## CONTENT STANDARD 1.0: IDENTIFY AND UTILIZE SAFETY PROCEDURES AND PROPER TOOLS

### Performance Standard 1.1: Demonstrate General Lab Safety Rules and Procedures

1.1.1 Describe general shop safety rules and procedures.
1.1.2 Utilize safe procedures for handling of tools and equipment.
1.1.3 Identify and use proper placement of floor jacks and jack standards.
1.1.4 Identify and use proper procedures for safe vehicle life operation.
1.1.5 Utilize proper ventilation procedures for working within the lab/shop area.
1.1.6 Identify marked safety areas.
1.1.7 Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other safety equipment.
1.1.8 Identify the location and use of eye wash stations.
1.1.9 Identify the location of the posted evacuation routes.
1.1.10 Comply with the required use of safety glasses, ear protection, gloves and shoes during lab/shop activities.
1.1.11 Identify and wear appropriate clothing for lab/shop activities.
1.1.12 Secure hair and jewelry for lab/shop activities.
1.1.13 Identify safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits.
1.1.14 Identify safety aspects of high voltage circuits (such as high intensity discharge (HID) lamps, ignition systems, injection systems, etc.)
1.1.15 Locate and interpret safety data sheets (SDS).
1.1.16 Handle and dispose of hazardous waste and materials.
1.1.1 Describe general shop safety rules and procedures.

### Performance Standard 1.2: Identify and Utilize Proper Tools

1.2.1 Identify tools and their usage in automotive applications.
1.2.2 Identify standard and metric designations and fasteners.
1.2.3 Demonstrate safe handling and use of appropriate tools.
1.2.4 Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
1.2.5 Demonstrate proper use of precision measuring tools (e.g., micrometer, dial-indicate, dial-caliper).

## CONTENT STANDARD 2.0: PERFORM BASIC VEHICLE SERVICE

### Performance Standard 2.1: Identify and Utilize Vehicle Service Information

2.1.1 Locate and utilize paper and/or electronic service information.
2.1.2 Locate and utilize Technical Service Bulletins (TSBs).
2.1.3 Demonstrate knowledge of special service messages, quotes, service campaigns/recalls,

vehicle/service warranty applications and service interval recommendations.

2.1.4 Locate Vehicle Identification Number (VIN) and production data code.

2.1.5 Analyze Vehicle Identification Number (VIN) information.

2.1.6 Identify other vehicle information labels (such as tire, emissions, etc.)

### Performance Standard 2.2: Prepare a Vehicle for the Customer

2.2.1 Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.)

2.2.2 Verify vehicle repair.

## CONTENT STANDARD 3.0: APPLY CONCEPTS OF ENGINE REPAIR (A1)

### Performance Standard 3.1: Demonstrate General Engine Service Techniques

3.1.1 Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.

3.1.2 Verify operation of the instrument panel engine warning indicators.

3.1.3 Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.

3.1.4 Install engine covers using gaskets, seals and sealers as required.

3.1.5 Demonstrate knowledge of timing belt removal and replacement.

3.1.6 Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert.

3.1.7 Identify hybrid vehicle internal combustion engine service precautions.

### Performance Standard 3.2: Perform Cylinder Head and Valve Train Service and Repair

3.2.1 Identify various cylinder head configurations (i.e., OHV, OHC, DOHC, VVT).

3.2.2 Demonstrate knowledge of valve adjustment (mechanic and hydraulic lifters).

### Performance Standard 3.3: Perform Lubrication and Cooling Systems Service and Repair

3.3.1 Diagnose various cooling system faults including block test, thermostat operation, coolant restrictions, leaks, and fan operation.

3.3.2 Inspect, replace and adjust drive belts, tensioners, and pulleys, check pulley and belt alignment.

3.3.3 Inspect and test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.

3.3.4 Perform oil and filter change.

## CONTENT STANDARD 4.0: ANALYZE AUTOMATIC TRANSMISSION/TRANSAXLE FOR SERVICE (A2)

### Performance Standard: 4.1: Perform General Transmission/Transaxle Service

4.1.1 Research applicable vehicle and service information, fluid type, vehicle service history, service precautions, and technical service bulletins.

4.1.2 Check fluid level in a transmission, or a transaxle equipped with a dip-stick.
4.1.3 Check fluid level in a transmission, or a transaxle not equipped with a dip-stick.
4.1.4 Check transmission fluid condition; check for leaks.

### Performance Standard 4.2: Perform In-Vehicle Transmission/Transaxle Service and Repair

4.2.1 Inspect, adjust, and replace external manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch.
4.2.2 Inspect for leakage at external seals, gaskets, and bushings.
4.2.3 Inspect powertrain mounts.
4.2.4 Drain and replace fluid and filter(s).

## CONTENT STANDARD 5.0: ANALYZE MANUAL DRIVETRAIN AND AXLES FOR SERVICE (A3)

### Performance Standard 5.1: Perform General Drive Train Service

5.1.1 Research applicable vehicle and service information, fluid type, vehicle service history, service precautions, and technical service bulletins.
5.1.2 Drain and refill manual transmission/transaxle and final drive unit.
5.1.3 Check fluid condition; check for leaks.

### Performance Standard 5.2: Investigate Clutch Systems for Service and Repair

5.2.1 Check and adjust clutch master cylinder fluid level.
5.2.2 Check for system leaks.
5.2.3 Describe basic operation of a manual clutch system.

### Performance Standard 5.3: Perform Drive Shaft and Half Shaft, Universal and Constant Velocity (CV) Joint Service and Repair

5.3.1 Diagnose, inspect, remove and replace front wheel drive (FWD) bearings, hubs, and seals.
5.3.2 Diagnose, inspect, service and replace shafts, yokes, boots, and universal/CV joints.

### Performance Standard 5.4: Assess Differential Case Assembly for Service

5.4.1 Demonstrate knowledge of differential operation.
5.4.2 Clean and inspect differential housing; check for leaks; inspect housing vent.
5.4.3 Check and adjust differential housing fluid level + A71.
5.4.4 Drain and fill differential housing.

### Performance Standard 5.5: Perform Drive Axle Service and Repair

5.5.1 Inspect and replace drive axle wheel studs.
5.6.1 Inspect front-wheel bearings and locking hubs.

## CONTENT STANDARD 6.0: PERFORM SUSPENSION AND STEERING SERVICE AND REPAIR (A4)

### Performance Standard 6.1: Prepare Vehicle for General Suspension and Steering Systems Service

6.1.1 Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
6.1.2 Disable and enable supplemental restraint system (SRS).

### Performance Standard 6.2: Perform Steering Systems Service and Repair

6.2.1 Demonstrate knowledge of various power steering systems.
6.2.2 Identify and inspect various steering system components.
6.2.3 Demonstrate knowledge of various suspension systems.
6.2.4 Identify and inspect various suspension system components.
6.2.5 Inspect electric power-assisted steering.
6.2.6 Identify electronically controlled suspension systems and safety precautions.
6.2.7 Identify hybrid vehicle power steering system electrical circuits and safety precautions.

### Performance Standard 6.3: Investigate Wheel Alignment Conditions

6.3.1 Demonstrate knowledge of alignment angles, including camber, caster, toe, and SAI.
6.3.2 Perform pre-alignment inspection and measure vehicle ride height, perform necessary action.

### Performance Standard 6.4: Perform Wheel and Tire Service and Repair

6.4.1 Inspect tire condition; identify tire wear patterns; check for correct size and application (load and speed ratings) and adjust air pressure; determine necessary action.
6.4.2 Rotate tires according to manufacturer's recommendations.
6.4.3 Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic).
6.4.4 Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
6.4.5 Inspect tire and wheel assembly for air loss; perform necessary action.
6.4.6 Repair tire according to industry standards.
6.4.7 Identify TPMS maintenance and relearn procedures.

## CONTENT STANDARD 7.0: ANALYZE BRAKE SYSTEMS FOR SERVICE AND REPAIR (A5)

### Performance Standard 7.1: Prepare Vehicle for General Suspension and Steering Systems Service Demonstrate Knowledge of General Brake Systems

7.1.1 Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
7.1.2 Describe procedure for performing a road test to check brake system operation, including the anti-lock brake system (ABS).
7.1.3 Demonstrate knowledge of basic hydraulic principles.

### Performance Standard 7.2: Perform Hydraulic System Service and Repair

7.2.1 Measure brake pedal height, travel, and free play (as applicable); determine necessary action.
7.2.2 Check master cylinder for internal/external leaks and proper operation.
7.2.3 Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks bulging, wear, loose fittings and support; determine necessary action.

7.2.4 Select, handle, store, and fill brake fluids to proper level.
7.2.5 Identify components of brake warning light system.
7.2.6 Bleed and/or flush brake system.
7.2.7 Test brake fluid for contamination.

## Performance Standard 7.3: Perform Drum Brake Service and Repair

7.3.1 Remove, clean, inspect, and measure brake drum diameter; determine necessary action.
7.3.2 Refinish brake drum and measure final drum diameter; compare with specifications.
7.3.3 Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.
7.3.4 Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
7.3.5 Readjust brake shoes and parking brake; install brake drums or drum/hub assemblies, wheel bearings; make final checks and adjustments.
7.3.6 Install wheel and torque lug nuts to proper specifications.

## Performance Standard 7.4: Perform Disc Brake Service and Repair

7.4.1 Remove and clean caliper assembly; inspect for leaks and damage/wear to caliper housing; determine necessary action.
7.4.2 Clean, inspect and lubricate clipper mounting and slides/pins for proper operation wear, and damage; determine necessary action.
7.4.3 Remove, inspect and replace pads and retaining hardware; determine necessary action.
7.4.4 Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks.
7.4.5 Clean and inspect rotor, measure rotor thickness, thickness variation, and lateral run out; determine necessary action.
7.4.6 Remove and reinstall rotor.
7.4.7 Refinish rotor on vehicle; measure final rotor thickness and compare with specifications.
7.4.8 Refinish rotor off vehicle; measure final rotor thickness and compare with specifications.
7.4.9 Retract and readjust caliper piston on an integral parking brake system.
7.4.10 Check brake pad wear indicator; determine necessary action.
7.4.11 Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations.

## Performance Standard 7.5: Analyze Power Assist Units

7.5.1 Check brake pedal free-travel with, and without, engine running to verify proper power booster operation.
7.5.2 Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.
7.5.3 Identify alternative power assist units.

## Performance Standard 7.6: Perform Miscellaneous Service and Repair (wheel bearings, parking brakes, electrical, etc.)

7.6.1 Remove, clean, inspect, repack, and install wheel bearings, races, seals; install hub and adjust bearings.
7.6.2 Check parking brake cables and components for wear, binding, and corrosion; clean,

lubricate, adjust or replace as needed.

7.6.3 Check parking brake operation and parking brake indicator light system operation; determine necessary action.

7.6.4 Check operation of brake stop light system.

## CONTENT STANDARD 8.0: ANALYZE ELECTRICAL/ELECTRONIC SYSTEM (A6)

### Performance Standard 8.1: Perform General Electronic Systems Service

8.1.1 Research applicable vehicle and service information vehicle service history, service precautions, and technical service bulletins.

8.1.2 Demonstrate knowledge of electrical/electronic series, parallel and series-parallel circuits using principles of electricity (Ohm's and Watt's Law).

8.1.3 Use and interpret wiring diagrams to trace electrical/electronic circuits.

8.1.4 Demonstrate proper use of digital millimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance.

8.1.5 Research the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits.

8.1.6 Check operations of electrical circuits with a test light.

8.1.7 Check operation of electrical circuits using fused jumper wires.

8.1.8 Measure key-off battery drain (parasitic draw).

8.1.9 Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.

8.1.10 Perform solder repair of electrical wiring.

8.1.11 Replace electrical connectors and terminal ends.

### Performance Standard 8.2: Perform Battery Service

8.2.1 Perform battery state-of-charge test; determine necessary action.

8.2.2 Confirm proper battery capacity for vehicle application; perform battery capacity test; determine necessary action.

8.2.3 Maintain or restore electronic memory functions.

8.2.4 Inspect and clean battery; fill battery cells, clean battery cables, connectors, clamps, and hold-downs.

8.2.5 Perform slow/fast battery charge according to manufacturer recommendations.

8.2.6 Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply.

8.2.7 Identify high voltage circuits of electric or hybrid electric vehicle and related safety precautions.

8.2.8 Identify electronic modules, security systems, radios, and other accessories that require re-initialization or code entry after reconnecting vehicle battery.

8.2.1 Perform battery state-of-charge test; determine necessary action.

8.2.2 Confirm proper battery capacity for vehicle application; perform battery capacity test; determine necessary action.

