



# **DIESEL ENGINE REPAIR 47.0600.40**

## **TECHNICAL STANDARDS**

An Industry Technical Standards Validation Committee developed and validated these standards on December 17, 2019. Because these standards align with the Automotive Service Excellence (ASE) Task List, students completing the program are eligible to earn the ASE Certification. The Arizona Career and Technical Education Quality Commission, the validating authority for the Arizona Skills Standards Assessment System, endorsed these standards on January 22, 2020.

Note: Arizona's Professional Skills are taught as an integral part of the Diesel Engine Repair program.

**The Technical Skills Assessment for Diesel Engine Repair is available SY2022-2023.**

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### **STANDARD 1.o PERFORM AUTOMOTIVE SHOP AND SAFETY TASKS**

- 1.1 Identify general shop safety rules and procedures
- 1.2 Utilize safe procedures for handling of tools and equipment
- 1.3 Identify and use proper placement of floor jacks and jack stands
- 1.4 Identify and use proper procedures for safe lift operation
- 1.5 Utilize proper ventilation procedures for working within the lab/shop area
- 1.6 Identify marked safety areas
- 1.7 Identify the location and the types of fire extinguishers and other fire safety equipment
- 1.8 Demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment
- 1.9 Identify the location and use of eye wash stations and/or showers
- 1.10 Identify the location of the posted evacuation routes
- 1.11 Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities
- 1.12 Identify and wear appropriate clothing for lab/shop activities
- 1.13 Secure hair and jewelry for lab/shop activities
- 1.14 Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits
- 1.15 Demonstrate awareness of the safety aspects of high voltage circuits (such as high intensity discharge (HID) lamps, ignition systems, injection systems, etc.)
- 1.16 Locate and demonstrate knowledge of safety data sheets (SDS)
- 1.17 Identify tools and their usage in transportation applications
- 1.18 Identify standard and metric designation
- 1.19 Demonstrate safe handling and use of appropriate tools
- 1.20 Demonstrate proper cleaning, storage, and maintenance of tools and equipment
- 1.21 Demonstrate proper use of precision measuring tools (i.e., micrometer, dial-indicator, dial-caliper)
- 1.22 Identify information necessary and the service requested on a repair order
- 1.23 Identify high-pressure fluids systems' safety
- 1.24 Identify high-temperature components' safety

### **STANDARD 2.o PERFORM PRE-TRIP INSPECTION**

- 2.1 Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins
- 2.2 Inspect level and condition of fuel, oil, diesel exhaust fluid (DEF), and coolant
- 2.3 Inspect engine assembly for fuel, oil, coolant, air, and other leaks

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- 2.4 Check engine operation (starting and running) including noise, vibration, smoke, etc.
- 2.5 Use appropriate electronic service tool(s) and procedures to check, record, and clear diagnostic codes; check and record trip/operational data; reset maintenance monitor (if applicable); interpret digital multimeter (DMM) readings
- 2.6 Identify and evaluate system components, configurations, and types of the following: cylinder head(s), valve train, engine block, engine lubrication, engine cooling, air induction, exhaust, fuel, and engine braking

### **STANDARD 3.0 PERFORM LUBRICATION SYSTEM PM**

- 3.1 Test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit; test engine oil temperature and check operation of temperature sensor
- 3.2 Check engine oil level, condition, and consumption; take engine oil sample
- 3.3 Determine proper lubricant; perform oil and filter service

### **STANDARD 4.0 PERFORM COOLING SYSTEM PM**

- 4.1 Check engine coolant type, level, condition, and test coolant for freeze protection and additive package concentration
- 4.2 Verify coolant temperature; check operation of temperature and level sensors, gauge, and/or sending unit
- 4.3 Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment
- 4.4 Recover coolant, flush, and refill with recommended coolant/additive package; bleed cooling system
- 4.5 Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed
- 4.6 Inspect water pump, hoses, and clamps
- 4.7 Inspect and pressure test cooling system(s); pressure test cap, tank(s), and recovery systems; inspect radiator and mountings
- 4.8 Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud
- 4.9 Identify engine block heater(s)

