

# 2024 Automotive Maintenance and Light Repair

## Program Standards

### CONTENT STANDARD 1.0: PROFESSIONAL ORGANIZATIONS AND LEADERSHIP

#### Performance Standard 1.1: Student Leadership in Career Technical Student Organizations (CTSO) and Professional Associations

- 1.1.1 Explore the role of professional organizations and/or associations in the automotive repair industry.
- 1.1.2 Define the value, role, and opportunities provided through career technical student organizations.
- 1.1.3 Engage in career exploration and leadership development.

### CONTENT STANDARD 2.0: SAFETY PROCEDURES FOR LAB AND TOOLS

#### Performance Standard 2.1: General Lab Safety Rules and Procedures

- 2.1.1 Identify and use proper placement of floor jacks and jack stands.
- 2.1.2 Identify and use proper procedures for safe vehicle lift operation.
- 2.1.3 Identify proper ventilation requirements for working within the lab/shop area.
- 2.1.4 Identify marked safety areas.
- 2.1.5 Identify the location and the types of fire extinguishers and other fire safety equipment.
- 2.1.6 Identify the location of eye wash station(s) and the procedure for proper use.
- 2.1.7 Identify the location of the posted evacuation routes.
- 2.1.8 Comply with the required personal protective equipment (PPE) requirements (e.g., safety glasses, ear protection, gloves, shoes).
- 2.1.9 Secure hair and jewelry for lab/shop activities.
- 2.1.10 Identify safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits (e.g., high-intensity discharge (HID) lamps, ignition systems, injection systems).
- 2.1.11 Locate and interpret safety data sheets (SDS).
- 2.1.12 Handle, store, and dispose of hazardous waste and materials (e.g., batteries, oil, diesel, gasoline, antifreeze).

#### Performance Standard 2.2: Tool and Equipment Identification and Use

- 2.2.1 Identify tools and equipment and their appropriate uses in automotive maintenance and repair.
- 2.2.2 Identify standard and metric fasteners.
- 2.2.3 Describe thread repair; identify the required tools needed to perform the repair.
- 2.2.4 Demonstrate the safe handling and appropriate use of tools and equipment.
- 2.2.5 Describe the use of, read, and interpret precision measuring tools (e.g., micrometer, dial-indicator, digital/dial-caliper).
- 2.2.6 Demonstrate cleaning, storage, and maintenance of tools and equipment.

### CONTENT STANDARD 3.0: BASIC VEHICLE SERVICE

#### Performance Standard 3.1: Vehicle Service Information

- 3.1.1 Reference vehicle service information, such as fluid type, vehicle service history when available, service precautions, technical service bulletins, and recalls, including for vehicles equipped with advanced driver assistance systems (ADAS).
- 3.1.2 Retrieve and record diagnostic trouble codes (DTC), onboard diagnostics (OBD) monitor status, freeze frame data, and clear codes and data when directed.
- 3.1.3 Locate the vehicle identification number (VIN) and production data code.
- 3.1.4 Interpret VIN information.
- 3.1.5 Identify additional vehicle information labels (e.g., tires, emissions).
- 3.1.6 Reset maintenance notifications/reminders after services are completed.
- 3.1.7 Verify and interpret vehicle warning indicators (e.g., messages, lights).
- 3.1.8 Identify policy requirements for the return of a vehicle to a customer (e.g., floor mats, steering wheel cover).

### CONTENT STANDARD 4.0: ENGINE REPAIR

#### Performance Standard 4.1: General Engine Service

- 4.1.1 Inspect engine assembly for fuel, oil, coolant, and other leaks.
- 4.1.2 Install engine covers, using vehicle-specific gaskets, seals, and sealers as required.
- 4.1.3 Describe the function of the timing belt/chain.
- 4.1.4 Inspect, replace, and adjust drive belts (e.g., alternator, power steering pump, air conditioning, stretch-fit serpentine belts), tensioners, and pulleys, checking pulley and belt alignment.
- 4.1.5 Inspect engine mounts.
- 4.1.6 Identify service precautions related to service of the internal combustion engine of a hybrid vehicle.
- 4.1.7 Identify engine block assembly components and configurations.
- 4.1.8 Identify the cylinder head and valve train components and configurations.
- 4.1.9 Describe the operation of engines equipped with variable valve timing (VVT) systems.