8.2.3 Maintain or restore electronic memory functions.

### Performance Standard 8.3: Perform Starting System Service and Repair

8.3.1 Perform starter current draw test; determine necessary action.
8.3.2 Perform starter circuit voltage drop tests; determine necessary action.
8.3.3 Inspect and test starter relays and solenoid; determine necessary action.
8.3.4 Remove and install starter in a vehicle.
8.3.5 Inspect and test switches, connectors, and wires of starter control circuits; determine necessary action.

### Performance Standard 8.4: Perform Charging System Service and Repair

8.4.1 Perform charging system output test; determine necessary action.
8.4.2 Inspect, adjust, or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment.
8.4.3 Remove, inspect and reinstall generator (alternator).
8.4.4 Perform charging circuit voltage drop tests; determine necessary action

### Performance Standard 8.5: Perform Lighting Systems Service and Repair

8.5.1 Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed.
8.5.2 Aim headlights.
8.5.3 Identify system voltage and safety precautions associated with high intensity discharge headlights.

### Performance Standard 8.6: Perform Accessories Service and Repair

8.6.1 Disable and enable the airbag system for vehicle service; verify indicator lamp operation.
8.6.2 Remove and reinstall door panel.
8.6.3 Describe the operation of keyless entry/remote-start system.
8.6.4 Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators.
8.6.5 Verify windshield wiper and washer operation; replace wiper blades.

## CONTENT STANDARD 9.0: ANALYZE HEATING AND AIR CONDITIONING SYSTEMS (A7)

### Performance Standard 9.1: Demonstrate Knowledge of A/C Systems

9.1.1 Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
9.1.2 Identify A/C components on a vehicle.

### Performance Standard 9.2: Inspect Refrigeration System Components

9.2.1 Inspect and replace A/C compressor drive belts, pulleys, and tensioners; determine necessary action.
9.2.2 Research hybrid vehicle A/C system electrical circuits and the service/safety precautions.
9.2.3 Inspect A/C condenser for airflow restrictions; determine necessary action.

### Performance Standard 9.3: Inspect Heating, Ventilation, and Engine Cooling Systems

9.3.1 Inspect engine cooling and heater system hoses; perform necessary action.

### Performance Standard 9.4: Inspect operating systems and related controls

9.4.1 Inspect A/C-heater ducts, doors, hoses, cabin filters, and outlets; perform necessary action.
9.4.2 Identify the source of A/C system odors.

## CONTENT STANDARD 10.0: ANALYZE ENGINE PERFORMANCE (A8)

### Performance Standard 10.1: Perform General Engine Service

10.1.1 Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
10.1.2 Demonstrate knowledge of 4-stroke engine.
10.1.3 Perform engine absolute (vacuum) manifold pressure tests; determine necessary action.
10.1.4 Perform cylinder cranking and running compressions tests; determine necessary action.
10.1.5 Perform cylinder leakage test; determine necessary action.
10.1.6 Verify engine operating temperature.
10.1.7 Remove and replace spark plugs; inspect secondary ignition components for wear and damage.

### Performance Standard 10.2: Analyze Computerized Engine Controls

10.2.1 Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable.
10.2.2 Describe the importance of operating all OBDII monitors for repair verification.

### Performance Standard 10.3: Perform Fuel, Air Induction, and Exhaust Systems Service and Repair

10.3.1 Replace fuel filter(s).
10.3.2 Inspect, service, or replace air filters, filter housing and intake duct work.
10.3.3 Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields; determine necessary action.
10.3.4 Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; repair or replace as needed.
10.3.5 Describe diesel exhaust fluid (DEF).

### Performance Standard 10.4: Perform Emissions Control Systems Service and Repair

10.4.1 Demonstrate knowledge of basic emission control components.

## CONTENT STANDARDS 1.0: IDENTIFY AND UTILIZE SAFETY PROCEDURES AND PROPER TOOLS

### Performance Standards 1.1 General Lab Safety Rules and Procedures

1.1.1 Describe general shop safety rules and procedures (i.e., safety test).
1.1.2 Utilize safe procedures for handling of tools and equipment.
1.1.3 Identify and use proper placement of floor jacks and jack stands.
1.1.4 Identify and use proper procedures for safe vehicle lift operation.
1.1.5 Utilize proper ventilation procedures for working within the lab/shop area.
1.1.6 Identify marked safety areas.
1.1.7 Identify the location and the types of fire extinguishers and other fire safety equipment.
1.1.8 Demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
1.1.9 Identify the location and use of eye wash stations.
1.1.10 Identify the location of the posted evacuation routes.
1.1.11 Comply with the required use of PPE during lab/shop activities.
1.1.12 Identify and wear appropriate clothing for lab/shop activities.
1.1.13 Secure hair and jewelry for lab/shop activities.
1.1.14 Research safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits.
1.1.15 Research safety aspects of high voltage circuits (such as high intensity discharge (HID) lamps, ignition systems, injection systems, etc.)
1.1.16 Locate and interpret safety data sheets (SDS).

### Performance Standards 1.2: Identify and Utilize Proper Tools

1.2.1 Identify tools and their usage in automotive applications.
1.2.2 Identify standard and metric designation.
1.2.3 Demonstrate safe handling and use of appropriate tools.
1.2.4 Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
1.2.5 Demonstrate proper use of precision measuring tools (i.e., tram gauges, mil thickness gauge).

## CONTENT STANDARDS 2.0: INVESTIGATE INDUSTRY CAREERS

### Performance Standards 2.1: Explore careers

2.1.1 Research the different career opportunities in the transportation career path.
2.1.2 Investigate new and emerging vehicle technologies and trends.

## CONTENT STANDARDS 3.0 DEMOSTRATE DAMAGE ANALYSIS, ESTIMATING AND CUSTOMER SERVICE SKILLS

### Performance Standards 3.1: identify Vehicle Construction and Parts

3.1.1 Identify type of vehicle construction (space frame, auto body, body-over-frame).
3.1.2 Recognize the different damage characteristics of space frame, uni-body, and body-over-frame vehicles.
3.1.3 Identify impact energy absorbing components.
3.1.4 Identify steel types; determine reparability.
3.1.5 Identify aluminum/magnesium components; determine reparability.
3.1.6 Identify plastic/composite components; determine reparability.
3.1.7 Identify vehicle glass components and repair/replacement procedures.
3.1.8 Identify add-on accessories.

### Performance Standards 3.2: Perform Damage Analysis

3.2.1 Position the vehicle for inspection.
3.2.2 Prepare vehicle for inspection by providing access to damaged areas.
3.2.3 Analyze damage to determine appropriate methods for overall repairs.
3.2.4 Determine the direction, point(s) of impact, and extent of direct, indirect, and inertia damage.
3.2.5 Gather details of the incident/accident necessary to determine the full extent of vehicle damage.
3.2.6 Identify and record pre-existing damage.
3.2.7 Identify and record prior repairs.
3.2.8 Perform visual inspection of structural components and members.
3.2.9 Identify structural damage using measuring tools and equipment.
3.2.10 Perform visual inspection of non-structural components and members.
3.2.11 Determine parts, components, material type(s) and procedures necessary for a proper repair.
3.2.12 Identify type and condition of finish; determine if refinishing is required.
3.2.13 Identify suspension, electrical, and mechanical component physical damage.
3.2.14 Identify safety systems physical damage.
3.2.15 Identify interior component damage.
3.2.16 Identify damage to add-on accessories and modifications.
3.2.17 Identify single (one time) use components.

### Performance Standards 3.3: Demonstrate Estimating Procedures

3.3.1 Determine and record customer/vehicle owner information.
3.3.2 Identify and record vehicle identification number (VIN) information, including nation of origin, make, model, restraint system, body type, production date, engine type, and assembly plant.
3.3.3 Identify and record vehicle options, including trim level, paint code, transmission, accessories, and modifications.

3.3.4 Identify safety systems; determine replacement items.
3.3.5 Apply appropriate estimating and parts nomenclature (terminology).
3.3.6 Determine and apply appropriate estimating sequence.
3.3.7 Utilize estimating guide procedure pages.
3.3.8 Apply estimating guide footnotes and headnotes as needed.
3.3.9 Estimate labor value for operations requiring judgment.
3.3.10 Select appropriate labor value for each operation (structural, non-structural, mechanical, and refinish).
3.3.11 Select and price OEM parts; verify availability, compatibility, and condition.
3.3.12 Select and price alternative/optional OEM parts; verify availability, compatibility and condition.
3.3.13 Select and price aftermarket parts; verify availability, compatibility, and condition.
3.3.14 Select and price recyclable/used parts; verify availability, compatibility and condition.
3.3.15 Select and price remanufactured, rebuilt, and reconditioned parts; verify availability, compatibility and condition.
3.3.16 Determine price and source of necessary sublet operations.
3.3.17 Determine labor value, prices, charges, allowances, or fees for non-included operations and miscellaneous items.
3.3.18 Recognize and apply overlap deductions, included operations, and additions.
3.3.19 Determine additional material and charges.
3.3.20 Determine refinishing material and charges.
3.3.21 Apply math skills to establish charges and totals.
3.3.22 Interpret computer-assisted and manually written estimates; verify the information is current.
3.3.23 Identify procedural differences between computer-assisted systems and manually written estimates.
3.3.24 Identify procedures to restore corrosion protection; establish labor values, and material charges.
3.3.25 Determine the cost effectiveness of the repair and determine the approximate vehicle retail, and repair value.
3.3.26 Recognize the differences in estimation procedures when using different information provider systems.
3.3.27 Verify accuracy of estimate compared to the actual repair and replacement operations.
3.3.28 Demonstrate ability to access OEM repair information.

## Performance Standards 3.4: Demonstrate Customer Relations And Sales Skills

3.4.1 Acknowledge and/or greet customer/client.
3.4.2 Listen to customer/client; collect information and identify customers/client's concerns, needs and expectations.
3.4.3 Establish cooperative attitude with customer/client.
3.4.4 Identify yourself to customer/client; offer assistance.

3.4.5 Resolve customer/client conflicts .
3.4.6 Identify customer/client preferred communication method; follow up to keep customer/client informed about parts and the repair process.
3.4.7 Recognize basic claims handling procedures; explain to customer/client.
3.4.8 Project positive attitude and professional appearance.
3.4.9 Provide and review warranty information.
3.4.10 Estimate and explain duration of out-of-service time.
3.4.11 Apply negotiation skills to obtain a mutual agreement.
3.4.12 Interpret and explain manual or computer-assisted estimate to customer/client.

## CONTENT STANDARDS 4.0: PERFORM NON-STURCTURAL ANALYSIS AND DAMAGE REPAIR (BODY COMPONENTS)

### PERFORMANCE STANDARDS 4.1: DEMONSTRATE INSPECTION AND PREPARATION TECHNIQUES

4.1.1 Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan.
4.1.2 Inspect, remove, label, store, and reinstall exterior trim and moldings.
4.1.3 Inspect, remove, label, store, and reinstall interior trim and components.
4.1.4 Inspect, remove, label, store, and reinstall body panels and components that may interfere with or be damaged during repair.
4.1.5 Inspect, remove, label, store, and reinstall vehicle mechanical and electrical components that may interfere with or be damaged during repair.
4.1.6 Protect panels, glass, interior parts, and other vehicles adjacent to the repair area.
4.1.7 Soap and water wash entire vehicle; complete pre-repair inspection checklist.
4.1.8 Prepare damaged area using water-based and solvent-based cleaners.
4.1.9 Remove corrosion protection, undercoating's, sealers, and other protective coatings as necessary to perform repairs.
4.1.10 Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair.
4.1.11 Inspect, remove, and replace seatbelt and shoulder harness assembly and components.
4.1.12 Inspect restraint system mounting areas for damage; repair as needed.
4.1.13 Verify proper operation of seatbelt.

### Performance Standards 4.2: Perform Outer Body Panel Repair, Replacement, and Adjustments

4.1.1 Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan.
4.1.2 Inspect, remove, label, store, and reinstall exterior trim and moldings.
4.1.3 Inspect, remove, label, store, and reinstall interior trim and components.
4.1.4 Inspect, remove, label, store, and reinstall body panels and components that may interfere with

or be damaged during repair.

4.1.5 Inspect, remove, label, store, and reinstall vehicle mechanical and electrical components that may interfere with or be damaged during repair.

4.1.6 Protect panels, glass, interior parts, and other vehicles adjacent to the repair area.

4.1.7 Soap and water wash entire vehicle; complete pre-repair inspection checklist.

4.1.8 Prepare damaged area using water-based and solvent-based cleaners.

4.1.9 Remove corrosion protection, undercoating's, sealers, and other protective coatings as necessary to perform repairs.

4.1.10 Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair.

