspect, clean, and determine condition of spray guns and related equipment (air hoses, regulators, air lines, air source, spray environment, and fillers) (HP-I) B. Select spray gun setup (fluid needle, nozzle, and cap) for product being applied (ASE-HP-I) C. Test and adjust spray gun using fluid, air and pattern control valves (ASE-HP-I) D. Demonstrate an understanding of the operation of pressure spray equipment (ASE-HP-G)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRRL09. Paint mixing, matching and applying ***Identify color codes, prepare and apply refinish materials, and identify strategies for applying paints to address differing conditions***	A. Identify color code by manufacturer's vehicle information label (ASE-HP-I) B. Shake, stir, reduce, catalyze/activate, and strain refinish materials (ASE-HP-I) C. Apply finish using appropriate spray techniques (gun arc, angle, distance, travel speed, and spray pattern overlap) for the finish being applied (ASE-HP-I) D. Apply selected product on test or let-down panel; check for color match, properly store and maintain a color catalog (ASE-HP-I) E. Understand the application of single stage topcoats (ASE-HP-G) F. Apply basecoat/clearcoat for panel blending, panel refinishing and cut-in's (ASE-HP-I) G. Apply basecoat/clearcoat for overall refinishing (ASE-HP-G) H. Remove nibs or imperfections from basecoat (ASE-HP-I) I. Identify product expiration dates as applicable (ASE-HP-I) J. Refinish plastic parts (ASE-HP-I) K. Apply multi-stage coats for panel blending and overall refinishing (ASE-HP-G) L. Identify and mix paint using a formula (ASE-HP-I) M. Identify poor hiding colors; determine necessary action (ASE-HP-G) N. Tint color using formula to achieve a blendable match (ASE-HP-G) O. Identify alternative color formula to achieve a blendable match (ASE-HP-I) P. Identify the materials equipment, and preparation differences between solvent and waterborne technologies (ASE-HP-G)
FA-CRRL10. Paint defects – causes and cures ***Identify the types and causes of paint defects and how they can be corrected***	A. Identify blistering (raising of the paint surface, air entrapment); correct the cause(s) and the condition (ASE-HP-G) B. Identify a dry spray appearance in the paint surface; correct the cause(s) and the condition (ASE-HP-I) C. Identify the presence of fish-eyes (crater-like openings) in the finish; correct the cause(s) and the condition (ASE-HP-I) D. Identify lifting; correct the cause(s) and the condition (ASE-HP-G) E. Identify clouding (mottling and streaking in metallic finishes); correct the cause(s) and the condition (ASE-HP-I) F. Identify orange peel; correct the cause(s) and the condition (ASE-HP-I) G. Identify overspray; correct the cause(s) and the condition (ASE-HP-I) H. Identify solvent popping in freshly painted surface; correct the cause(s) and the condition (ASE-HP-G) I. Identify sags and runs in paint surface; correct the cause(s) and the condition (ASE-HP-I) J. Identify sanding marks or sandscratch swelling; correct the cause(s) and the condition (ASE-HP-I) K. Identify contour mapping/edge mapping; correct the cause(s) and the condition (ASE-HP-G)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
	L. Identify color difference (off-shade); correct the cause(s) and the condition (ASE-HP-G) M. Identify tape tracking; correct the cause(s) and the condition (ASE-HP-G) N. Identify low gloss condition; correct the cause(s) and the condition (ASE-HP-G) O. Identify poor adhesion; correct the cause(s) and the condition (ASE-HP-G) P. Identify paint cracking (shrinking, splitting, crowsfeet or line-checking, micro-checking, etc.); correct the cause(s) and the condition (ASE-HP-G) Q. Identify corrosion; correct the cause(s) and the condition (ASE-HP-G) R. Identify dirt or dust in the paint surface; correct the cause(s) and the condition (ASE-HP-I) S. Identify water spotting; correct the cause(s) and the condition (ASE-HP-G) T. Identify finish damage caused by bird droppings, tree sap, and other natural causes; correct the condition (ASE-HP-G) U. Identify finish damage caused by airborne contaminants (acids, soot, rail dust, and other industrial-related causes); correct the condition (ASE-HP-G) V. Identify die-back conditions (dulling of the paint film showing haziness); correct the cause(s) and the condition (ASE-HP-G) W. Identify chalking (oxidation); correct the cause(s) and the condition (ASE-HP-G) X. Identify bleed-through (staining); correct the cause(s) and the condition (ASE-HP-G) Y. Identify pinholing; correct the cause(s) and the condition (ASE-HP-G) Z. Identify buffing-related imperfections (swirl marks, wheel burns); correct the condition (ASE-HP-I) AA. Identify pigment flotation (color change through film build); correct the cause(s) and the condition (ASE-HP-G)
FA-CRRL11. Final detail ***Demonstrate how to remove defects and perform vehicle clean-up***	A. Apply decals, transfers, tapes, stone guards, moldings, and emblems, etc. (ASE-HP-G) B. Sand, buff and polish fresh finish to remove defects and texture as required (ASE-HP-I) C. Sand, buff and polish existing finish to recondition defects as required, match existing finish (ASE-HP-I) D. Clean interior, exterior, and glass (ASE-HP-I) E. Clean body openings (door jambs, gaps, and edges, etc.) (ASE-HP-I) F. Remove overspray (ASE-HP-I) G. Perform vehicle clean-up; complete quality control using a checklist (ASE-HP-I) H. Measure and record film thickness before and after buffing (ASE-HP-I) I. Perform nib sanding to remove small imperfections as required (ASE-HP-I)