#### Performance Standard 4.2: Lubrication and Cooling Systems

- 4.2.1 Identify lubrication and cooling system components and configurations.
- 4.2.2 Perform cooling system pressure check (e.g., inspect and test radiator, coolant recovery tank, heater core, and galley plug) to identify leaks.
- 4.2.3 Verify the operation of the cooling system (e.g., leak, fans, heater) after service or repair.
- 4.2.4 Inspect and test the pressure cap.
- 4.2.5 Determine necessary action to remedy issues related to the radiator, pressure cap, coolant recovery tank, heater core, and galley plug.
- 4.2.6 Identify causes of engine overheating.
- 4.2.7 Identify types of water pumps (e.g., gear-driven, belt-driven, chain-driven, electric).
- 4.2.8 Remove, inspect, and replace the thermostat and gasket/seal.
- 4.2.9 Inspect and test coolant.
- 4.2.10 Drain and recover coolant.
- 4.2.11 Describe procedures for flushing and refilling the cooling system with recommended coolant, using a radiator vacuum tool or bleed air, as required.
- 4.2.12 Perform oil and filter changes.

## CONTENT STANDARD 5.0: AUTOMATIC TRANSMISSION/TRANSAXLE

### Performance Standard 5.1: General Transmission/Transaxle

- 5.1.1 Identify drive train and axle components and configurations.
- 5.1.2 Describe transmission/transaxle fluids, the importance of fluid quality, and differences in electric vehicle (EV)/hybrid transmissions.
- 5.1.3 Check transmission fluid condition.
- 5.1.4 Check fluid level in a transmission or transaxle equipped with and without a dipstick; verify the procedure with a scan tool.
- 5.1.5 Check for transmission fluid leaks.
- 5.1.6 Describe hydraulic principles (i.e., Pascal's law) at work in a transmission/transaxle.

### Performance Standard 5.2: In-Vehicle Transmission/Transaxle

- 5.2.1 Inspect, adjust, and replace external manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch.
- 5.2.2 Describe relearn procedures.
- 5.2.3 Drain and replace fluid and filter(s).

### Performance Standard 5.3: Off-Vehicle Transmission/Transaxle

- 5.3.1 Describe the basic operational characteristics of a continuously variable transmission (CVT).
- 5.3.2 Describe the basic operational characteristics of hybrid and electric vehicle (EV) drive trains.

## CONTENT STANDARD 6.0: MANUAL DRIVE TRAIN AND AXELS

### Performance Standard 6.1: General Drive Train

- 6.1.1 Check fluid condition and for leaks.
- 6.1.2 Drain and refill manual transmission/transaxle and final drive unit.

### Performance Standard 6.2: Clutch Systems

- 6.2.1 Check and adjust the clutch master cylinder fluid level.
- 6.2.2 Check for hydraulic system leaks.

### Performance Standard 6.3: Drive Shaft and Half Shaft, Universal and Constant Velocity (CV) Joint

- 6.3.1 Inspect front and rear wheel bearings.
- 6.3.2 Diagnose, inspect, service, and replace shafts, yokes, boots, and universal/CV joints.
- 6.3.3 Check for leaks at drive assembly and transfer case seals; check vents; check fluid level.

### Performance Standard 6.4: Differential Case Assembly

- 6.4.1 Inspect differential housing, check for leaks, and inspect the housing vent.
- 6.4.2 Check and adjust differential housing fluid level.
- 6.4.3 Drain and fill differential housing, per manufacturer specification.

### Performance Standard 6.5: Drive Axle

- 6.5.1 Inspect and replace drive axle wheel studs.
- 6.5.2 Describe the function of wheel bearings.

### Performance Standard 6.6: Four-Wheel Drive/All-Wheel Drive

- 6.6.1 Identify concerns related to variations in tire circumference and/or final drive ratios.
- 6.6.2 Check transfer case/four-wheel drive fluid levels.

## CONTENT STANDARD 7.0: SUSPENSION AND STEERING SERVICE AND REPAIR

### Performance Standard 7.1: General Suspension and Steering Systems

- 7.1.1 Identify and inspect suspension and steering system components and configurations.
- 7.1.2 Disable and enable supplemental restraint system (SRS) and verify indicator lamp operation.
- 7.1.3 Compare electric and hydraulic power steering.

### Performance Standard 7.2: Wheel Alignment Conditions

- 7.2.1 Describe four-wheel alignment angles (e.g., camber, caster, toe) and effects on vehicle handling/tire wear.
- 7.2.2 Perform pre-alignment inspection and measure vehicle ride height, suggesting appropriate service.