4.1.11 Inspect, remove, and replace seatbelt and shoulder harness assembly and components.

4.1.12 Inspect restraint system mounting areas for damage; repair as needed.

4.1.13 Verify proper operation of seatbelt.

4.2.14 Identify one-time use fasteners.

4.2.15 Clean, inspect, and prepare reusable fasteners.

## Performance Standards 4.2: Apply Metal Finishing and Body Filling Techniques

4.3.1 Remove paint from the damaged area of a body panel.

4.3.2 Locate and repair surface irregularities on a damaged body panel.

4.3.3 Demonstrate hammer and dolly techniques.

4.3.4 Heat shrink stretched panel areas to proper contour.

4.3.5 Cold shrink stretched panel areas to proper contour.

4.3.6 Prepare and apply body filler.

4.3.7 Identify different types of body fillers.

4.3.8 Rough sand body filler to contour; finish sand.

## Performance Standards 4.4: Inspect moveable glass and hardware components

4.4.1 Inspect, adjust, repair or replace window regulators, run channels, glass, power mechanisms, and related controls.

4.4.2 Inspect, adjust, repair, remove, reinstall or replace weather-stripping.

4.4.3 Cycle electrical components as needed.

## Performance Standards 4.6: Utilize Plastic and Adhesives

4.6.1 Identify the types of plastics; determine reparability.

4.6.2 Clean and prepare the surface of plastic parts; identify the types of plastic repair procedures.

4.6.3 Demonstrate one-sided, two-sided, and tab repair.

4.6.4 Repair rigid, semi-rigid, or flexible plastic panels.

4.6.5 Remove or repair damaged areas from rigid exterior composite panels.

4.6.6 Replace bonded rigid exterior composite body panels; straighten or align panel supports.

4.6.7 Demonstrate the proper cleanup procedures for specific adhesives.

## CONTENT PERFORMACE 5.0: PERFORM STRUCTURAL ANALYSIS AND DAMAGE REPAIR

### Performance Standards 5.1: Demonstrate Inspections and Repair Techniques

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|---|---|
| 5.1.1 | Measure and diagnose structural damage using a tram gauge. |
| 5.1.2 | Attach vehicle to anchoring devices. |
| 5.1.3 | Determine the extent of the direct and indirect damage and the direction of impact; document the methods and sequence of repair. |
| 5.1.4 | Analyze and identify crush/collapse zones. |
| 5.1.5 | Restore mounting and anchoring locations. |
| 5.1.6 | Check for water leaks, dust leaks, and wind noise. |
| 5.1.7 | Perform visual inspection and measuring checks to identify steering and suspension collision damage. |
| 5.1.8 | Reinstall wheels and torque lug nuts. |

## CONTENT STANDARDS 6.0: DEMOSTRATE PAINTING AND REFINISHING TECHNIQUES

### Performance Standards 6.1: Apply Safety Precautions

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|---|---|
| 6.1.1 | Identify and take necessary precautions with hazardous operations and materials according to federal, state, and local regulations. |
| 6.1.2 | Identify safety and personal health hazards according to OSHA guidelines and the “Right to Know Law”. |
| 6.1.3 | Inspect spray environment and equipment to ensure compliance with federal, state and local regulations, and for safety and cleanliness hazards. |
| 6.1.4 | Select and use a NIOSH approved air purifying respirator. Inspect condition and ensure fit and operation. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation. |
| 6.1.5 | Select and use a NIOSH approved supplied air (Fresh Air Make-up) respirator system. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation . |
| 6.1.6 | Select and use appropriate PPE. |

### Performance standards 6.2: Utilize Surface Preparation Techniques

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| 6.2.1 | Inspect, remove, store, and replace exterior trim and components necessary for proper surface preparation. |
| 6.2.2 | Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants. |
| 6.2.3 | Inspect and identify type of finish, surface condition, and film thickness; develop and document a plan for refinishing using a total product system. |
| 6.2.4 | Strip paint to bare substrate (paint removal). |

| | |
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| 6.2.5 | Dry or wet sand areas to be refinished. |
| 6.2.6 | Featheredge areas to be refinished. |
| 6.2.7 | Apply suitable metal treatment or primer in accordance with total product systems. |
| 6.2.8 | Mask and protect other areas that will not be refinished. |
| - | Mix primer, primer-surface or primer-sealer. |
| 6.2.10 | Identify a complimentary color or shade of undercoat to improve coverage. |
| 6.2.11 | Apply primer onto surface of repaired area. |
| 6.2.12 | Apply two-component finishing filler to minor surface imperfections. |
| 6.2.13 | Block sand area to which primer-surface has been applied. |
| 6.2.14 | Dry sand area to which finishing filler has been applied. |
| 6.2.15 | Remove dust from area to be refinished, including cracks or moldings of adjacent areas. |
| 6.2.16 | Clean area to be refinished using a final cleaning solution. |
| 6.2.17 | Remove, with a tack rag, any dust or lint particles from the area to be refinished. |
| 6.2.18 | Apply suitable sealer to the area being refinished. |
| 6.2.19 | Scuff sand to remove nibs or imperfections from a sealer. |
| 6.2.20 | Apply stone chip resistant coating. |
| 6.2.21 | Restore caulking and seam sealers to repaired areas. |
| 6.2.22 | Prepare adjacent panels for blending. |
| 6.2.23 | Identify the types of rigid, semi-rigid or flexible plastic parts to be refinished; determine the materials needed, preparation, and refinishing procedures. |
| 6.2.24 | Identify metal parts to be refinished; determine the materials needed, preparation, and refinishing procedures. |

## Performance Standards 6.3: Perform Spray Gun and Related Equipment Operations

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|---|---|
| 6.4.1 | Identify color code by manufacturer's vehicle information label. |
| 6.4.2 | Shake, stir, reduce, catalyze/activate, and strain refinish materials. |
| 6.4.3 | Apply finish using appropriate spray techniques (gun arc, angle, distance, travel speed, and spray pattern overlap) for the finish being applied. |
| 6.4.4 | Demonstrate a let-down panel; check for color match. |
| 6.4.5 | Apply single stage topcoat. |
| 6.4.6 | Apply basecoat/clear coat for panel blending and panel refinishing. |
| 6.4.7 | Apply basecoat/clear coat for overall refinishing. |
| 6.4.8 | Remove nibs or imperfections from basecoat. |
| 6.4.9 | Refinish rigid or semi-rigid plastic parts. |
| 6.4.10 | Refinish flexible plastic parts. |
| 6.4.11 | Demonstrate knowledge of multi-stage coats for panel blending and overall refinishing. |
| 6.4.12 | Identify and mix paint using a formula. |
| 6.4.13 | Identify poor hiding colors; determine necessary action. |

6.4.14 Tint color using formula to achieve a bendable match.
6.4.15 Identify alternative color formula to achieve a bendable match.
6.4.16 Identify the materials equipment, and preparation differences between solvent and waterborne technologies.

## Performance Standards 6.5: Identify Paint Defects--Cause Anca Cures

6.5.1 Identify blistering (raising of the paint surface, air entrapment); determine the cause(s) and correct the condition.
6.5.2 Identify a dry spray appearance in the paint surface; determine the cause(s) and correct the condition.
6.5.3 Identify the presence of fish-eyes (crater-like openings) in the finish; determine the cause(s) and correct the condition.
6.5.4 Identify lifting; determine the cause(s) and correct the condition.
6.5.5 Identify clouding (mottling and streaking in metallic finishes); determine the cause(s) and correct the condition.
6.5.6 Identify orange peel; determine the cause(s) and correct the condition.
6.5.7 Identify overspray; determine the cause(s) and correct the condition.
6.5.8 Identify solvent popping in freshly painted surface; determine the cause(s) and correct the condition.
6.5.9 Identify sags and runs in paint surface; determine the cause(s) and correct the condition.
6.5.10 Identify sanding marks or sand scratch swelling; determine the cause(s) and correct the condition.
6.5.11 Identify contour mapping/edge mapping while finish is drying; determine the cause(s) and correct the condition.
6.5.12 Identify color difference (off-shade); determine the cause(s) and correct the condition.
6.5.13 Identify tape tracking; determine the cause(s) and correct the condition.
6.5.14 Identify low gloss condition; determine the cause(s) and correct the condition.
6.5.15 Identify poor adhesion; determine the cause(s) and correct the condition.
6.5.16 Identify paint cracking (shrinking, splitting, crow's feet or line-checking, micro-checking, etc.); determine the cause(s) and correct the condition.
6.5.17 Identify corrosion; determine the cause(s) and correct the condition.
6.5.18 Identify dirt or dust in the paint surface; determine the cause(s) and correct the condition.
6.5.19 Identify water spotting; determine the cause(s) and correct the condition.
6.5.20 Identify finish damage caused by bird droppings, tree sap, and other natural causes; correct the condition.
6.5.21 Identify finish damage caused by airborne contaminants (acids, soot, rail dust, and other industrial-related causes); correct the condition.
6.5.22 Identify die-back conditions (dulling of the paint film showing haziness); determine the cause(s)

and correct the condition.

6.5.23 Identify chalking (oxidation); determine the cause(s) and correct the condition.

6.5.24 Identify bleed-through (staining); determine the cause(s) and correct the condition.

6.5.25 Identify pin-holing; determine the cause(s) and correct the condition.

6.5.26 Identify buffing-related imperfections (swirl marks, wheel burns); correct the condition.

6.5.27 Identify pigment flotation (color change through film build); determine the cause(s) and correct the condition.

## Performance Standards 6.6: Perform Detail Procedures

6.6.1 Apply decals, transfers, tapes, pinstripes (painted and taped), etc.

6.6.2 Sand, buff and polish fresh or existing finish to remove defects as required.

6.6.3 Clean interior, exterior, and glass.

6.6.4 Clean body openings (door jambs and edges, etc.)

6.6.5 Remove overspray.

6.6.6 Perform vehicle clean-up; complete quality control using a checklist.

## CONTENT STANDARD 1: IDENTIFY AND UTILIZE SAFETY PROCEDURES AND PROPER TOOLS

### Performance Standard 1.1: Demonstrate General Lab Safety Rules and Procedures

1.1.1 Describe general shop safety rules and procedures (i.e., safety test).
1.1.2 Utilize safe procedures for handling of tools and equipment.
1.1.3 Identify and use proper placement of floor jacks and jack stands.
1.1.4 Identify and use proper lifting procedures and proper use of support equipment (e.g., lifts, hoists, rigging, etc.)
1.1.5 Utilize proper ventilation procedures for working within the lab/shop area.
1.1.6 Identify marked safety areas.
1.1.7 Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
1.1.8 Identify the location and use of eye wash stations.
1.1.9 Identify the location of the posted evacuation routes.
1.1.10 Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities (i.e., personal protection equipment – PPE).
1.1.11 Identify and wear appropriate clothing for lab/shop activities.
1.1.12 Secure hair and jewelry for lab/shop activities.
1.1.13 Research safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits.
1.1.14 Research safety aspects of high voltage circuits (such as high intensity discharge (HID) lamps, ignition systems, fuel injection systems, etc.)
1.1.15 Locate and interpret safety data sheets (SDS).
1.1.16 Prepare time or job cards, reports or records.
1.1.17 Perform housekeeping duties.
1.1.18 Follow verbal instructions to complete work assignments.
1.1.19 Follow written instructions to complete work assignments.

### Performance Standard 1.2:

1.2.1 Identify appropriate tools and their usage in diesel service applications.
1.2.2 Identify standard and metric designation.
1.2.3 Demonstrate safe handling and use of appropriate tools.
1.2.4 Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
1.2.5 Demonstrate proper use of precision measuring tools (i.e., micrometer, dial-indicator, dial-caliper).

## CONTENT STANDARD 2: PERFORM BASIC VECHILE SERVICE

### Performance Standard 2.1: Identify and Utilize Vehicle Service Information

2.1.1 Locate and utilize paper and/or electronic service information.
2.1.2 Locate and utilize Technical Service Bulletins (TSBs).
2.1.3 Demonstrate knowledge of special service messages, quotes, service campaigns/recalls, vehicle/service warranty applications, and service interval recommendations.

2.1.4 Locate Vehicle Identification Number (VIN) and production date code.
2.1.5 Analyze Vehicle Identification Number (VIN) information.
2.1.6 Research other vehicle information labels (such as tire, emissions, etc.)

### Performance Standard 2.2: Prepare a Vehicle for Service

2.2.1 Identify information needed and the service requested on a repair order.
2.2.2 Identify purpose and demonstrate proper use of fender covers, seat covers, and floor mats.
2.2.3 Demonstrate use of the three C's (concern, cause, and correction).
2.2.4 Review vehicle service history.
2.2.5 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

### Performance Standard 2.3: Prepare A Vehicle for the Customer

2.3.1 Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.)

## CONTENT STANDARD 3: APPLY CINCEOTS IF DIESEL ENGINER SERVICE

### Performance Standard 3.1: Perform Preliminary Engine Inspection

3.1.1 Inspect fuel, oil, Diesel Exhaust Fluid (DEF) and coolant levels, and condition; determine needed action.
3.1.2 Identify engine fuel, oil, coolant, air, and other leaks; determine needed action.
3.1.3 Observe engine exhaust smoke color and quantity.
3.1.4 Check and record electronic diagnostic codes.