III. Non-structural Analysis and Damage Repair (Body Components)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRRL12. Preparation ***Inspect remove, protect, label, store, inventory, and reinstall vehicle components***	A. Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan (ASE-HP-I) B. Inspect, remove, protect, label, store, inventory, and reinstall exterior trim and moldings (ASE-HP-I) C. Inspect, remove, protect, label, store, inventory, and reinstall interior trim and components (ASE-HP-I) D. Inspect, remove, protect, label, store, inventory, and reinstall body panels and components that may interfere with or be damaged during repair (ASE-HP-I) E. Inspect, remove, protect, label, store, inventory, and reinstall vehicle mechanical and electrical components that may interfere with or be damaged during repair (ASE-HP-G) F. Protect panels, glass, interior parts, and other vehicles adjacent to the repair area (ASE-HP-I) G. Soap and water wash entire vehicle; complete pre-repair inspection checklist (ASE-HP-I) H. Prepare damaged area using water-based and solvent-based cleaners (ASE-HP-I) I. Remove corrosion protection, undercoating, sealers, and other protective coatings as necessary to perform repairs (ASE-HP-I) J. Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair (ASE-HP-I)
FA-CRRL13. Outer body panel repairs, replacements, and adjustments ***Inspect remove, replace, and align vehicle components***	A. Inspect/locate direct, indirect, or hidden damage and direction of impact (ASE-HP-I) B. Inspect, remove and replace welded steel panel or panel assemblies (ASE-HP-G) C. Determine the extent of damage to aluminum body panels; repair or replace (ASE-HP-G) D. Inspect, remove, replace, and align hood, hood hinges, and hood latch (ASE-HP-I) E. Inspect, remove, replace, and align deck lid, lid hinges, and lid latch (ASE-HP-I) F. Inspect, remove, replace, and align doors, latches, hinges, and related hardware (ASE-HP-I) G. Inspect, remove, replace and align tailgates, hatches, liftgates and sliding doors (ASE-HP-G) H. Inspect, remove, replace, overhaul, and align bumpers, covers, reinforcements, guards, impact absorbers, and mounting hardware (ASE-HP-I) I. Inspect, remove, replace and align fenders, and related panels (ASE-HP-I) J. Restore corrosion protection during and after the repair (ASE-HP-I) K. Replace door skins (ASE-HP-G) L. Restore sound deadeners and foam materials (ASE-HP-G) M. Perform panel bonding and weld bonding (ASE-HP-G) N. Diagnose and repair water leaks, dust leaks, and wind noise (ASE-HP-G) O. Identify one-time use fasteners (ASE-HP-G) P. Weld damaged or torn steel body panels; repair broken welds (ASE-HP-G) Q. Inspect, identify labels/decals and replace as necessary (ASE-HP-G)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRRL14. Metal finishing and body filling ***Locate and repair surface irregularities and straighten contours using different types of fillers and techniques***	A. Prepare a panel for body filler by abrading or removing the coatings; featheredge, refine scratches, and clean the surface before the application of body filler (ASE-HP-I) B. Locate and repair surface irregularities and straighten contours on a damaged body panel using power tools, hand tools, and weld-on pulling attachments (ASE-HP-I) C. Demonstrate hammer and dolly techniques (ASE-HP-I) D. Heat shrink stretched panel areas to proper contour (ASE-HP-G) E. Cold shrink stretched panel areas to proper contour (ASE-HP-I) F. Identify body filler defects; correct the cause and condition (Pinholing, ghosting, staining, over catalyzing, etc.) (ASE-HP-I) G. Identify different types of body fillers (ASE-HP-G) H. Shape body filler to contour; finish sand (ASE-HP-I) I. Perform proper metal finishing techniques for aluminum (ASE-HP-G) J. Perform proper application of body filler to aluminum (ASE-HP-G) K. Locate and repair surface irregularities and straighten contours on a damaged panel using Glue-Pulling Dent Repair (GPDR) (ASE-HP-G) L. Mix and apply body filler (ASE-HP-I)
FA-CRRL15. Moveable glass and hardware ***Inspect, remove, repair, or replace window, roof panels, and related mechanisms and components***	A. Inspect, adjust, overhaul repair or replace window regulators, run channels, glass, power mechanisms, and related controls (ASE-HP-I) B. Inspect, adjust, repair, remove, reinstall or replace weather-stripping (ASE-HP-G) C. Inspect, remove, repair or replace, and adjust removable power operated roof panel and hinges, latches, guides, handles, retainer, and controls of sunroofs (ASE-HP-G) D. Inspect, remove, reinstall, and align convertible top and related mechanisms (ASE-HP-G) E. Identify or recalibrate electrical components that may need to be initialized (ASE-HP-G)
FA-CRRL16. Plastics, adhesives, and welding ***Identify plastic types and repair using bonded and welding techniques***	A. Identify the types of plastics; determine repairability (HP-1) B. Clean and prepare the surface of plastic parts; identify the types of plastic repair procedures (HP-1) C. Repair rigid, semi-rigid, and flexible plastic panels (HP-1) D. Remove, replace, or repair damaged areas of rigid exterior composite panels (ASE-HP-G) E. Replace bonded rigid exterior composite body panels; straighten or align panel supports (ASE-HP-G) F. Repair plastic parts by welding (nitrogen, airless) (ASE-HP-G) G. Perform a single-sided adhesively bonded cosmetic repair (HP-1) H. Perform a double-sided adhesively bonded repair (HP-1) I. Perform an adhesively bonded or welded tab repair (HP-1) J. Shape and reform damaged plastic (ASE-HP-G)

IV. Welding, Cutting, and Joining

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRRL17. Metal welding, cutting, and joining ***Determine the correct GMAW welder type, set up and perform welds, and identify the causes of various welding defects***	A. Identify the considerations for cutting, removing, and welding various types of steel, aluminum, and other metals (ASE-HP-G) B. Determine the correct GMAW welder type, electrode/wire type, diameter, and gas to be used in a specific welding situation (HP-1) C. Set up, attach work clamp (ground), and adjust the GMAW welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the substrate being welded (HP-1) D. Store, handle, and install high-pressure gas cylinders; test for leaks (HP-1) E. Determine the proper angle of the gun to the joint and direction of gun travel for the type of weld being made (HP-1) F. Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations (ASE-HP-G) G. Identify hazards; foam coatings and flammable materials prior to welding/cutting procedures (ASE-HP-G) H. Protect computers and other electronics/wires prior to welding procedures (ASE-HP-G) I. Clean and prepare the metal to be welded, assure good metal fit-up, apply weld-through primer if necessary, clamp or tack as required (HP-1) J. Determine the joint type (butt weld with backing, lap, etc.) for weld being made (HP-1) K. Determine the type of weld (continuous, stitch weld, plug, etc.) for each specific welding operation (HP-1) L. Perform the following welds: plug, butt weld with and without backing, and fillet etc., in the flat, horizontal, vertical, and overhead positions (HP-1) M. Perform visual evaluation and destructive test on each weld type (HP-1) N. Identify the causes of various welding defects; make necessary adjustments (ASE-HP-I) O. Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments (HP-1) P. Identify cutting process for different substrates and locations; perform cutting operation (HP-1) Q. Identify different methods of attaching structural components (squeeze type resistance spot welding (STRSW), riveting, structural adhesive, MIG bronze, rivet bonding, weld bonding, etc.) (ASE-HP-G)