### Performance Standard 7.3: Wheel and Tire

- 7.3.1 Describe the tire sidewall markings in detail, including the P-metric size, treadwear, temperature, traction rating, and tire production date.
- 7.3.2 Measure tread depth, using a tread-depth tool.
- 7.3.3 Determine necessary action to remedy issues related to tire condition.
- 7.3.4 Rotate tires, including using a tire pressure monitoring system (TPMS) relearn procedure, according to the manufacturer's recommendations.
- 7.3.5 Dismount, inspect, and remount tire on the wheel, including for those using TPMS.
- 7.3.6 Balance wheel and tire assembly.
- 7.3.7 Inspect tire and wheel assembly for air loss.
- 7.3.8 Determine necessary action to remedy tire air loss.
- 7.3.9 Describe the procedure for repairing a tire according to the tire manufacturer.

### Performance Standard 7.4: Related Suspension and Steering

- 7.4.1 Inspect rack and pinion steering gear inner tie rod ends (i.e., sockets) and bellows boots.
- 7.4.2 Inspect power steering fluid level and condition.
- 7.4.3 Flush, fill, and bleed power steering system.
- 7.4.4 Identify proper fluid type according to the manufacturer's specifications.
- 7.4.5 Inspect for power steering and electric steering fluid leakage.
- 7.4.6 Inspect and replace power steering hoses and fittings.
- 7.4.7 Inspect pitman arm, relay (center link/intermediate) rod, idler arm, mountings, and steering linkage damper.
- 7.4.8 Inspect tie rod ends (i.e., sockets), tie rod sleeves, and clamps.
- 7.4.9 Inspect upper and lower control arms, bushings, and shafts.
- 7.4.10 Inspect and replace rebound bumpers.
- 7.4.11 Inspect track bar, strut rods/radius arms, and related mounts and bushings.
- 7.4.12 Inspect upper and lower ball joints (with or without wear indicators).
- 7.4.13 Inspect suspension system coil springs and spring insulators (silencers).
- 7.4.14 Inspect suspension system torsion bars and mounts.
- 7.4.15 Inspect and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links.
- 7.4.16 Inspect, remove, and/or replace strut cartridge or assembly, inspecting mounts and bushings.
- 7.4.17 Inspect front strut bearing and mount.
- 7.4.18 Inspect components of suspension systems (e.g., coil, leaf, torsion).
- 7.4.19 Describe the function of electronically controlled suspension and steering systems and components (e.g., active suspension, stability control).
- 7.4.20 Inspect, remove, and/or replace shock absorbers, inspecting mounts and bushings.

## CONTENT STANDARD 8.0: BRAKE SYSTEMS

### Performance Standard 8.1: General Brake Systems

- 8.1.1 Identify brake system components and configuration.
- 8.1.2 Describe procedure for performing a road test to check brake system operation, including the anti-lock brake system (ABS).
- 8.1.3 Describe basic hydraulic principles at work in brake systems.
- 8.1.4 Install wheel and torque lug nuts.

### Performance Standard 8.2: Hydraulic System

- 8.2.1 Describe brake pedal height, travel, and feel.
- 8.2.2 Check master cylinder for internal/external leaks and proper operation.
- 8.2.3 Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks bulging, wear, loose fittings, and support.
- 8.2.4 Select, handle, store, and fill brake fluids to proper level.
- 8.2.5 Identify components of hydraulic brake warning light system.
- 8.2.6 Bleed and/or flush brake system.
- 8.2.7 Test brake fluid for contaminants, water, and boiling point, using a refractometer.

### Performance Standard 8.3: Drum Brakes

- 8.3.1 Remove, clean, inspect, and measure brake drum diameter and determine serviceability.
- 8.3.2 Refinish brake drum and measure final drum diameter, comparing with specifications.
- 8.3.3 Remove, clean, inspect, and replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates.
- 8.3.4 Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
- 8.3.5 Pre-adjust brake shoes and parking brake, installing brake drums or drum/hub assemblies and wheel bearings and make final checks and adjustments.

### Performance Standard 8.4: Disc Brakes

- 8.4.1 Remove and clean caliper assembly, inspecting for leaks and damage/wear to caliper housing.
- 8.4.2 Inspect caliper mounting.
- 8.4.3 Remove, inspect, and replace brake pads and retaining hardware, cleaning and lubricating caliper slides, cleaning rotor mounting surface, removing and replacing rotor.
- 8.4.4 Describe the procedure for burnishing brake pads against the rotor.
- 8.4.5 Refinish the rotor on and off vehicle, measuring final rotor thickness and comparing with specifications.
- 8.4.6 Retract and readjust caliper piston on an integral/electric parking brake system.