### Performance Standard 3.2:

3.2.1 Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action.
3.2.2 Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action.
3.2.3 Inspect valve train components; determine needed action.
3.2.4 Reassemble cylinder head.
3.2.5 Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash.
3.2.6 Adjust valve bridges (crossheads); adjust valve clearances and injector settings.

### Performance Standard 3.3: Perform Engine Blocks Service and Repair

3.3.1 Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components.
3.3.2 Disassemble, clean, and inspect engine block for cracks/damage; measure mating surfaces for war page; check condition of passages, core/expansion and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; determine needed action.
3.3.3 Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action.
3.3.4 Inspect in-block camshaft bearings for wear and damage; determine needed action.
3.3.5 Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play.
3.3.6 Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil

passages; check passage plugs; measure journal diameter; determine needed action.

3.3.7 Inspect main bearings for wear and damage; check bearing clearances; check crankshaft end play

3.3.8 Inspect, install, and time gear train; measure gear backlash; determine needed action.

3.3.9 Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings.

3.3.10 Determine piston-to-cylinder wall clearance; check ring-to-groove fit and end gap; install rings on pistons.

3.3.11 Assemble pistons and connecting rods; install in block; install rod bearings and check clearances.

3.3.12 Check condition of piston cooling jets (nozzles); determine needed action

3.3.13 Inspect crankshaft vibration damper; determine needed action.

3.3.14 Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure run out; determine needed action.

## Performance Standard 3.4: Perform Engine Blocks Service and Repair

3.4.1 Check engine oil level, condition, and consumption; determine needed action.

3.4.2 Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; check drive gear clearances; determine needed action.

3.4.3 Determine proper lubricant and filter requirements.

3.4.4 Perform oil and filter change.

## Performance Standard 3.5: Perform Cooling Systems Service and Repair

3.5.1 Check engine coolant type, level, condition, and consumption; test coolant for freeze protection and additive package concentration; determine needed action.

3.5.2 Test coolant temperature and check operation of temperature and level sensors, gauge, and/or sending unit; determine needed action.

3.5.3 Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.

3.5.4 Recover coolant, refill with recommended coolant/additive package, and bleed cooling system per manufacturers specification.

3.5.5 Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed.

3.5.6 Inspect water pump and coolant hoses; replace as needed.

3.5.7 Inspect, clean, and pressure test radiator. Pressure test cap, tank(s), and recovery systems; determine needed action.

3.5.8 Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed.

## Performance Standard 3.6: Inspect Air Induction and Exhaust Systems

3.6.1 Check air induction system: piping, hoses, clamps, and mounts; service or replace air filter as needed.

3.6.2 Inspect intake manifold, gaskets, and connections; determine needed action.

3.6.3 Inspect charge air cooler assemblies; determine needed action.

3.6.4 Inspect exhaust manifold, piping, mufflers, and mounting hardware; determine needed

action.

## Performance Standard 3.7: Perform Fuel Supply System Services

3.7.1 Check fuel level, and condition; determine needed action.
3.7.2 Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action.
3.7.3 Inspect primary fuel delivery system; determine needed action.

# CONTENT STANDARD 4: PERFORM PREVENTATIVE MAINTENANCE INSPECTIONS

## Performance Standard 4.1 : Assess Engine Systems for Service

4.1.1 Check engine starting/operation, record idle and governed rpm.
4.1.2 Inspect belts, tensioners, and pulleys; check and adjust belt tension; check belt alignment.
4.1.3 Check engine oil level and condition; check dipstick seal.
4.1.4 Inspect engine mounts for looseness and deterioration.
4.1.5 Check engine for oil, coolant, air, fuel, and exhaust leaks (engine off and running).
4.1.6 Check engine compartment wiring harnesses, connectors, and seals for damage and proper routing.

## Performance Standard 4.2 : Investigate Fuel Systems for Service

4.2.1 Check fuel tanks, mountings, lines, caps, and vents
4.2.2 Drain water from fuel system.
4.2.3 Service water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system.

## Performance Standard 4.3: Assess Air Induction and Exhaust Systems for Service

4.3.1 Check exhaust system mountings for looseness and damage
4.3.2 Check engine exhaust system for leaks, proper routing, and damaged or missing components to include exhaust gas recirculation (EGR) system and after treatment devices, if equipped.
4.3.3 Check air induction system: piping, charge air cooler, hoses, clamps, and mountings; check for air restrictions and leaks.
4.3.4 Inspect turbocharger for leaks; check mountings and connections.
4.3.5 Service or replace air filter as needed; check and reset air filter restriction indicator.
4.3.6 Inspect crankcase ventilation system.
4.3.7 Inspect diesel exhaust fluid (DEF) system, to include tanks, lines, gauge, pump, and filter.

## Performance Standard 4.4: Assess Air Induction and Exhaust Systems for Service

4.4.1 Check operation of fan clutch.
4.4.2 Inspect radiator (including air flow restriction, leaks, and damage) and mountings.
4.4.3 Inspect fan assembly and shroud.
4.4.4 Pressure test cooling system and radiator cap.
4.4.5 Inspect coolant hoses and clamps.
4.4.6 Inspect coolant recovery system.
4.4.7 Check coolant for contamination, additive package concentration, aeration, and protection level (freeze point).
4.4.8 Service coolant filter.
4.4.9 Inspect water pump.

## Performance Standard 4.5: Assess Air Induction and Exhaust Systems For Service

4.5.1 Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs.

## Performance Standard 4.6: Investigate Cab and Hood Instruments and Controls for Serviceability

4.6.1 Inspect key condition and operation of ignition switch.
4.6.2 Check warning indicators.
4.6.3 Check instruments; record oil pressure and system voltage.
4.6.4 Check HVAC controls.
4.6.5 Check operation of all accessories.
4.6.6 Using electronic service tool(s) or on-board diagnostic system; retrieve engine monitoring information; check and record diagnostic codes and trip/operational data (including engine, transmission, ABS, and other systems).

## Performance Standard 4.7: Assess Cab And Hood Safety Equipment for Service

4.7.1 Check operation of electric/air horns and reverse warning devices.
4.7.2 Check condition of spare fuses, safety triangles, fire extinguisher, and all required decals.
4.7.3 Inspect seat belts and sleeper restraints.
4.7.4 Inspect wiper blades and arms.

## Performance Standard 4.8: Inspect Cab and Hood Hardware/Accessories for Service

4.8.1 Check operation of wiper and washer.
4.8.2 Inspect windshield glass for cracks or discoloration; check sun visor.
4.8.3 Check seat condition, operation, and mounting.
4.8.4 Check door glass and window operation.
4.8.5 Inspect steps and grab handles.
4.8.6 Inspect mirrors, mountings, brackets, and glass.
4.8.7 Record all observed physical damage.
4.8.8 Lubricate all cab and hood grease fittings.
4.8.9 Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables.

## Performance Standard 4.9: Examine Heating, Ventilation & Air Conditioning (HVAC) Systems for Service

4.9.1 Inspect A/C condenser and lines for condition and visible leaks; check mountings.
4.9.2 Inspect A/C compressor and lines for condition and visible leaks; check mountings.
4.9.3 Check A/C system condition and operation; check A/C monitoring system, if applicable.
4.9.4 Check HVAC air inlet filters and ducts; service as needed..

## Performance Standard 4.10: Assess Battery and Starting Systems

4.10.1 Inspect battery box(es), cover(s), and mountings.
4.10.2 Inspect battery hold-downs, connections, cables, and cable routing; service as needed.
4.10.3 Check/record battery state-of-charge (open circuit voltage) and condition.
4.10.4 Perform battery test (load and/or capacitance).
4.10.5 Inspect starter, mounting, and connections.
4.10.6 Engage starter; check for unusual noises, starter drag, and starting difficulty.

## Performance Standard 4.11: Assess Charging Systems

4.11.1 Inspect alternator, mountings, cable, wiring, and wiring routing; determine needed action.
4.11.2 Perform alternator output tests.

## Performance Standard 4.12: Assess Charging Systems

4.12.1 Check operation of interior lights.
4.12.2 Check all exterior lights, lenses, reflectors, and conspicuity tape; check headlight alignment.
4.12.3 Inspect and test tractor-to-trailer multi-wire connector(s), cable(s), and holder(s).

## Performance Standard 4.13: Examine Air Brakes for Service

4.13.1 Check operation of parking brake.
4.13.2 Record air governor cut-in and cut-out setting (psi).
4.13.3 Check operation of air reservoir/tank drain valves
4.13.4 Check air system for leaks (brakes released).
4.13.5 Check air system for leaks (brakes applied).
4.13.6 Test one-way and double-check valves.
4.13.7 Check low air pressure warning devices.
4.13.8 Check tractor protection valve.
4.13.9 Test air pressure build-up time.
4.13.10 Inspect coupling air lines, holders, and glad-hands.
4.13.11 Check brake chambers and air lines for secure mounting and damage.
4.13.12 Check operation of air drier.
4.13.13 Inspect and record brake shoe/pad condition, thickness, and contamination.
4.13.14 Inspect and record condition of brake drums/rotors.
4.13.15 Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing.
4.13.16 Check operation and adjustment of brake automatic slack adjusters (ASA); check and record push rod stroke.
4.13.17 Lubricate all brake component grease fittings.
4.13.18 Check condition and operation of hand brake (trailer) control valve, if applicable.
4.13.19 Drain air tanks and check for contamination.
4.13.20 Check condition of pressure relief (safety) valves.

## Performance Standard 4.14: Investigate Hydraulic Brakes for Service

4.14.1 Check master cylinder fluid level and condition.
4.14.2 Inspect brake lines, fittings, flexible hoses, and valves for leaks and damage.
4.14.3 Check parking brake operation; inspect parking brake application and holding devices; adjust as needed.
4.14.4 Check operation of hydraulic system: pedal travel, pedal effort, pedal feel.
4.14.5 Inspect calipers/wheel cylinders for leakage, binding and damage.
4.14.6 Inspect brake assist system (booster), hoses and control valves; check reservoir fluid level and condition.
4.14.7 Inspect and record brake pad/lining condition, thickness, and contamination.
4.14.8 Inspect and record condition of brake rotors/drums.

4.14.9 Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing.

## Performance Standard 4.15: Analyze Drive Train for Service

4.15.1 Check clutch linkage/cable and levers for looseness or binding, lubricate release/throwout bearing as required.
4.15.2 Check hydraulic clutch slave and master cylinders, lines, fittings, hoses, and fluid level.
4.15.3 Check transmission case, seals, filter, hoses, lines and cooler for cracks and leaks.
4.15.4 nspect transmission breather.
4.15.5 Inspect transmission mounts.
4.15.6 Check transmission oil level, type, and condition; add proper type of lubricant as needed.
4.15.7 Inspect U-joints, yokes, driveshafts, boots/seals, center bearings, and mounting hardware for looseness, damage, and proper phasing.
4.15.8 Inspect axle housing(s) for cracks and leaks.
4.15.9 Inspect axle breather(s).
4.15.10 Lubricate all drive train grease fittings.
4.15.11 Check drive axle(s) oil level, type, and condition; add proper type of lubricant as needed.
4.15.12 Check transmission wiring, connectors, seals, and harnesses for damage and proper routing.
4.15.13 Check pedal height and travel, inspect clutch safety switch.
4.15.14 Measure driveline angles; determine necessary action.

## Performance Standard 4.16: Investigate Suspension and Steering Systems for Service

4.16.1 Check steering wheel operation for free play and binding.
4.16.2 Check power steering pump, mounting, and hoses for leaks, condition, and routing; check fluid level.
4.16.3 Inspect steering gear for leaks and secure mounting.
4.16.4 Inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, and linkages.
4.16.5 Check kingpins for wear.
4.16.6 Check wheel bearings for looseness and noise.
4.16.7 Check oil level and condition in all non-drive hubs; check for leaks.
4.16.8 Inspect springs, pins, hangers, shackles, spring U-bolts, and insulators.
4.16.9 Inspect shock absorbers for leaks and secure mounting.
4.16.10 Inspect air suspension springs, mounts, hoses, valves, linkage, and fittings for leaks and damage.
4.16.11 Check and record suspension ride height.
4.16.12 Lubricate all suspension and steering grease fittings.
4.16.13 Check axle locating components (radius, torque, and/or track rods).

## Performance Standard 4.17: Assess Tires and Wheels for Service

4.17.1 Inspect tires for wear patterns and proper mounting.
4.17.2 Inspect tires for cuts, cracks, bulges, and sidewall damage.
4.17.3 Inspect valve caps and stems; determine needed action.
4.17.4 Measure and record tread depth; probe for imbedded debris.