V. Structural Analysis and Damage Repair

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRRL18. Frame inspection and repair ***Analyze, straighten, and align various types of vehicular structural damage***	A. Measure and diagnose structural damage using a metric tape measure and a tram gauge (ASE-HP-I) B. Properly install vehicle on to a frame bench/rack (ASE-HP-G) C. Analyze, straighten and align mash (collapse) damage (ASE-HP-G) D. Analyze, straighten and align sag damage (ASE-HP-G) E. Analyze, straighten and align side sway damage (ASE-HP-G) F. Analyze, straighten and align twist damage (ASE-HP-G) G. Analyze, straighten and align diamond frame damage (ASE-HP-G) H. Remove and replace damaged structural components (ASE-HP-G) I. Remove and replace protective coatings; restore corrosion protection to repaired or replaced frame areas and anchoring locations (ASE-HP-G) J. Analyze and identify misaligned or damaged steering, suspension, and powertrain mounting points and components (ASE-HP-G) K. Align or replace misaligned or damaged steering, suspension, and powertrain mounting points and components (ASE-HP-G) L. Identify heat limitations and monitoring procedures for structural components (ASE-HP-G) M. Demonstrate an understanding of structural foam applications (ASE-HP-G) N. Measure and diagnose structural damage using a three-dimensional measuring system (mechanical, electronic, laser), etc. (ASE-HP-G) O. Determine the extent of the direct and indirect damage and the direction of impact; document the methods and sequence of repair (ASE-HP-I) P. Analyze and identify crush/collapse zones (ASE-HP-I)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRRL19. Frame inspection and repair ***Analyze, straighten, and align various types of vehicular structural damage***	A. Analyze and identify misaligned or damaged steering, suspension, and powertrain mounting points that can cause vibration, steering, and chassis alignment problems (ASE-HP-G) B. Align or replace misaligned or damaged steering, suspension, and powertrain mounting points that can cause vibration, steering and chassis alignment problems (ASE-HP-G) C. Measure and diagnose unibody damage using a metric tape measure and tram gauge (ASE-HP-I) D. Measure and diagnose unibody vehicles using a dedicated (fixture) measuring system (ASE-HP-G) E. Diagnose and measure unibody vehicles using a three-dimensional measuring system (mechanical, electronic, and laser, etc.) (ASE-HP-G) F. Determine the extent of the direct and indirect damage and the direction of impact; plan and document the methods and sequence of repair (ASE-HP-I) G. Attach anchoring devices to vehicle; remove or reposition components as necessary (ASE-HP-G) H. Straighten and align roof rails/headers and roof panels (ASE-HP-G) I. Straighten and align rocker panels and pillars (ASE-HP-G) J. Straighten and align vehicle openings and floor pans (ASE-HP-G) K. Straighten and align quarter panels, wheelhouse assemblies, and rear body sections (including rails and suspension/powertrain mounting points) (ASE-HP-G) L. Straighten and align front-end sections (aprons, strut towers, upper and lower rails, steering, and suspension/power train mounting points, etc.) (ASE-HP-G) M. Determine structural repair component or replacement recommendations (ASE-HP-G) N. Identify proper cold stress relief methods (ASE-HP-I) O. Determine sectioning procedures of a steel body structure (ASE-HP-I) P. Remove and replace damaged structural components (ASE-HP-G) Q. Determine the extent of damage to aluminum structural components; repair, weld, or replace (ASE-HP-G) R. Analyze and identify crush/collapse zones (ASE-HP-I)
FA-CRRL20. Stationary glass ***Identify considerations for removal and remove, reinstall, or replace modular glass***	A. Identify considerations for removal, handling, one time use parts, and installation of advanced glass systems (comfort and safety features) (ASE-HP-G) B. Remove and reinstall or replace modular glass using recommended materials (ASE-HP-G) C. Check for water leaks, dust leaks, and wind noise (ASE-HP-G) D. Identify considerations for pre-scan, post-scan, and recalibration procedures (ASE-HP-G)