### Performance Standard 8.5: Power Assist Units

- 8.5.1 Identify components of the brake power-assist system (vacuum and hydraulic) and the electronic power brake assist system.
- 8.5.2 Check brake pedal free-travel with and without engine running to verify proper power booster operation.
- 8.5.3 Check vacuum supply, with a manifold or auxiliary pump, to a vacuum-type power booster.

**Performance Standard 8.6: Miscellaneous Brakes Systems**

- 8.6.1 Identify electronic brake control system components and describe their functions (i.e., ABS [anti-lock braking system], TCS [traction control system], ESC [electronic stability control]).
- 8.6.2 Describe the function of serviceable and non-serviceable wheel bearings.
- 8.6.3 Check parking brake operation, cables, indicator lamp, and components for wear, binding, and corrosion, cleaning, lubricating, adjusting or replacing, as needed.
- 8.6.4 Check operation of the external brake light system.
- 8.6.5 Describe the operation of a regenerative braking system.

**CONTENT STANDARD 9.0: ELECTRICAL/ELECTRONIC SYSTEM**

**Performance Standard 9.1: General Electronic Systems Service**

- 9.1.1 Identify electrical/electronic system components (e.g., alternator, fuse, diode) and configurations.
- 9.1.2 Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's law).
- 9.1.3 Interpret wiring diagrams to trace electrical/electronic circuits.
- 9.1.4 Demonstrate proper use of digital multi-meter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance.
- 9.1.5 Describe shorts, grounds, opens, and resistance problems and causes.
- 9.1.6 Describe the function of electrical testing equipment (e.g., test light, oscilloscope, short finder, logic probe).
- 9.1.7 Check basic operations of electrical circuits, using appropriate testing equipment.
- 9.1.8 Describe the procedure for measuring key-off battery drain (i.e., parasitic draw).
- 9.1.9 Inspect and test fusible links, circuit breakers, and fuses.
- 9.1.10 Repair wire, using solder and heat shrink.

**Performance Standard 9.2: Battery Service**

- 9.2.1 Perform battery state-of-charge test.
- 9.2.2 Perform battery capacity and load test, verifying proper battery capacity for vehicle application.
- 9.2.3 Maintain or restore electronic memory.
- 9.2.4 Inspect and clean batteries, fill battery cells, and check battery cables, connectors, clamps, and hold-downs.
- 9.2.5 Perform slow/fast battery charge, according to battery manufacturer recommendations.
- 9.2.6 Jump-start a vehicle, using jumper cables and a booster battery or an auxiliary power supply.
- 9.2.7 Identify electronic modules, security systems, radios, and other accessories that require re-initialization or code entry after reconnecting the vehicle battery.

**Performance Standard 9.3: Starting System**

- 9.3.1 Perform starter current draw test.
- 9.3.2 Perform starter circuit-voltage drop tests.
- 9.3.3 Describe procedures for the removal and installation of a starter in a vehicle.
- 9.3.4 Inspect and test switches, connectors, and wires of starter control circuits (e.g., relays, solenoid).
- 9.3.5 Describe the operation of an automatic idle-start/stop-stop system.

**Performance Standard 9.4: Charging System**

- 9.4.1 Perform charging system output test.
- 9.4.2 Describe procedures for inspection and function of the charging system.
- 9.4.3 Perform charging circuit voltage drop tests.





#### Performance Standard 9.5: Lighting Systems

- 9.5.1 Inspect interior and exterior lamps and sockets, including headlights and auxiliary lights (fog lights/driving lights), replacing as needed.
- 9.5.2 Aim headlights.

#### Performance Standard 9.6: Accessories

- 9.6.1 Describe vehicle comfort, convenience, access, safety, and related systems operation.
- 9.6.2 Describe the removal and reinstallation of the interior panel.
- 9.6.3 Identify tools and fasteners associated with panel removal and reinstallation.
- 9.6.4 Describe the operation of keyless entry/remote-start systems.
- 9.6.5 Verify windshield wiper and washer operation, replacing wiper blades.

### CONTENT STANDARD 10.0: HEATING AND AIR CONDITIONING SYSTEMS

#### Performance Standard 10.1: A/C Systems

- 10.1.1 Identify heating, ventilation, and air conditioning (HVAC) refrigerant types, components, and configurations.
- 10.1.2 Identify steps of an A/C performance test and operation of air conditioning refrigerant recovery machines.
- 10.1.3 Inspect A/C heater ducts, doors, hoses, cabin filters, and outlets and determine necessary remedy.