4.17.5 Check and record air pressure; adjust air pressure in accordance with manufacturers' specifications.
4.17.6 Check wheel mounting hardware; determine needed action.
4.17.7 Inspect wheels for cracks, damage and proper hand hold alignment.
4.17.8 Check tire matching (diameter and tread) on single and dual tire applications.

### Performance Standard 4.18: Analyze Frame and Fifth Wheel for Service

4.18.1 Inspect fifth wheel mounting, bolts, air lines, and locks.
4.18.2 Test operation of fifth wheel locking device; adjust if necessary.
4.18.3 Check quarter fenders, mud flaps, and brackets
4.18.4 Check pintle hook assembly and mounting, if applicable
4.18.5 Lubricate all fifth wheel grease fittings and plate, of applicable.
4.18.6 Inspect frame and frame members for cracks and damage.

## CONTENT STANDARD 5: ANALYZE HYDRAULIC SYSTEMS

### Performance Standard 5.1: Investigate General System Operations

5.1.1 Identify system type (closed and open) and verify proper operation
5.1.2 Read and interpret system diagrams and schematics.

### Performance Standard 5.2: Asses Hydraulic Pumps

5.2.1 Identify system fluid type.
5.2.2 Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems.
5.2.3 Determine pump type, rotation, and drive system.

### Performance Standard 5.3: Perform Filtration/Reservoirs (Tanks) Service

5.3.1 Identify type of filtration system; verify filter application and flow direction.
5.3.2 Service filters and breathers.
5.3.3 Identify causes of system contamination; determine needed action.
5.3.4 Check reservoir fluid level and condition; determine needed action.
5.3.5 Inspect reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines.

### Performance Standard 5.4: Examine Hoses, Fittings, and Connections

5.4.1 Diagnose causes of component leakage, damage, and restriction; determine needed action.
5.4.2 Inspect hoses and connections (length, size, routing, bend radii, and protection); repair or replace as needed.
5.4.3 Inspect and replace fitting seals and sealants.

### Performance Standard 5.5: Evaluate Actuators for Service

5.5.1 Identify actuator type (single/double acting, multi-stage/telescopic, and motors).
5.5.2 Identify the cause of seal failure; determine needed repairs.
5.5.3 Identify the cause of incorrect actuator movement and leakage (internal and external); determine needed repairs.
5.5.4 Inspect actuator mounting, frame components, and hardware for looseness, cracks, and damage; determine needed action.
5.5.5 Inspect actuators for dents, cracks, damage, and leakage; determine needed action.
5.5.6 Purge and/or bleed system in accordance with manufacturers' recommended procedures.

## CONTENT STANDARD 6 : ANALYZE BRAKE SYSTEMS

### Performance Standard 6.1 : Assess Air Brakes – Air Supply and Service Systems

6.1.1 Identify poor stopping, air leaks, premature wear, pulling, grabbing, dragging, or balance problems caused by supply and service system malfunctions; determine needed action.
6.1.2 Check air system build-up time; determine needed action.
6.1.3 Drain air reservoir/tanks; check for oil, water, and foreign material; determine needed action.
6.1.4 Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed.
6.1.5 Inspect and test air tank relief (safety) valves, one-way (single) check valves.
6.1.6 Inspect and test brake application (foot/treadle) valve, fittings, and mounts; check pedal operation; determine needed action.
6.1.7 Inspect and test stop light circuit switches, wiring, and connectors; determine needed action.
6.1.8 Inspect and test emergency (spring) brake control valve(s).
6.1.9 Inspect and test low pressure warning devices, wiring, and connectors; determine needed action.
6.1.10 Inspect and test air pressure gauges, lines, and fittings; determine needed action.

### Performance Standard 6.2 : Assess Air Brakes – Mechanical/Foundation Brakes

6.2.1 Identify poor stopping, brake noise, premature wear, pulling, grabbing, or dragging problems caused by the foundation brake, slack adjuster, and brake chamber problems; determine needed action.
6.2.2 Inspect service brake chambers, pushrod, clevis, and mounting brackets.
6.2.3 Identify type and inspect slack adjusters.
6.2.4 Inspect camshafts, tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; determine needed action.
6.2.5 Inspect and measure brake shoes or pads; determine needed action.
6.2.6 Inspect and measure brake drums or rotors; determine needed action.

### Performance Standard 6.3 : Assess Air Brakes – Parking Brakes

6.3.1 Inspect parking (spring) brake check valves, lines, hoses, and fittings.
6.3.2 Inspect and test parking (spring) brake application and release valve
6.3.3 Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations.

### Performance Standard 6.4 : Assess Hydraulic Brakes – Hydraulic System

6.4.1 Identify poor stopping, premature wear, pulling, dragging, balance, or pedal feel problems caused by the hydraulic system; determine needed action.
6.4.2 Inspect and test master cylinder for internal/external leaks and damage; determine needed action.
6.4.3 Inspect hydraulic system brake lines, flexible hoses, and fittings for leaks and damage; determine needed action.
6.4.4 Inspect and test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; determine needed action.
6.4.5 Inspect and test brake pressure differential valve and warning light circuit switch, bulbs/LEDs, wiring, and connectors; determine needed action.
6.4.6 Inspect disc brake caliper assemblies; determine needed action.

6.4.7 Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type.

## Performance Standard 6.5 : Assess Hydraulic Brakes – Mechanical/Foundation Brakes

6.5.1 Identify poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by mechanical components; determine needed action.

6.5.2 Inspect and measure rotors; determine needed action.

6.5.3 Inspect and measure disc brake pads; inspect mounting hardware; determine needed action.

6.5.4 Check parking brake operation; inspect parking brake application and holding devices; determine needed action.

## Performance Standard 6.6 : Assess Hydraulic Brakes – Power Assist Units

6.6.1 Identify stopping problems caused by the brake assist (booster) system; determine needed action.

6.6.2 Inspect, test, repair, or replace hydraulic brake assist (booster), hoses, and control valves; determine proper fluid type.

6.6.3 Check emergency (back-up, reserve) brake assist system.

## Performance Standard 6.7 : Diagnose Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC) Systems

6.7.1 Observe antilock brake system (ABS) warning light operation (includes trailer and dash mounted trailer ABS warning light); determine needed action.

6.7.2 Diagnose antilock brake system (ABS) electronic control(s) and components; determine needed action.

6.7.3 Identify poor stopping and wheel lock-up problems caused by failure of the antilock brake system (ABS); determine needed action.

6.7.4 Test and check operation of antilock brake system (ABS) components; determine needed action.

6.7.5 Test antilock brake system (ABS) wheel speed sensors and circuits; determine needed action.

6.7.6 Bleed the ABS hydraulic circuits.

## Performance Standard 6.8 : Perform Wheel Bearing Service and Repair

6.8.1 Inspect and service wheel bearings according to manufactures specifications.

6.8.2 Identify, inspect or replace unitized/preset hub bearing assemblies.

# CONTENT STANDARD 7: PERFORM SUSPENSION AND STEERING SERVICE

## Performance Standard 7.1 : Assess Steering Systems - Column

7.1.1 Identify causes of fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determine needed action.

7.1.2 Inspect steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft; determine needed action.

7.1.3 Remove the steering wheel (includes steering wheels equipped with electrical/electronic controls and components); install and center the steering wheel. Inspect, test, replace and calibrate steering angle sensor.

7.1.4 Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures.

## Performance Standard 7.2 : Assess Steering Systems - Column

7.2.1 Identify causes of power steering system noise, steering binding, darting/oversteer, reduced wheel cut, steering wheel kick, pulling, non-recovery, turning effort, looseness, hard steering,

overheating, fluid leakage, and fluid aeration problems; determine needed action.

7.2.2 Determine recommended type of power steering fluid; check level and condition; determine needed action.

7.2.3 Flush and refill power steering system; purge air from system.

## Performance Standard 7.3 : Assess Steering Systems - Linkage

7.3.1 Inspect steering linkage components.

7.3.2 Check and adjust steering (wheel) stops.

## Performance Standard 7.4 : Investigate Suspension Systems

7.4.1 Inspect front axles and attaching hardware; determine needed action .

7.4.2 Inspect kingpins, steering knuckle bushings, locks, bearings, seals, and covers; determine needed action.

7.4.3 Inspect shock absorbers, bushings, brackets, and mounts; determine needed action.

7.4.4 Inspect leaf springs, center bolts, clips, pins and bushings, shackles, U-bolts, insulators, brackets, and mounts; determine needed action.

7.4.5 Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, torque arms, related bushings, mounts, shims, and cams; determine needed action.

7.4.6 Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; determine needed action.

7.4.7 Inspect air springs, mounting plates, springs, suspension arms, and bushings.

7.4.8 Measure and adjust ride height; determine needed action.

## Performance Standard 7.5 : Perform Wheel Alignment Diagnosis, Adjustment, and Repair

7.5.1 Identify causes of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problems; adjust or repair as needed.

7.5.2 Check and adjust camber.

7.5.3 Check and adjust caster.

7.5.4 Check and adjust toe settings.

7.5.5 Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed.

7.5.6 Identify turning/Ackerman angle (toe-out-on-turns) problems; determine needed action.

7.5.7 Check front axle alignment (centerline); adjust or repair as needed.

## Performance Standard 7.6 : Evaluate Wheels and Tires

7.6.1 Identify tire wear patterns; check tread depth and pressure determine needed action

7.6.2 Identify wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed action.

7.6.3 Remove and install steering and drive axle wheel/tire assemblies; torque mounting hardware to specifications with torque wrench.

7.6.4 Inspect tire for proper application, (size, load range, position, and tread design); determine needed action.

7.6.5 Inspect wheel/rims for proper application, load range, size, and design; determine needed action.

7.6.6 Check operation of tire pressure monitoring system (TPMS); determine needed action.

## CONTENT STANDARD 8: ANALYZE ELECTRIC/ELECTRONIC SYSTEMS

### Performance Standard 8.1: Perform General Electrical Systems Service

8.1.1 Read and interpret electrical/electronic circuits using wiring diagrams.
8.1.2 Check continuity in electrical/electronic circuits using appropriate test equipment.
8.1.3 Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using appropriate test equipment.
8.1.4 Check current flow in electrical/electronic circuits and components using appropriate test equipment.
8.1.5 Check resistance in electrical/electronic circuits and components using appropriate test equipment.
8.1.6 Locate shorts, grounds, and opens in electrical/electronic circuits.
8.1.7 Identify parasitic (key-off) battery drain problems; perform tests; determine needed action.
8.1.8 Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed.
8.1.9 Check frequency and pulse width signal in electrical/electronic circuits using appropriate test equipment.

### Performance Standard 8.2 : Perform Battery Service

8.2.1 Identify battery type; perform appropriate battery load test; determine needed action.
8.2.2 Determine battery state of charge using an open circuit voltage tes.t
8.2.3 Inspect, clean, and service battery; replace as needed.
8.2.4 Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed.
8.2.5 Charge battery using appropriate method for battery type.
8.2.6 Inspect, test, and clean battery cables and connectors; repair or replace as needed.
8.2.7 Jump start a vehicle using jumper cables and a booster battery or appropriate auxiliary power supply using proper safety procedures.
8.2.8 Perform battery capacitance test; determine needed action.

### Performance Standard 8.3 : Perform Starting System Service

8.3.1 Perform starter circuit cranking voltage and voltage drop tests; determine needed action
8.3.2 Inspect and test components (key switch, push button and/or magnetic switch) and wires and harnesses in the starter control circuit; replace as needed.
8.3.3 Inspect and test, starter relays and solenoids/switches; replace as needed.
8.3.4 Remove and replace starter; inspect flywheel ring gear or flex plate.
8.3.5 Perform starter current draw test; determine needed action.

### Performance Standard 8.4 : Perform Charging System Diagnosis and Repair

8.4.1 Test instrument panel mounted volt meters and/or indicator lamps; determine needed action.
8.4.2 Identify causes of a no charge, low charge, or overcharge problems; determine needed action.
8.4.3 Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment.
8.4.4 Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action.
8.4.5 Perform charging circuit voltage drop tests; determine needed action.
8.4.6 Remove and replace alternator.
8.4.7 Inspect, repair, or replace cables, wires, and connectors in the charging circuit.

## Performance Standard 8.5 : Perform Lighting Systems Diagnosis and Repair

8.5.1 Identify causes of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation.

8.5.2 Test, replace, and aim headlights.

8.5.3 Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components/modules; repair or replace as needed.

8.5.4 Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays, wires, and control components/modules of parking, clearance, and taillight circuits; repair or replace as needed.

8.5.5 Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed.

8.5.6 Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed.

8.5.7 Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed.

8.5.8 Inspect and test reverse lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, wires and control components/modules; repair or replace as needed.