VI. Mechanical and Electrical Components

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRRL21. Suspension and steering ***Remove, replace, inspect, and replace suspension and steering components***	A. Perform visual inspection and measuring checks to identify steering and suspension collision damage (ASE-HP-G) B. Identify one–time use fasteners (ASE-HP-I) C. Clean, inspect, and prepare reusable fasteners (ASE-HP-I) D. Remove, replace, inspect or adjust power steering pump, pulleys, belts, hoses, fittings and pump mounts (ASE-HP-G) E. Remove and replace power steering gear (non-rack and pinion type) (ASE-HP-G) F. Inspect, remove, and replace power rack and pinion steering gear and related components (ASE-HP-G) G. Inspect and replace parallelogram steering linkage components (ASE-HP-G) H. Inspect, remove and replace upper and lower control arms and related components (ASE-HP-G) I. Inspect, remove and replace steering knuckle/spindle/hub assemblies (including bearings, races, seals, etc.) (ASE-HP-G) J. Inspect, remove and replace front suspension system coil springs and spring insulators (silencers) (ASE-HP-G) K. Inspect, remove, replace, and adjust suspension system torsion bars, and mounts (ASE-HP-G) L. Inspect, remove and replace stabilizer bar bushings, brackets, and links (ASE-HP-G) M. Inspect, remove and replace MacPherson strut or assembly, upper bearing, and mount (ASE-HP-G) N. Inspect, remove, and replace rear suspension system transverse links, control arms, stabilizer bars, bushings, and mounts (ASE-HP-G) O. Inspect, remove, and replace suspension system leaf spring(s) and related components (ASE-HP-G) P. Inspect axle assembly for damage and misalignment (ASE-HP-G) Q. Inspect, remove and replace shock absorbers (ASE-HP-G) R. Diagnose, inspect, adjust, repair or replace active suspension systems and associated lines and fittings (ASE-HP-G) S. Measure vehicle ride height and wheelbase according to manufacturer specifications (ASE-HP-I) T. Inspect, remove, replace, and align front and rear frame (cradles/subframe) (ASE-HP-G) U. Diagnose and inspect steering wheel, steering column, and components (ASE-HP-G) V. Verify proper operation of steering systems including electronically controlled, hydraulic and electronically assisted steering systems (ASE-HP-G) W. Diagnose front and rear suspension system noises and body sway problems; determine necessary action (ASE-HP-G)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
	X. Diagnose vehicle wandering, pulling, hard steering, bump steer, memory steering, torque steering, and steering return problems; determine necessary action (ASE-HP-G) Y. Demonstrate an understanding of wheel, suspension, and steering alignments (caster, camber, toe, SAI etc.) (ASE-HP-G) Z. Inspect tires; identify tire wear patterns, direction of rotation and location; check tire size, identify nitrogen or air, check tire pressure monitoring system (TPMS) and adjust air pressure (ASE-HP-I) AA. Diagnose wheel/tire vibration, shimmy, tire pull (lead), wheel hop problems; determine needed repairs (ASE-HP-G) AB. Measure wheel, tire, axle, and hub runout; determine needed repairs (ASE-HP-I) AC. Reinstall wheels and torque lug nuts (ASE-HP-I) AD. Perform initialization or calibration procedures following suspension and/or steering system repairs (ASE-HP-G) AE. Perform a tire pressure monitoring system (TPMS) recalibration (ASE-HP-G) AF. Lift the vehicle for inspection, service, and repair by properly raising and supporting the vehicle (ASE-HP-G)
FA-CRRL22. Electrical ***Check electrical systems and inspect, clean, repair, or replace fuses and battery components***	A. Demonstrate an understanding of Ohm's Law (ASE-HP-I) B. Check for available voltage, voltage drop and current, and resistance in electrical wiring circuits and components with a DMM (digital multimeter) (ASE-HP-I) C. Repair wiring and connectors (ASE-HP-G) D. Inspect, test, and replace fusible links, circuit breakers, and fuses (ASE-HP-I) E. Perform battery state-of-charge test and slow/fast battery charge (ASE-HP-I) F. Inspect, clean, repair or replace battery, battery cables, connectors and clamps (ASE-HP-I) G. Dispose/recycle batteries according to local, state, and federal requirements (ASE-HP-G) H. Identify programmable electrical/electronic components and check for malfunction indicator lamp (MIL) and fault codes; record data for reprogramming before disconnecting battery (ASE-HP-I) I. Inspect alignment, adjust, remove and replace alternator (generator), drive belts, pulleys, and fans (ASE-HP-I) J. Check operation and aim headlamp assemblies and fog/driving lamps; determine needed repairs (ASE-HP-G) K. Inspect, test, and repair or replace switches, relays, bulbs, sockets, connectors, and ground wires of interior and exterior light circuits (ASE-HP-I) L. Remove and replace horn(s); check operation (ASE-HP-I) M. Check operation of wiper/washer systems; determine needed repairs (ASE-HP-I) N. Check operation of power side and tailgate window; determine needed repairs (ASE-HP-I)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
	O. Check operation of motorized sliding doors, lift gates tailgates, running boards, etc.; determine needed repairs (ASE-HP-G) P. Inspect, remove and replace power seat, motors, linkages, cables, etc. (ASE-HP-G) Q. Inspect, remove and replace components of electric door and hatch/trunk lock (ASE-HP-G) R. Inspect, remove and replace components of keyless lock/unlock devices and alarm systems (ASE-HP-G) S. Inspect, remove and replace components of electrical sunroof and convertible/retractable hard top (ASE-HP-G) T. Check operation of electrically heated mirrors, windshields, back lights, panels, etc.; determine needed repairs (ASE-HP-I) U. Demonstrate self-grounding procedures (anti-static) for handling electronic components (ASE-HP-I) V. Check for module communication errors using a scan tool (ASE-HP-G) W. Use wiring diagrams, component location, and diagnostic flow charts during diagnosis of electrical circuit problems (ASE-HP-G) X. Identify safe disabling techniques of high voltage systems on hybrid/electric vehicles (ASE-HP-G) Y. Identify potential safety and materials handling concerns associated with high voltage hybrid/electric vehicle battery systems (ASE-HP-G)
FA-CRR23. Brakes ***Inspect and replace brake lines, hoses, brake shoes or pads and check for damaged components***	A. Inspect brake lines, hoses, and fittings for damage or wear; tighten fittings and supports; replace brake lines (double flare and ISO types) (ASE-HP-G) B. Replace hoses, fittings, seals, and supports (ASE-HP-G) C. Identify, handle, store, and fill with appropriate brake fluids (ASE-HP-G) D. Bleed (manual, pressure, or vacuum) hydraulic brake system (ASE-HP-G) E. Pressure test brake hydraulic system; determine necessary action (ASE-HP-G) F. Adjust brake shoes or pads; remove and reinstall brake drums or drum/hub assemblies (ASE-HP-G) G. Remove, clean and inspect caliper and rotor assembly and mountings for wear and damage; reinstall (ASE-HP-I) H. Inspect parking brake system operation; repair or adjust as necessary; verify operation (ASE-HP-G) I. Identify the proper procedures for handling brake dust (ASE-HP-G) J. Check for bent or damaged brake system components (ASE-HP-G) K. Demonstrate an understanding of various types of advanced braking systems (ABS, electronic parking brake, hydraulic, electronic, traction and stability control) (ASE-HP-G)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRR24. Heating and air conditioning ***Identify, A/C system components, service A/C system fluids, and inspect, test, and replace A/C system components***	A. Identify and comply with environmental regulations relating to refrigerants and coolants (ASE-HP-G) B. Maintain and verify correct operation of certified refrigerant recovery and recharging equipment (ASE-HP-G) C. Locate and identify A/C system service ports (ASE-HP-I) D. Recover, label and recycle refrigerant from an A/C system (ASE-HP-G) E. Select refrigerant, evacuate, and recharge A/C system (ASE-HP-G) F. Select oil type and install correct amount in A/C system (ASE-HP-G) G. Inspect, adjust, and replace A/C compressor drive belts; check pulley alignment (ASE-HP-G) H. Remove and replace A/C compressor; inspect, repair or replace A/C compressor mount (ASE-HP-G) I. Inspect, repair or replace A/C system mufflers, hoses, lines, fittings, orifice tube, expansion valve, and seals (ASE-HP-G) J. Inspect, test, and replace A/C system condenser and mounts (ASE-HP-G) K. Inspect and replace receiver/drier or accumulator/drier (ASE-HP-G) L. Inspect and repair A/C component wiring (ASE-HP-G) M. Demonstrate an understanding of safe handling procedures associated with high voltage A/C compressors and wiring (ASE-HP-G) N. Inspect and protect open A/C system components from contaminants during repairs (ASE-HP-G)
FA-CRR25. Cooling systems ***Inspect, test, remove, and/or replace cooling system components and fluids***	A. Check engine cooling and heater system hoses and belts; determine necessary action (ASE-HP-I) B. Inspect, test, remove, and replace radiator, pressure cap, coolant system components, and water pump (ASE-HP-G) C. Recover, refill, and bleed system with proper coolant and check level of protection; leak test system and dispose of materials in accordance with EPA regulations (ASE-HP-I) D. Remove, inspect and replace fan (both electrical and mechanical), fan sensors, fan pulley, fan clutch, and fan shroud; check operation (ASE-HP-G) E. Inspect, remove, and replace auxiliary oil/fluid coolers; check oil levels (ASE-HP-G) F. Demonstrate an understanding of hybrid/electric cooling systems (ASE-HP-G)