# CONTENT STANDARD 9: INVESTIGATE TRANSPORTATION SYSTEMS

## Performance Standard 9.1 : Assess Transportation Systems

9.1.1 Describe the history of the automobile and the effects on society.

9.1.2 Research the different career opportunities in the transportation career path.

9.1.3 Investigate new and emerging technologies.

9.1.4 Analyze workplace situations and use problem-solving techniques to improve the workplace environment.

## CONTENT STANDARD 1: EMPLOYABILITY SKILLS AND HABITS

### Performance Standard 1.1: Identify employment opportunities.

1.1.1 Identify the requirements for a job/job description.
1.1.2 Investigate educational opportunities.
1.1.3 Investigate occupational opportunities.
1.1.4 Locate resources for finding employment.
1.1.5 Confer with prospective employers
1.1.6 Identify job trends.
1.1.7 Research geographic locations.

### Performance Standards 1.2: Explain the purpose of building codes.

1.2.1 Match terms associated with building codes to their correct definitions.
1.2.2 Interpret sections of the building codes.
1.2.3 Discuss the importance of complying with building code requirements.

### Performance Standards 1.3: Identify OSHA standards.

1.3.1 Define the purpose of OSHA.
1.3.2 Describe the inspection process by OSHA.
1.3.3 Describe the record keeping requirements for OSHA compliance.
1.3.4 List safety and health hazards that OSHA may inspect for in a shop or on a job site.
1.3.5 List OSHA safe working procedures that apply to building trades work assignments.
1.3.6 OSHA 10 Training.

## CONTENT STANDARD 2: BUILDING MATERIALS AND ENERGY CONSERVATION STRATEGIES

### Performance Standards 2.1: Identify types of lumber and their uses.

2.1.1 Define terms associated with lumber
2.1.2 Select characteristics to consider in using lumber
2.1.3 Identify common defects in lumber
2.1.4 Select from a list standard lumber grades.
2.1.5 Write actual sizes for given nominal sizes of lumber.

### Performance Standard 2.2: Demonstrate knowledge of plywood.

2.2.1 Match letters designating veneers used in plywood to their correct descriptions.
2.2.2 Distinguish between standard interior and exterior plywood grades.

### Performance Standard 2.3: Identify materials used for paneling, trim and moldings.

2.3.1 Select from a list solid softwoods used for paneling.
2.3.2 Select from a list solid hardwoods used for paneling.
2.3.3 Select from a list types of woods used for trim and moldings.
2.3.4 Identify types of trim and moldings.

### Performance Standard 2.4: Demonstrate familiarity with energy-saving construction techniques.

2.4.1 Discuss the importance of conserving energy to the owners/occupants of a building and to the nation and the world.
2.4.2 Describe techniques used in solar construction.
2.4.3 State advantages and disadvantages of solar construction.
2.4.4 Discuss advanced framing techniques
2.4.5 Explain the importance of r-factor in building construction.
2.4.6 Select from a list benefits of using insulation in a structure.
2.4.7 Explain the functions of the two basic kinds of insulation.
2.4.8 Name general classifications of insulation materials.
2.4.9 List areas where insulation should be used in construction.
2.4.10 List factors that determine the amount of insulation needed.
2.4.11 Interpret sections of state and local codes pertaining to energy efficiency.

## CONTENT STANDARD 3: MATH AND MEASUREMENT SKILLS

### Performance Standard 3.1: Identify basic mathematical terms and symbols.

3.1.1 Match terms associated with basic math to their correct definitions.
3.1.2 Match symbols used in math problems to their correct names.

### Performance Standard 3.2: Perform mathematical operations using whole numbers.

3.2.1 Label the place values of a whole number.
3.2.2 Add whole numbers.
3.2.3 Subtract whole numbers.
3.2.4 Multiply whole numbers.

### Performance Standard 3.3: Perform calculations using fractions, decimals and percentages.

3.3.1 Distinguish among types of fractions.
3.3.2 Reduce fractions to lowest terms.
3.3.3 Convert mixed numbers to improper fractions.
3.3.4 Convert improper fractions to mixed numbers.
3.3.5 Add fractions.
3.3.6 Subtract fractions.
3.3.7 Multiply fractions.
3.3.8 Divide fractions.
3.3.9 Label the place values of a decimal number.
3.3.10 Add decimal numbers.
3.3.11 Subtract decimal numbers.
3.3.12 Multiply decimal numbers.
3.3.13 Divide decimal numbers.

3.3.14 Convert decimal fractions to common fractions.
3.3.15 Convert common fractions to decimal numbers and percentages.
3.3.16 Identify decimal and fractional equivalents.
3.3.17 Convert percentages to fractions and decimal numbers.
3.3.18 Solve percentage problems.
3.3.19 Solve basic ratio and proportion problems.

**Performance Standard 3.4: Demonstrate knowledge of basic geometry.**

3.4.1 Match terms used in geometry to their correct definitions.
3.4.2 Match types of geometric figures to their correct descriptions.
3.4.3 Match units of measure to their correct equivalents.
3.4.4 Calculate the area of geometric figures.
3.4.5 Calculate the volume of solid figures.
3.4.6 Estimate cubic yards.

**Performance Standard 3.5: Perform measuring operations used in the building trades.**

3.5.1 Match to their correct definitions terms associated with measuring.
3.5.2 Identify basic measuring tools used by carpenters.
3.5.3 Convert fractional inches to hundredths of a foot.
3.5.4 Identify graduations on an engineer's rule.
3.5.5 Read an engineer's rule to the nearest hundredth of a foot.
3.5.6 Read a tape to the nearest fraction of an inch.
3.5.7 Describe measuring methods used to square lines.
3.5.8 Read measurements on architect's and engineer's rules.
3.5.9 Read measurements on tapes.
3.5.10 Demonstrate the ability to use basic measuring tools and the 3-4-5 method to lay out the perimeter of a building.

## CONTENT STANDARD 4: BASIC BLUEPRINT READING AND DRAWING SKILLS

**Performance Standard 4.1: Demonstrate plan reading skills.**

4.1.1 Match types of drawings usually included in a set of plans to their correct descriptions.
4.1.2 List information found on types of drawings in a set of plans.
4.1.3 Identify lines in the alphabet of lines.
4.1.4 Identify selected symbols commonly used on plans.
4.1.5 Identify selected abbreviations commonly used on plans.
4.1.6 Match architects conventions to their correct representations.
4.1.7 State the purpose of written specifications.
4.1.8 Use an architect's scale.
4.1.9 Use an engineer's scale.
4.1.10 Interpret a finish schedule.

## CONTENT STANDARD 5: PROPER USE AND MAINTENANCE OF HAND AND POWER TOOLS

### Performance Standards 5.1: Identify common carpenters' hand tools.

5.1.1 State guidelines for care and safe use of hand tools.
5.1.2 Match the following types of tools to their correct uses: hammers, handsaws, squares, planes, measuring instruments, pliers, other miscellaneous hand tools
5.1.3 Identify the following types of tools: layout instruments, boring and drilling hand tools, screwdrivers, wrenches, files, chisels, clamps, and tools used to install drywall.

### Performance Standards 5.2: Demonstrate proper and safe use of common carpenters' hand tools.

5.2.1 Safely and correctly use carpenter hand tools.

### Performance Standard 5.3: Use power tools correctly and safely.

5.3.1 Match terms associated with power tools to their correct definitions.
5.3.2 State general safety rules pertaining to power tools.
5.3.3 Select from a list general guidelines for proper care of power tools.
5.3.4 Select from a list safe uses of the following tools: table saw, jointer, planer, shaper, table band saw, bench grinder, drill press, combination belt and disc sander, power miter saw, screw gun, hand-held grinder
5.3.5 State rules for the safe use of portable power saws.
5.3.6 State rules for the safe use of routers and trimmers.
5.3.7 State rules for the safe use of portable drills, screwguns, and hammer drills.
5.3.8 State rules for the safe use of portable power planes.
5.3.9 State rules for the safe use of pneumatic fasteners.
5.3.10 Identify the parts of a powder-actuated tool.
5.3.11 Select from a list uses of powder-actuated tools.
5.3.12 State rules for the safe use of a powder-actuated tool.
5.3.13 Match circular-saw blades to their correct uses.
5.3.14 Complete a safety test for specific tools.
5.3.15 Perform rip and miter cut-off operations.
5.3.16 Drill and bore holes.
5.3.17 Perform jointing operations.
5.3.18 Perform a face-planing operation.
5.3.19 Perform edge-shaping operations.

## CONTENT STANDARD 6: SITE PREPARATION, CONCRETE FORMS AND FORMING

### Performance Standard 6.1: Set up and use a transit and a builder's level.

6.1.1 Match terms associated with leveling instruments to their correct definitions.
6.1.2 List uses of a level.
6.1.3 Identify types of levels.
6.1.4 Identify parts of a level.

6.1.5 List uses of a transit.
6.1.6 State the rules for proper care of leveling instruments.
6.1.7 Identify parts of a leveling rod.
6.1.8 Set up and adjust a level and transit
6.1.9 Use a level to check elevations.
6.1.10 Use a level to perform differential leveling.
6.1.11 Measure and read angles in the field.
6.1.12 Set up and use laser instruments.
6.1.13 Establish elevation reference points from bench mark.
6.1.14 Establish footing grade.
6.1.15 Locate and square corners.
6.1.16 Set grade stakes.
6.1.17 Correctly mark a story pole.
6.1.18 Install batter boards.

## Performance Standard 6.2: Demonstrate basic knowledge of concrete footings and foundations.

6.2.1 Match terms associated with concrete foundations to their correct definitions.
6.2.2 State principal properties of good concrete.
6.2.3 State factors that affect properties of concrete mixture.
6.2.4 Match types of admixtures used in concrete to their correct functions.
6.2.5 State benefits of admixtures in concrete.
6.2.6 State advantages of using vibrators in concrete.
6.2.7 Select from a list types of vibrators used to consolidate concrete.
6.2.8 Label parts of a concrete foundation.
6.2.9 Identify types of concrete footings and foundations.
6.2.10 Discuss the design of footings and foundations.
6.2.11 Arrange in order steps involved when constructing concrete foundations.
6.2.12 Interpret sections of the state and local codes that pertain to concrete construction.

## Performance Standard 6.3: Determine concrete volume.

6.3.1 List methods used to estimate concrete volume.
6.3.2 Estimate concrete using methods listed in objective one.
6.3.3 Estimate amount of concrete for a footing.
6.3.4 Estimate amount of materials needed to pour a foundation.
6.3.5 Calculate the cubic yards of concrete needed to pour a structure

## Performance Standard 6.4: Explain the use of reinforcing in footings and foundations.

6.4.1 Name types of reinforcing material used in concrete.
6.4.2 Match common rebar numbers to their correct diameter sizes.

6.4.3 Select from a list common sizes of welded wire fabric.

**Performance Standard 6.5: Demonstrate the ability to recognize and use types of concrete forms, associated hardware, and materials.**

6.5.1 Match to their correct definitions terms associated with forming.
6.5.2 Explain the purpose of forms.
6.5.3 Name five types of forms.

## CONTENT STANDARD 7: FRAME FLOORS, SILLS, WALLS AND CEILINGS CONSTRUCTION

**Performance Standard 7.1: Demonstrate a basic knowledge of floors and sills.**

7.1.1 Match terms associated with frame floors and sills to their correct definitions.
7.1.2 Identify floor and sill framing and support members.
7.1.3 Name methods used to fasten sills to the foundation.
7.1.4 Select from a list types of beams/girders.
7.1.5 List types of floor joists.
7.1.6 Label types of bridging.
7.1.7 List types of flooring materials.
7.1.8 Discuss functional designs used to lay subflooring.
7.1.9 List purposes of subflooring and underlayment.
7.1.10 Match fasteners used in floor framing to their correct uses.
7.1.11 Select from a list considerations that determine size and spacing for joists.
7.1.12 Select from a list considerations that determine size and spacing for beams.
7.1.13 Select from a list considerations that determine size and spacing for girders.
7.1.14 Discuss common methods used to attach decks to structures.
7.1.15 Estimate the amount of material needed to frame a floor assembly.
7.1.16 Interpret state and local code sections pertaining to floors, sills, walls and ceilings.

**Performance Standard 7.2: Apply a basic knowledge of floors and sills.**

7.2.1 Install bridging.
7.2.2 Install joists for a cantilever floor.
7.2.3 Install subfloor materials.
7.2.4 Install a single floor system using tongue and groove material.

**Performance Standard 7.3: Identify wall and partition members.**

7.3.1 Match terms associated with framing walls and ceilings to their correct definitions.
7.3.2 Identify framing members used in wall and partition framing.
7.3.3 Identify methods used to construct outside corners of wall frames.
7.3.4 Identify common methods used to construct partition T's.
7.3.5 Label types of headers.
7.3.6 Calculate rough opening (R.O.) dimensions for doors.
7.3.7 Calculate the length of trimmers for window and door openings.