Code and Knowledge and Skill Statement	Suggested Performance Indicators
FA-CRR26. Drive train ***Inspect, remove, and/or replace drive train components***	A. Remove, replace, and adjust shift or clutch linkage as required (ASE-HP-G) B. Remove and replace electronic sensors, wires, and connectors (ASE-HP-G) C. Remove and reinstall powertrain assembly; inspect, replace, and align powertrain mounts (ASE-HP-G) D. Remove and replace drive axle assembly (ASE-HP-G) E. Inspect, remove and replace half shafts and axle constant velocity (CV) joints (ASE-HP-G) F. Inspect, remove and replace drive shafts and universal joints (ASE-HP-G) G. Demonstrate an understanding of safe handling procedures associated with high voltage powertrain components (ASE-HP-G)
FA-CRR27. Fuel, intake, and exhaust systems ***Inspect, remove, and/or replace fuel, intake and exhaust components***	A. Inspect, remove and replace exhaust pipes, mufflers, converters, resonators, tail pipes, and heat shields (ASE-HP-G) B. Inspect, remove and replace fuel/DEF tank, tank filter, cap, filler hose, pump/sending unit and inertia switch; inspect and replace fuel lines and hoses (ASE-HP-G) C. Inspect, remove and replace engine components of air intake components (ASE-HP-G) D. Inspect, remove and replace canister, filter, vent, and purge lines of fuel vapor (EVAP) control systems (ASE-HP-G)
FA-CRR28. Restraint systems ***Inspect, remove, and/or replace seatbelt system and Supplemental Restraint System components***	A. Inspect, remove, and replace seatbelt and shoulder harness assembly and components (ASE-HP-G) B. Inspect restraint system mounting areas for damage; repair as needed (ASE-HP-G) C. Inspect the operation of the seatbelt system (ASE-HP-I) D. Disable and enable Supplemental Restraint System (SRS) (ASE-HP-G) E. Inspect, protect, remove and replace Supplemental Restraint Systems (SRS) sensors and wiring; ensure sensor orientation (ASE-HP-G) F. Verify that Supplemental Restraint System (SRS) is operational (ASE-HP-I) G. Inspect, remove, replace and dispose of deployed and non-deployed airbag(s) and pretensioners (ASE-HP-G) H. Use Diagnostic Trouble Codes (DTC) to diagnose and repair the Supplemental Restraint System (SRS) (ASE-HP-G) I. Demonstrate an understanding of advanced restraint and occupant classification systems (OCS) (ASE-HP-G) J. Identify components of Supplemental Restraint Systems (SRS) (ASE-HP-I)

Diesel and Heavy Equipment Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

- ● **Foundational -** *Basic skills that **should be taught** within high school or, if not feasible, at a partnering college*
- ■ **Intermediate -** *Advanced skills **encouraged to be taught** within high school, with some offered at a partnering college*
- ▲ **Advanced -** *Highly technical skills that **may be taught** within high school, with most offered at a partnering college*

I. Diesel Engines

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE01. General ***Research vehicle information, inspect engine fluid level and condition, perform diagnostics, and identify system components***	A. Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins (ASE-P1) B. Inspect level and condition of fuel, oil, diesel exhaust fluid (DEF), and coolant (ASE-P1) C. Inspect engine assembly for fuel, oil, coolant, air, and other leaks (ASE-P1) D. Use appropriate electronic service tool(s) and procedures to check, record, and clear diagnostic codes; check and record trip/operational data; reset maintenance monitor (if applicable); interpret digital multimeter (DMM) readings (ASE-P1) E. Identify system components, configurations, and types of the following: cylinder head(s), valve train, engine block, engine lubrication, engine cooling, air induction, exhaust, fuel, and engine braking (ASE-P1) F. Check engine operation (starting and running) including: noise, vibration, smoke, etc. (ASE-P2)	A. ● B. ● C. ● D. ● E. ●	F. ■	
FA-DHE02. Cylinder head and valve train ***Inspect electronic wiring harness and brackets***	A. Inspect electronic wiring harness and brackets for wear, bending, cracks, and looseness (ASE-P1)	A. ●		

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE03. Engine block ***Inspect crankshaft and engine mounts***	A. Inspect crankshaft vibration damper; inspect engine mounts (ASE-P1)	A. ●		
FA-DHE04. Lubrication systems ***Test engine oil pressure and levels, and perform oil and filter service***	A. Determine proper lubricant; perform oil and filter service (ASE-P1) B. Test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit; test engine oil temperature and check operation of temperature sensor (ASE-P1) C. Check engine oil level, condition, and consumption; take engine oil sample (ASE-P1)	A. ● B. ●	C. ■	
FA-DHE05. Cooling system ***Inspect coolant and coolant system components and replace as needed***	A. Check engine coolant type, level, condition, and test coolant for freeze protection and additive package concentration (ASE-P1) B. Verify coolant temperature; check operation of temperature and level sensors, gauge, and/or sending unit (ASE-P1) C. Recover coolant, flush, and refill with recommended coolant/additive package; bleed cooling system (ASE-P1) D. Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed (ASE-P1) E. Inspect water pump, hoses, and clamps (ASE-P1) F. Inspect, and pressure test cooling system(s); pressure test cap, tank(s), and recovery systems; inspect radiator and mountings (ASE-P1) G. Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud (ASE-P1) H. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment (ASE-P1) I. Identify engine block heater(s) (ASE-P2)	A. ● B. ● C. ● D. ● E. ● F. ● G. ●	H. ■	I. ▲