7.3.8 Calculate the length of headers for rough openings.
7.3.9 Select from a list construction details that should be added during wall framing.
7.3.10 List methods used to brace walls.
7.3.11 Select from a list of nails most often used in framing.
7.3.12 Select from a list factors to consider before selecting joist size and spacing.

**Performance Standard 7.4: Estimate materials required for a single-story structure.**

7.4.1 Estimate materials for joists.
7.4.2 Calculate the amount of materials required for wall and partition framing.

**Performance Standard 7.5: Frame a single-story structure.**

7.5.1 Demonstrate the ability to lay out wall and partition locations on a floor.
7.5.2 Cut studs, trimmers, cripples, and headers to length.
7.5.3 Assemble corners, T's, and headers.
7.5.4 Construct wall sections for a single-story structure.
7.5.5 Erect and brace wall sections for a single-story structure.
7.5.6 Layout and install ceiling joists.

**Performance Standard 7.6: Demonstrate the ability to work with metal framing systems.**

7.6.1 Name components of metal stud systems.
7.6.2 Identify fasteners used for metal stud construction.
7.6.3 Identify tools and equipment used in metal stud construction.
7.6.4 List areas where metal stud systems are used.
7.6.5 Select from a list advantages of metal stud systems

**Performance Standard 7.7: Identify types of finish flooring.**

7.7.1 Match terms associated with floor finishes to their correct definitions.
7.7.2 Name types of underlayment for finish flooring.
7.7.3 Name types of finish flooring.

**Performance Standard 7.8: Install finish flooring.**

7.8.1 Estimate the number of 4'x 8' sheets of underlayment needed to floor a room.
7.8.2 Estimate the number of tiles needed to floor a room.
7.8.3 Demonstrate the ability install underlayment.
7.8.4 Demonstrate the ability to install various types of flooring.

## CONTENT STANDARD 8: ROOF CONSTRUCTION TECHNIQUES

**Performance Standard 8.1: Identify different roof framing members.**

8.1.1 Match terms associated with roof framing to their correct definitions.
8.1.2 List types of roof supports.
8.1.3 Identify roof framing members.
8.1.4 Label roof framing units.
8.1.5 Discuss slope.

8.1.6 Identify parts of a rafter.
8.1.7 List methods for determining rafter length.
8.1.8 List types of vents used in roof construction.

**Performance Standard 8.2: Construct a roof, including all openings and sheathing.**

8.2.1 Calculate the length of a common rafter.
8.2.2 Calculate the length of a hip rafter.
8.2.3 Calculate the length of jack rafters.
8.2.4 Estimate material needed to frame a roof.
8.2.5 Lay out rafter locations on top plate and ridge board.
8.2.6 Lay out, cut, and erect rafters for gable roofs.
8.2.7 Erect trusses.
8.2.8 Lay out, cut, and erect rafters for hip roofs.
8.2.9 Apply roof sheathing.

**Performance Standard 8.3: Demonstrate the ability to erect trusses.**

8.3.1 Erect trusses by hand and or light crane.
8.3.2 Apply roof sheathing.

**Performance Standard 8.4: Demonstrate and apply knowledge of cornices and gable ends.**

8.4.1 Match terms associated with cornices and gable ends to their correct definitions.
8.4.2 Label types of cornice designs.
8.4.3 Identify parts of a box cornice.
8.4.4 Identify parts of a boxed rake section.
8.4.5 Identify types of cornice moldings.
8.4.6 Label types of tail-rafter cuts.
8.4.7 Select from a list materials used for soffits.
8.4.8 Select from a list hardware and fasteners used on or with cornices.
8.4.9 Name exterior wall coverings used on gable ends.
8.4.10 Estimate material needed for cornices and gable ends.
8.4.11 Demonstrate the ability to build a horizontal box cornice.
8.4.12 Demonstrate the ability apply siding to a gable end.

**Performance Standards 8.6: Discuss roof materials**

8.6.1 Match terms associated with roofing to their correct definitions.
8.6.2 State safety rules pertaining to roofing.
8.6.3 Name classes of roofing.
8.6.4 Match minimum slope requirements to their specific roofing applications.
8.6.5 List types of roofing materials.
8.6.6 Interpret sections of state and local codes that pertain to roofs and roofing.

**Performance Standards 8.7: Apply roofing and flashing.**

8.7.1 State procedures and decking requirements for applying wood shingles, wood shakes, tile, metal, slate and asphalt shingles.
8.7.2 List guidelines for applying underlayment.
8.7.3 Describe general requirements for applying flashing.
8.7.4 Select from a list types of materials used for flashing.
8.7.5 Match roofing equipment and tools to their correct uses.
8.7.6 Select from a list procedures for applying double starter course of asphalt shingles.
8.7.7 State procedures for applying shingles with cutouts that break joint in half.
8.7.8 Arrange in order steps for installing flashing at open-valley locations.
8.7.9 Estimate roofing materials needed for a three-tab asphalt shingle roof.
8.7.10 Demonstrate the ability to apply various roofing material.
8.7.11 Discuss appropriate installation of roof gutters.

## CONTENT STANDARD 9: INTERIOR STAIRCASES CONSTRUCTION

### Performance Standard 9.1: Identify types of special house designs and special framing projects.

9.1.1 Match terms associated with stairs to their correct definitions.
9.1.2 Identify parts of a staircase.
9.1.3 Identify basic types of stairs.
9.1.4 List factors that must be considered when building a staircase.
9.1.5 State rules of thumb for unit rise and unit run.
9.1.6 Label methods used to secure stringers.
9.1.7 Discuss requirements of state and local codes that pertain to stairs.

### Performance Standard 9.2: Construct a staircase.

9.2.1 Calculate number and size of risers and treads for a stair of given dimensions.
9.2.2 Estimate materials for stairs.
9.2.3 Construct a staircase.

### Performance Standard 9.3: Identify types of handrails and railings.

9.3.1 Match terms associated with handrails and railings to their correct definitions.
9.3.2 List factors that must be considered when selecting handrails and railings.
9.3.3 Discuss requirements of state and local codes that pertain to handrails and railings.

### Performance Standard 9.4: Construct handrails and railings.

9.4.1 Estimate materials needed for a handrail or railing.
9.4.2 Determine the correct fasteners to use with handrails and railings.

## CONTENT STANDARD 10: SHEATHING, SIDING, AND EXTERIOR BUILDING MATERIALS

### Performance Standard 10.1: Identify different types of wall sheathing and siding.

10.1.1 Match terms associated with exterior walls and trim to their correct definitions.
10.1.2 Name types of wall sheathing.
10.1.3 Identify styles of siding.

10.1.4 Identify joint details for plywood siding.
10.1.5 Identify types of exterior moldings and trims.
10.1.6 List recommendations for waterproofing exterior walls.
10.1.7 List advantages and disadvantages of various types of siding.

**Performance Standard 10.2: Install different types of wall sheathing and siding.**

10.2.1 Estimate amounts of siding for given jobs.
10.2.2 Estimate siding for a house with a gable roof.
10.2.3 Estimate sheathing and siding for a house with a hip roof.
10.2.4 Install sheathing.
10.2.5 Install bevel siding.
10.2.6 Install sheathing and plywood siding.

## CONTENT STANDARD 11: WINDOWS, EXTERIOR AND INTERIOR DOORS, AND ASSOCIATED TRIM

**Performance Standards 11.1: Identify different types of windows.**

11.1.1 Match windows and accessories to their correct descriptions.
11.1.2 Name types of sliding windows.
11.1.3 Name types of swinging windows.
11.1.4 Name types of fixed windows.
11.1.5 Select from a list types of materials used to construct windows.
11.1.6 Identify parts of a window installation.
11.1.7 Select from a list types of materials used for window panes.

**Performance Standard 11.2: Demonstrate the ability to install various kinds of window units.**

11.2.1 State information a carpenter should know when installing windows.
12.2.2 State recommendations for a good window installation.
11.2.3 Demonstrate the ability to install a double-hung wood window unit.
11.2.4 Demonstrate the ability to install fixed windows.
11.2.5 Demonstrate the ability to install swinging windows.

**Performance Standard 11.3: Install a complete entry including threshold, frame, door, hardware, trim and weather stripping.**

11.3.1 Match terms associated with exterior doors to their correct definitions.
11.3.2 State basic classifications of exterior doors.
11.3.3 Identify types of entry doors.
11.3.4 List advantages and disadvantages of sliding glass and patio doors.
11.3.5 Identify parts of an exterior door installation.
11.3.6 List materials used in door construction.
11.3.7 Name materials used for exterior door sills.
11.3.8 Select from a list standard sizes of exterior doors.

11.3.9 Explain the numbering system for doors.
11.3.10 Complete statements about recommended finish clearances and dimensions for hanging doors.
11.3.11 Identify door swing (hand).
11.3.12 Identify hardware used with exterior doors.
11.3.13 List types of thresholds used with entrance doors.
11.3.14 Demonstrate the ability to install a metal threshold on a concrete floor.
11.3.15 Demonstrate the ability to install an exterior prehung door unit.
11.3.16 Demonstrate the ability to install entry door frame, casing, door and lock.
11.3.17 Demonstrate the ability to install weatherstripping.
11.3.18 Demonstrate the ability to install door frame and inside jambs for an overhead garage door.

## Performance Standard 11.4: Discuss interior door installation.

11.4.1 Match terms associated with interior doors and trim to their correct definitions.
11.4.2 State the general types of interior door construction.
11.4.3 State the basic classifications of interior doors.
11.4.4 Identify types of interior doors.
11.4.5 Identify parts of an interior door unit.
11.4.6 Select from a list standard sizes of interior doors and jambs.
11.4.7 Identify hand of a door.

## Performance Standard 11.5: Install various types of door units, locks and trim.

11.5.1 Select from a list recommended finish clearances and dimensions for hanging doors.
11.5.2 Identify hardware used with interior doors.
11.5.3 Identify types of interior trim.
11.5.4 Estimate material needed to trim a room.
11.5.5 Demonstrate the ability to install an interior door frame, hang door, lock and trim.
11.5.6 Demonstrate the ability to install a prehung door unit.
11.5.7 Demonstrate the ability to install a bi-fold door unit.
11.5.8 Demonstrate the ability to install a pocket door unit.
11.5.9 Demonstrate the ability to install window trim.

## Performance Standards 11.6: Discuss types of insulation and vapor barriers.

11.6.1 Match terms associated with insulation to their correct definitions.
11.6.2 Explain the functions of the two basic kinds of insulation.
11.6.3 Select from a list benefits of using insulation in a structure.
11.6.4 List types of insulation commonly used in residential construction.
11.6.5 Name general classifications of insulation materials.
11.6.6 List areas where insulation should be used in residential construction.
11.6.7 List factors that determine the amount of insulation needed for walls, ceilings, and floors.
11.6.8 Name types of materials used for vapor barriers.

**Performance Standards 11.7: Install insulation and vapor barriers.**

11.7.1 Select from a list methods used to apply insulation and vapor barriers.
11.7.2 Estimate the packages of insulation needed to insulate a structure.
11.7.3 Demonstrate the ability to Install vapor barrier and insulation for a concrete slab on grade.
11.7.4 Demonstrate the ability to install blanket insulation in walls.

**Performance Standard 11.8: Demonstrate a knowledge of drywall.**

11.8.1 Match terms associated with drywall to their correct definitions.
11.8.2 Name types of drywall.
11.8.3 Select from a list standard sizes of drywall.
11.8.4 Identify standard edge shapes of drywall.
11.8.5 State benefits of using drywall.
11.8.6 Describe types of base or construction where drywall is used.
11.8.7 Identify hardware and fasteners used with drywall.
11.8.8 Select from a list types of finishes that may be applied to drywall.

**Performance Standard 11.9: Install drywall materials.**

11.9.1 Estimate materials needed to drywall a structure.
11.9.2 Install drywall.
11.9.3 Finish drywall joints and depressions.

## CONTENT STANDARDS 12: CABINETS AND SPECIAL BUILT-INS

**Performance Standard 12.1: Identify parts of a cabinet.**

12.1.1 Match terms associated with cabinet installation and special built-ins to their correct definitions.
12.1.2 Name types of cabinets.
12.1.3 Identify parts of a cabinet.
12.1.4 Name the standard sizes of base and top cabinets.
12.1.5 Discuss types of material used on counter tops.

**Performance Standard 12.2: Install cabinets and shelves.**

12.2.1 Install a factory-built cabinet.
12.2.2 Install shelves in a closet.

## CONTENT STANDARD 13: JOB COORDINATION

**Performance Standards 13.1: Demonstrate the ability to coordinate with other trades.**

13.1.1 Select from a list of activities that may affect the work of plumbers, electricians, mechanical contractors, and glaziers.
13.1.2 Identify structural problems that may be caused by plumbing and electrical installation.
13.1.3 Discuss the importance of correctly orienting knockouts on BCIs and other prefabricated materials.
13.1.4 Explain the importance of placing large fixtures before framing is completed.

13.1.5 Discuss the reasons for minimizing the number of plumbing vents in metal roofs.
13.1.6 Explain the importance of nailing directly over studs when doubling top plates.
13.1.7 Point out the reasons carpenters should know basic wiring and plumbing practices, especially when remodeling.
13.1.8 Identify structural problems that may be caused by plumbing and electrical installation.

**Performance Standards 13.2: Demonstrate an awareness of inspection requirements.**

13.2.1 Explain the purpose of Building Codes.
13.2.2 Discuss the importance of knowing state and local codes and ordinances.
13.2.3 Match activities on a job schedule with required inspections.
13.2.4 Identify required building permits.
13.2.5 Visit the Building Inspectors Office.
13.2.6 Determine the average lead-time required to get an inspector on site.
13.2.7 Observe building inspections.

## CONTENT STANDARD 1.0: IDENTIFY LAB ORGANIZATION AND SAFETY PROCEDURES

### Performance Standard 1.1: Demonstrate General Lab Safety Rules and Procedures

1.1.1 Describe general shop safety rules and procedures (i.e., safety test).
1.1.2 Describe OSHA in workplace safety.
1.1.3 Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities (i.e., personal protection equipment – PPE).
1.1.4 Operate lab equipment according to safety guidelines.
1.1.5 Identify and use proper lifting procedures and proper use of support equipment (i.e., rigging, chains, straps, cables).
1.1.6 Utilize proper ventilation procedures for working within the lab/shop area.
1.1.7 Identify marked safety areas.
1.1.8 Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
1.1.9 Identify the location and use of eye wash stations.
1.1.10 Identify the location of the posted evacuation routes.
1.1.11 Identify and wear appropriate clothing for lab/shop activities.
1.1.12 Secure hair and jewelry for lab/shop activities.
1.1.13 Demonstrate knowledge of the safety aspects of high voltage circuits.
1.1.14 Locate and interpret safety data sheets (SDS).
1.1.15 Perform housekeeping duties.
1.1.16 Follow verbal instructions to complete work assignments.
1.1.17 Follow written instructions to complete work assignments.
1.1.18 Identify requirements for Hot Work Permits.
1.1.19 Identify what constitutes a confined space.

### Performance Standard 1.2: Identify and Utilize Hand Tools

1.2.1 Identify hand tools and their appropriate usage.
1.2.2 Identify standard and metric designation.
1.2.3 Demonstrate safe handling and use of appropriate tools.
1.2.4 Demonstrate proper cleaning, storage, and maintenance of tools.

### Performance Standard 1.3: Identify and Utilize Power Tools and Equipment

1.3.1 Identify power tools and equipment, and their appropriate usage.
1.3.2 Demonstrate safe handling and use of appropriate power tools and equipment.
1.3.3 Demonstrate proper cleaning, storage, and maintenance of power tools and equipment.

## CONTENT STANDARD 2.0: APPLY FUNDAMENTAL PRINT READING, MEASUREMENT AND LAYOUT/FIT-UP TECHNIQUES

### Performance Standard 2.1: Demonstrate Print Reading and Sketching Practices

2.1.1 Interpret basic elements of a technical drawing (i.e., title block information, dimensions, line types).
2.1.2 Identify and explain industry standard welding symbols.
2.1.3 Prepare a materials list from a technical drawing (i.e., bill of material).

2.1.4 Describe various types of drawings (i.e., part, assembly, pictorial, orthographic, isometric, and schematic).
2.1.5 Understand dimensioning, sectional drawings, fasteners, tables, charts, and assembly drawings.
2.1.6 Sketch or draw a basic welding drawing.
2.1.7 Fabricate parts from a drawing or sketch.

### Performance Standard 2.2: Demonstrate Measuring and Scaling Techniques

2.2.1 Identify industry standard units of measure.
2.2.2 Convert between customary (i.e., SAE, Imperial) and metric systems.
2.2.3 Measure and calculate size, area, and volume.
2.2.4 Determine and apply the equivalence between fractions and decimals.
2.2.5 Identify measuring tools.

### Performance Standards 2.3: Utilize Layout Principles and Practices

2.3.1 Interpret drawing, sketch or specification information.
2.3.2 Prepare work area for layout.
2.3.3 Select appropriate materials to complete work assignment.
2.3.4 Use layout and marking tools as required.
2.3.5 Layout parts using measurement practices.

### Performance Standards 2.4: Demonstrate Preparation and Fit-Up Practices

2.4.1 Identify and explain job specifications.
2.4.2 Use fit-up gauges and measuring devices to check joint fit-up.
2.4.3 Identify and explain distortion and how it is controlled.
2.4.4 Fit-up joints using plate and pipe fit-up tools.
2.4.5 Check for joint misalignment and poor fit-up before and after welding.

## CONTENT STANDARD 3.0: IDENTIFY PROPERTIES OF METALS

### Performance Standard 3.1: Identify Material Properties and Science

3.1.1 Identify the difference between ferrous and non-ferrous metals.
3.1.2 Identify and explain forms and shapes of structural metals.

### Performance Standard 3.2: Identify Filler Metals

3.2.1 Explain AWS filler metal classifications systems.
3.2.2 Identify different types of filler metals.
3.2.3 Explain the storage and control of filler metals.

## CONTENT STANDARD 4.0: APPLY SHIELDED METAL ARC WELDING (SMAW) TECHNIQUES

### Performance Standard 4.1: Safety Procedures

4.1.1 Identify and explain different types of welding current and polarity.
4.1.2 Perform safety inspections of SMAW equipment and accessories.
4.1.3 Maintain SMAW equipment and accessories.

### Performance Standard 4.2: Produce Welds using SMAW on Carbon Steel

4.2.1 Set up for SMAW operations.
4.2.2 Operate SMAW equipment.

4.2.3 Perform welds in the 1F position.
4.2.3 Perform welds in the 2F position.
4.2.4 Perform welds in the 3F position.
4.2.5 Perform welds in the 4F position.
4.2.6 Perform welds in the 1G position.
4.2.7 Perform welds in the 2G position.
4.2.8 Perform welds in the 3G position.
4.2.9 Perform welds in the 4G position.
4.2.10 Describe 2G, 5G and 6G welding positions.

## CONTENT STANDARD 5.0: APPLY GAS METAL ARC WELDING (GMAW-S, GMAW) TECHNIQUES

### Performance Standard 5.1: Utilize Safety Procedures

5.1.1 Identify and explain the use of GMAW equipment (i.e., spray transfer, globular, short circuit, pulse).
5.1.2 Perform safety inspections of GMAW equipment and accessories.
5.1.3 Maintain GMAW equipment and accessories.
5.1.4 Demonstrate safe startup, shutdown, disassembly, and cylinder exchange procedures of GMAW equipment.

### Performance Standard 5.2: Produce Welds using GMAW-S on Carbon Steel

5.2.1 Set up for GMAW-S operations.
5.2.2 Operate GMAW-S equipment.
5.2.3 Perform welds in the 1F position.
5.2.4 Perform welds in the 2F position.
5.2.5 Perform welds in the 3F position.
5.2.6 Perform welds in the 4F position.
5.2.7 Perform welds in the 1G position.
5.2.8 Perform welds in the 2G position.
5.2.9 Perform welds in the 3G position.

## CONTENT STANDARD 6.0: APPLY FLUX CORED ARC WELDING (FCAW-G) TECHNIQUE

### Performance Standard 6.1: Utilize Safety Procedures

6.1.1 Identify and explain the use of FCAW-G equipment ).
6.1.2 Perform safety inspections of FCAW-G equipment and accessories.
6.1.3 Maintain FCAW-G equipment and accessories.
6.1.4 Demonstrate safe startup, shutdown, disassembly, and cylinder exchange procedures of FCAW-G equipment.

### Performance Standard: 6.2: Produce Welds using FCAW-G on Carbon Steel

6.2.1 Set up for FCAW-G operations.
6.2.2 Operate FCAW-G equipment.
6.2.3 Perform welds in the 1F position.
6.2.4 Perform welds in the 2F position.
6.2.5 Perform welds in the 3F position.
6.2.6 Perform welds in the 4F position.

6.2.7 Perform welds in the 1G position.
6.2.8 Perform welds in the 2G position.
6.2.9 Perform welds in the 3G position.

## CONTENT STANDARD 7.0: APPLY GAS TUNGSTEN ARC WELDING (GTAW) TECHNIQUES

### Performance Standard 7.1: Utilize Safety Procedures

7.1.1 Perform safety inspections of GTAW equipment and accessories.
7.1.2 Maintain GTAW equipment and accessories.
7.1.3 Demonstrate safe startup, shutdown, disassembly, and cylinder exchange procedures of GTAW equipment.

### Performance Standard 7.2: Produce Welds using GTAW on Carbon Steel

7.2.1 Set up for GTAW operations
7.2.2 Operate GTAW equipment.
7.2.3 Perform welds in the 1F position.
7.2.4 Perform welds in the 2F position
7.2.5 Perform welds in the 3F position
7.2.6 Perform welds in the 1G position
7.2.7 Perform welds in the 2G position.
7.2.8 Perform welds in the 3G position.

### Performance Standard 7.3: Produce Welds using GTAW on Aluminum

7.3.1 Set up for GTAW operations.
7.3.2 Operate GTAW equipment.
7.3.3 Perform welds in the 1F position.
7.3.4 Perform welds in the 2F position.

## CONTENT STANDARD 8.0: APPLY THERMAL CUTTING PROCESSES

### Performance Standard 8.1: Demonstrate Oxy-Fuel Gas Cutting (OFC)

8.1.1 Perform safety inspections of OFC equipment and accessories.
8.1.2 Maintain OFC equipment and accessories.
8.1.3 Demonstrate safe startup, shutdown, disassembly, and cylinder exchange procedures of OFC equipment.
8.1.4 Set up for OFC operations.
8.1.5 Operate OFC equipment.
8.1.6 Perform straight, square edge cutting operations in the flat position.
8.1.7 Perform shape, square edge cutting operations in the flat position.
8.1.8 Perform straight, bevel edge cutting operations in the flat position.
8.1.9 Perform scarfing and gouging operations to remove base and weld metal, in flat and horizontal positions.

### Performance Standard 8.2: Demonstrate Plasma Arc Cutting (PAC) on Carbon Steel and Aluminum

8.2.1 Explain the PAC process.
8.2.2 Determine the appropriate PAC settings for the various types of metals.
8.2.3 Perform safety inspections of PAC equipment and accessories.
8.2.4 Maintain PAC equipment and accessories.

8.2.5 Set up for PAC operations.
8.2.6 Operate PAC equipment.
8.2.7 Perform straight, square edge cutting operations in the flat position.
8.2.8 Perform shape, square edge cutting operations in the flat position.

### Performance Standard 8.3: Demonstrate Manual Air Carbon Arc Cutting (CAC-A)

8.3.1 Performs safety inspections of manual CAC-A equipment and accessories.
8.3.2 Maintain CAC-A equipment and accessories.
8.3.3 Set up manual CAC-A scarfing and gouging operation on carbon steel.
8.3.4 Operate manual CAC-A equipment on carbon steel.
8.3.5 Perform scarfing and gouging operations to remove base and weld metal in the flat and horizontal positions on carbon steel.

## CONTENT STANDARD 9.0: IDENTIFY WELDING CODES, INSPECTIONS, AND TESTING PRINCIPLES

### Performance Standard 9.1: Identify Welding Codes, Qualifications and Certifications

9.1.1 Identify and explain weld imperfections and their causes.
9.1.2 Identify and explain welder qualification tests.
9.1.3 Explain the importance of quality workmanship.
9.1.4 Identify common destructive testing methods.
9.1.5 Perform a visual inspection of fillet welds.

### Performance Standard 9.2: Demonstrate Welding Inspection and Testing Principles

9.2.1 Define the role of welding inspection/inspector and testing in industry.
9.2.2 Examine cut surfaces and edges of prepared base metal parts.
9.2.3 Examine tack, root passes, intermediate layers, and completed welds.

## CONTENT STANDARD 10.0: APPLY FABRICATION FUNDAMENTALS

### Performance Standard 10.1: Utilize Base Metal Preparation Fundamentals

10.1.1 Clean base metal for welding or cutting.
10.1.2 Identify and explain joint design.
10.1.3 Select the proper joint design based on a welding procedure specification (WPS) or instructor's direction.
10.1.4 Mechanically bevel the edge of a mild steel plate (i.e., hand beveller, grinder).
10.1.5 Thermally bevel the end of a mild steel plate.

### Performance Standard 10.2: Demonstrate Fabrication Techniques

10.2.1 Demonstrate proper setup of fabrication area, equipment, and materials.
10.2.2 Construct projects in the proper sequence.
10.2.3 Properly layout projects from welding prints.
10.2.4 Check work for accuracy.