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE06. Air induction and exhaust systems ***Inspect air induction and exhaust systems and replace or service components as needed***	A. Check air induction system including: cooler assembly, piping, hoses, clamps, and mountings; replace air filter as needed; reset restriction indicator (if applicable) (ASE-P1) B. Inspect engine exhaust system, exhaust gas recirculation (EGR) system, and exhaust aftertreatment system for leaks, mounting, proper routing, and damaged or missing components (ASE-P1) C. Inspect crankcase ventilation system; service as needed (ASE-P1) D. Inspect turbocharger(s), wastegate(s), and piping systems (ASE-P2) E. Inspect intake manifold, gaskets, and connections (ASE-P1)	A. ● B. ● C. ●	D. ■ E. ■	
FA-DHE07. Fuel system ***Check fluid levels and components and replace as needed***	A. Check fuel level and condition (ASE-P1) B. Replace fuel filter; prime and bleed fuel system (ASE-P1) C. Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, hoses, lines, and fittings (ASE-P1) D. Inspect low pressure fuel system components (fuel pump, pump drives, screens, fuel/water separators/indicators, hoses, lines, filters, heaters, coolers, ECM cooling plates, check valves, pressure regulator valves, restrictive fittings, and mounting hardware) (ASE-P1) E. Inspect high pressure fuel system components (fuel pump, pump drives, hoses, injection lines, filters, hold-downs, fittings, seals, and mounting hardware) (ASE-P1)	A. ● B. ● C. ● D. ● E. ●		
FA-DHE08. Engine brakes ***Inspect engine compression and/or exhaust brake housing and components***	A. Inspect engine compression and/or exhaust brake housing, valves, seals, lines, and fittings (ASE-P1)			A. ▲

II. Drive Train

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE09. General ***Identify drive train components***	A. Identify drive train components, transmission type, and configuration (ASE-P1)	A. ●		
FA-DHE10. Clutch ***Inspect and adjust clutch and clutch components and determine needed action***	A. Inspect and adjust clutch, clutch brake, linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push-type and pull-type); check pedal height and travel; determine needed action (ASE-P1) B. Inspect clutch master cylinder fluid level; check clutch master cylinder, slave cylinder, lines, and hoses for leaks and damage; determine needed action (ASE-P1)	A. ● B. ●		
FA-DHE11. Transmission ***Inspect transmission components, replace, covers, and determine needed action***	A. Inspect transmission shifter and linkage; inspect transmission mounts, insulators, and mounting bolts (ASE-P1) B. Inspect transmission for leakage; determine needed action (ASE-P1) C. Check transmission fluid level and condition; determine needed action (ASE-P1) D. Inspect and test function of REVERSE light, neutral start, and warning device circuits (ASE-P1) E. Replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; determine needed action (ASE-P1) F. Inspect transmission breather; inspect transmission oil filters, coolers and related components; determine needed action (ASE-P2) G. Inspect speedometer components (ASE-P2)	A. ● B. ● C. ● D. ●	E. ■	F. ▲ G. ▲
FA-DHE12. Driveshaft and universal joints ***Inspect, service and/or replace driveshaft and universal joint components***	A. Inspect, service, and/or replace driveshafts, slip joints, yokes, drive flanges, support bearings, universal joints, boots, seals, and retaining/mounting hardware; check phasing of all shafts (ASE-P1)	A. ●		

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE13. Drive axles ***Check fluid levels and condition, inspect drive axel shafts, and remove and replace wheel assembly, determine needed action***	A. Check drive axle fluid level and condition; check drive axle filter; determine needed action (ASE-P1) B. Check for fluid leaks; inspect drive axle housing assembly, cover plates, gaskets, seals, vent/breather, and magnetic plugs (ASE-P1) C. Remove and replace wheel assembly; check rear wheel seal and axle flange for leaks; determine needed action (ASE-P1) D. Inspect air-operated power divider (inter-axle differential) assembly, including: diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls (ASE-P2) E. Inspect drive axle shafts; determine needed action (ASE-P2)	A. ● B. ● C. ●	D. ■ E. ■	

III. Brakes

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE14. General ***Identify brake system components and configurations and identify performance problems***	A. Identify brake system components and configurations (including air and hydraulic systems, parking brake, power assist, and vehicle dynamic brake systems) (ASE-P1) B. Identify brake performance problems caused by the mechanical/foundation brake system (air and hydraulic) (ASE-P1)	A. ● B. ●		
FA-DHE15. Air brakes: Air supply and service systems ***Inspect air supply system components and verify gauge operation and readings***	A. Verify proper gauge operation and readings; verify low pressure warning alarm operation; perform air supply system test such as pressure build-up, governor settings, and leakage; drain air tanks and check for contamination (ASE-P1) B. Inspect air supply system components such as compressor, governor, air drier, tanks, and lines; inspect service system components such as lines, fittings, mountings, and valves (hand brake/trailer control, brake relay, quick release, tractor protection, emergency/spring brake control/modulator, pressure relief/ safety) (ASE-P1)	A. ●	B. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE16. Air brakes: Mechanical/foundation brake system ***Inspect brake system components and determine needed action***	A. Inspect service brake chambers, diaphragms, clamps, springs, pushrods, clevises, and mounting brackets; determine needed action (ASE-P1) B. Identify slack adjuster type; inspect slack adjusters; determine needed action (ASE-P1) C. Check camshafts (S-cams), tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; determine needed action (ASE-P1) D. Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action (ASE-P1) E. Inspect, clean, and adjust air disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; perform needed action (ASE-P1) F. Remove brake drum; clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; determine needed action (ASE-P1)	A. B. C. D.	E. F.	
FA-DHE17. Air brakes: Parking brake system ***Inspect and test parking brake components and determine needed action***	A. Inspect and check parking (spring) brake chamber for leaks; determine needed action (ASE-P1) B. Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; determine needed action (ASE-P1) C. Inspect and test parking (spring) brake application and release valve; determine needed action (ASE-P1) D. Manually release (cage) and reset (uncage) parking (spring) brakes (ASE-P1)	A. B. C. D.		
FA-DHE18. Hydraulic brakes: Hydraulic system ***Check master cylinder fluid level and condition, inspect hydraulic brake system components and operation***	A. Check master cylinder fluid level and condition; determine proper fluid type for application (ASE-P1) B. Inspect hydraulic brake system components for leaks and damage (ASE-P1) C. Check hydraulic brake system operation including pedal travel, pedal effort, and pedal feel (ASE-P1)	A.	B. C.	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE19. Hydraulic brakes: Mechanical/ foundation brake system ***Inspect and measure rotor, disk brake, and brake drum components***	A. Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action (ASE-P1) B. Inspect and clean disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; determine needed action (ASE-P1) C. Remove brake drum; clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; inspect wheel cylinders; determine needed action (ASE-P1)	A. ● B. ● C. ●		
FA-DHE20. Hydraulic brakes: Parking brake system ***Check parking brake operation***	A. Check parking brake operation; inspect parking brake application and holding devices (ASE-P1)		A. ■	
FA-DHE21. Power assist systems ***Check brake assist/booster system components and emergency (back-up/reserve)***	A. Check brake assist/booster system (vacuum or hydraulic) hoses and control valves; check fluid level and condition (if applicable) (ASE-P1) B. Check operation of emergency (back-up/reserve) brake assist system (ASE-P1)	A. ● B. ●		

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE22. Vehicle dynamic brake systems (air and hydraulic); Antilock Brake System (ABS), Automatic Traction Control (ATC) system, and Electronic Stability Control (ESC) system ***Observe ABS and ATC and ESC warning light operations***	A. Observe antilock brake system (ABS) warning light operation including trailer and dash mounted trailer ABS warning light (ASE-P1) B. Observe automatic traction control (ATC) and electronic stability control (ESC) warning light operation (ASE-P2)	A. ●	B. ■	
FA-DHE23. Wheel bearings ***Inspect, lubricate, and/or replace wheel bearings and hub bearing assemblies***	A. Clean, inspect, lubricate, and/or replace wheel bearings and races/cups; replace seals and wear rings; inspect spindle/tube; inspect and replace retaining hardware; adjust wheel bearings; check hub assembly fluid level and condition; verify end play with dial indicator method (ASE-P1) B. Identify, inspect, and/or replace unitized/preset hub bearing assemblies (ASE-P2)	A. ●	B. ■	

IV. Suspension and Steering Systems

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE24. General ***Identify suspension and steering system components and configurations***	A. Identify suspension and steering system components and configurations (ASE-P1) B. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation (ASE-P1)	A. ●		B. ▲
FA-DHE25. Steering column ***Check steering wheel operation and mounting***	A. Check steering wheel for free play, binding, and proper centering; inspect and service steering shaft U-joint(s), slip joint(s), bearings, bushings, and seals; phase steering shaft (ASE-P1) B. Check operation of tilt and telescoping steering column (ASE-P1) C. Check cab mounting (ASE-P2)	A. ●		B. ▲ C. ▲
FA-DHE26. Steering pump and gear units ***Check power steering pump and gear operations and flush and refill system***	A. Check power steering pump and gear operation, mountings, lines, and hoses; check fluid level and condition; service filter; inspect system for leaks (ASE-P1) B. Flush and refill power steering system; purge air from system (ASE-P2)	A. ● B. ●		
FA-DHE27. Steering linkage ***Inspect steering linkage components***	A. Inspect tie rod ends, ball joints, kingpins, pitman arms, idler arms, and other steering linkage components; lubricate as needed (ASE-P1)	A. ●		

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE28. Suspension systems ***Inspect suspension system components (e.g., shock absorbers, spring, and axles)***	A. Inspect shock absorbers, bushings, brackets, and mounts; determine needed action (ASE-P1) B. Inspect leaf springs, center bolts, clips, pins, bushings, shackles, U-bolts, insulators, brackets, and mounts; determine needed action (ASE-P1) C. Inspect axle and axle aligning devices such as: radius rods, track bars, stabilizer bars, and torque arms; inspect related bushings, mounts, and shims (ASE-P1) D. Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; check and record ride height (ASE-P1) E. Inspect air springs, mounting plates, springs, suspension arms, and bushings (ASE-P1) F. Inspect tandem suspension equalizer components (ASE-P3)	A. ● B. ● C. ● D. ● E. ●	F. ■	
FA-DHE29. Wheel alignment ***Demonstrate understanding of alignment angles***	A. Demonstrate understanding of alignment angles (ASE-P3)			A. ▲
FA-DHE30. Wheels and tires ***Inspect tire conditions and wheel mounting hardware and identify potential problems***	A. Check wheel mounting hardware; check wheel condition; remove and install wheel/tire assemblies (steering and drive axle); torque fasteners to manufacturer's specification using torque wrench (ASE-P1) B. Inspect tire condition; identify tire wear patterns; measure tread depth; verify tire matching (diameter and tread); inspect valve stem and cap; set tire pressure (ASE-P1) C. Identify wheel/tire vibration, shimmy, pounding, and hop (tramp) problems (ASE-P2)	A. ●	B. ■ C. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE31. Frame and coupling devices ***Inspect frame components and configurations and service and/or adjust fifth wheel***	A. Inspect, service, and/or adjust fifth wheel, pivot pins, bushings, locking mechanisms, mounting hardware, air lines, and fittings (ASE-P1) B. Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage (ASE-P1) C. Check pintle hook and mounting (if applicable) (ASE-P1) D. Inspect frame hangers, brackets, and cross members (ASE-P3)	A. ● B. ● C. ●	D. ■	

V. Electrical/Electronic Systems

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE32. General ***Demonstrate knowledge of electrical/electronic principles, proper use of test equipment, and problems in electrical/electronic circuits***	A. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law) (ASE-P1) B. Demonstrate proper use of test equipment when measuring source voltage, voltage drop (including grounds), current flow, continuity, and resistance (ASE-P1) C. Demonstrate knowledge of the causes and effects of shorts, grounds, opens, and resistance problems in electrical/electronic circuits (ASE-P1) D. Use wiring diagrams to trace electrical/electronic circuits (ASE-P1) E. Measure parasitic (key-off) battery drain (ASE-P1) F. Demonstrate knowledge of the function, operation, and testing of fusible links, circuit breakers, relays, solenoids, diodes, and fuses (ASE-P1) G. Inspect, repair (including solder repair), and/or replace connectors, seals, terminal ends, and wiring; verify proper routing and securement (ASE-P1) H. Identify electrical/electronic system components and configuration (ASE-P1) I. Use appropriate electronic service tool(s) and procedures to check, record, and clear diagnostic codes; interpret digital (DMM) readings (ASE-P2) J. Check for malfunctions caused by faults in the data bus communications network (ASE-P2)	A. ● B. ● C. ● D. ● E. ● F. ● G. ● H. ●	I. ■ J. ■	

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE33. Battery system ***Identify battery type and system configurations, and inspect, charge, and/or jump-start vehicles***	A. Inspect battery, battery cables, connectors, battery boxes, mounts, and hold-downs; determine needed action (ASE-P1) B. Jump-start vehicle using a booster battery and jumper cables or using an appropriate auxiliary power supply (ASE-P1) C. Charge battery using appropriate method for battery type (ASE-P1) D. Identify battery type and system configuration (ASE-P1) E. Confirm proper battery capacity for application; perform battery state-of-charge test; perform battery capacity test, determine needed action (ASE-P1) F. Identify low voltage disconnect (LVD) systems (ASE-P2)	A. ● B. ● C. ● D. ● E. ● F. ●		
FA-DHE34. Starting system ***Demonstrate understanding of starter system operation, components, and configurations***	A. Demonstrate understanding of starter system operation (ASE-P1) B. Perform starter circuit cranking voltage and voltage drop tests (ASE-P1) C. Inspect starter control circuit switches, relays, connectors, terminals, wires, and harnesses (including over-crank protection) (ASE-P1)	A. ● B. ● C. ●		
FA-DHE35. Charging system ***Identify, check, and inspect charging system components and configurations***	A. Inspect generator (alternator) drive belt condition; check pulleys and tensioners for wear; check fans and mounting brackets; verify proper belt alignment (ASE-P1) B. Inspect cables, wires, and connectors in the charging circuit (ASE-P1) C. Identify and understand operation of the generator (alternator) (ASE-P1) D. Check instrument panel mounted voltmeters and/or indicator lamps (ASE-P1) E. Perform charging system voltage and amperage output tests; perform AC ripple test (ASE-P1)	A. ● B. ● C. ● D. ● E. ●		

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE36. Lighting system ***Inspect lighting system components and configurations***	A. Inspect cables, wires, and connectors in the lighting systems (ASE-P1) B. Inspect tractor-to-trailer multi-wire connectors, cables, and holders (ASE-P1) C. Inspect for brighter-than-normal, intermittent, dim, or no-light operation; determine needed action (ASE-P1) D. Test, replace, and aim headlights (ASE-P1)	A. ● B. ●	C. ■ D. ■	
FA-DHE37. Instrument cluster and driver information systems ***Check indicator operation and identify components and configurations***	A. Check gauge and warning indicator operation (ASE-P1) B. Identify the sensor/sending units, gauges, switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, printed circuits, and control components/modules of the instrument cluster, driver information system, and warning systems (ASE-P2)	A. ●	B. ■	

VI. Heating, Ventilation, and Air Conditioning (HVAC)

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE38. General ***Identify HVAC components and configuration***	A. Identify heating, ventilation, and air conditioning (HVAC) components and configuration (ASE-P1) B. Use appropriate electronic service tool(s) and procedures to check, record, and clear diagnostic codes; interpret digital multimeter (DMM) readings (ASE-P1)		A. ■ B. ■	
FA-DHE39. Refrigeration system components ***Inspect A/C system components and operation and determine needed action***	A. Check A/C system operation including system pressures; visually inspect A/C components for signs of leaks; check A/C monitoring system (if applicable) (ASE-P1) B. Inspect A/C condenser for airflow restrictions; determine needed action (ASE-P1) C. Inspect A/C compressor drive belts, pulleys, and tensioners; verify proper belt alignment (ASE-P1)	A. ●	B. ■	C. ▲

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE40. Heating, ventilation, and engine cooling systems ***Inspect engine cooling components and operation and identify A/C system odors***	A. Inspect engine cooling system and heater system hoses and pipes; determine needed action (ASE-P1) B. Inspect HVAC system-heater ducts, doors, hoses, cabin filters, and outlets; determine needed action (ASE-P1) C. Identify the source of A/C system odors (ASE-P2)	A. ●	B. ■	C. ▲
FA-DHE41. Operating systems and related controls ***Verify blower operation, air distribution, and temperature controls and determine action***	A. Verify blower motor operation; confirm proper air distribution; confirm proper temperature control; determine needed action (ASE-P1)			A. ▲

VII. Cab

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE42. General ***Use appropriate electronic service tools and procedures***	A. Use appropriate electronic service tool(s) and procedures to check, record, and clear diagnostic codes; check and record trip/operational data; reset maintenance monitor (if applicable); interpret digital multimeter (DMM) readings (ASE-P1)	A. ●		
FA-DHE43. Instruments and controls ***Inspect ignition system components and understand operation of auxiliary and electric power units***	A. Inspect mechanical key condition; check operation of ignition switch; check operation of indicator lights, warning lights and/or alarms; check instruments; record oil pressure and system voltage; check operation of electronic power take-off (PTO) and engine idle speed controls (if applicable) (ASE-P1) B. Check operation of all accessories (ASE-P1) C. Understand operation of auxiliary power unit (APU)/electric power unit (EPU) (ASE-P3)	A. ●	B. ■	C. ▲
FA-DHE44. Safety equipment ***Check operation and condition of safety equipment***	A. Check operation of horns (electric and air); check warning device operation (reverse, air pressure, etc.); check condition of spare fuses, safety triangles, fire extinguisher, and all required decals; inspect seat belts and sleeper restraints; inspect condition of wiper blades and arms (ASE-P1)	A. ●		
FA-DHE45. Hardware ***Check operation of cab hardware (e.g., wipers, windshield), lubricate cab grease fittings, and inspect cab mountings and fender components***	A. Check operation of wipers and washer; inspect windshield glass for cracks or discoloration; check sun visor; check seat condition, operation, and mounting; check door glass and window operation; verify operation of door and cab locks; inspect steps and grab handles; inspect mirrors, mountings, brackets, and glass (ASE-P1) B. Record all physical damage (ASE-P2) C. Inspect cab mountings, hinges, latches, linkages, and ride height (ASE-P1) D. Lubricate all cab grease fittings; inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables (ASE-P2) E. Inspect quarter fender, mud flaps, and brackets (ASE-P1)	A. ● B. ● C. ●		D. ▲ E. ▲

VIII. Hydraulics

Code and Knowledge and Skill Statement	Suggested Performance Indicators	Foundational	Intermediate	Advanced
FA-DHE42. General ***Identify and inspect hydraulic system components and check fluid level and condition***	A. Check fluid level and condition; take a hydraulic fluid sample for analysis (ASE-P3) B. Inspect hoses and connections for leaks, proper routing, and proper protection; determine needed action (ASE-P3) C. Identify hydraulic system components; locate filtration system components; service filters and breathers (ASE-P3) D. Verify placement of equipment/component safety labels and placards; determine needed action (ASE-P3)	A. ● B. ● C. ●		D. ▲