### **STANDARD 5.0 PERFORM AIR INDUCTION AND EXHAUST SYSTEM PM**

- 5.1 Inspect turbocharger(s), wastegate(s), and piping systems
- 5.2 Check air induction system including cooler assembly, piping, hoses, clamps, and mountings; replace air filter as needed; reset restriction indicator (if applicable)
- 5.3 Inspect intake manifold, gaskets, and connections
- 5.4 Inspect engine exhaust system, exhaust gas recirculation (EGR) system, and exhaust after treatment systems [e.g., Diesel Exhaust Fluid (DEF), Selective Catalyst Reduction (SCR), Diesel Particulate Filter (DPF)] for leaks, mounting, proper routing, and damaged or missing components
- 5.5 Inspect crankcase ventilation system; service as needed
- 5.6 Inspect engine compression and/or exhaust brake housing, valves, seals, lines, and fittings

### **STANDARD 6.0 PERFORM FUEL SYSTEM PM**

- 6.1 Check fuel level and condition
- 6.2 Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, hoses, lines, and fittings
- 6.3 Inspect low pressure fuel system components (fuel pump, pump drives, screens, fuel/water separators/indicators, hoses, lines, filters, heaters, coolers, ECM cooling plates, check valves, pressure regulator valves, restrictive fittings, and mounting hardware)
- 6.4 Replace fuel filter; prime and bleed fuel system
- 6.5 Properly discharge a high-pressure fuel system
- 6.6 Inspect high pressure fuel system components (fuel pump, pump drives, hoses, injection lines, filters, hold-downs, fittings, seals, and mounting hardware)

### **STANDARD 7.0 PERFORM DRIVE TRAIN PM**

- 7.1 Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins
- 7.2 Identify drive train components, transmission type, and configuration
- 7.3 Inspect and adjust clutch, clutch brake, linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push-type and pull-type); check pedal height and travel; determine needed action

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- 7.4 Inspect clutch master cylinder fluid level; check clutch master cylinder, slave cylinder, lines, and hoses for leaks and damage; determine needed action
- 7.5 Inspect transmission shifter and linkage; inspect transmission mounts, insulators, and mounting bolts
- 7.6 Inspect transmission for leakage; determine needed action
- 7.7 Replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; determine needed action
- 7.8 Check transmission fluid level and condition; determine needed action
- 7.9 Inspect transmission breather; inspect transmission oil filters, coolers and related components; determine needed action
- 7.10 Inspect speedometer components
- 7.11 Inspect and test function of REVERSE light, neutral start, and warning device circuits
- 7.12 Inspect, service, and/or replace driveshafts, slip joints, yokes, drive flanges, support bearings, universal joints, boots, seals, and retaining/mounting hardware; check phasing of all shafts
- 7.13 Identify power takeoff components (PTOs)
- 7.14 Check for fluid leaks; inspect drive axle housing assembly, cover plates, gaskets, seals, vent/breather, and magnetic plugs
- 7.15 Check drive axle fluid level and condition; check drive axle filter; determine needed action
- 7.16 Inspect air-operated power divider (inter-axle differential) assembly including: diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls
- 7.17 Inspect drive axle shafts; determine needed action
- 7.18 Remove and replace wheel assembly; check rear wheel seal and axle flange for leaks; determine needed action
- 7.19 Inspect electric two-speed motor and wiring for proper function

#### STANDARD 8.o PERFORM AIR BRAKE SYSTEM PM

- 8.1 Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins
- 8.2 Identify brake system components and configurations (including air and hydraulic systems, parking brake, power assist, and vehicle dynamic brake systems)
- 8.3 Identify brake performance problems caused by the mechanical/foundation brake system (air and hydraulic)
- 8.4 Inspect air supply system components such as compressor, governor, air drier, tanks, and lines; inspect service system components such as lines, fittings, mountings, and valves (hand brake/trailer control, brake relay, quick release, tractor protection, emergency/spring brake control/modulator, pressure relief/safety)
- 8.5 Verify proper gauge operation and readings; verify low pressure warning alarm operation; perform air supply system tests such as pressure build-up, governor settings, and leakage; drain air tanks and check for contamination
- 8.6 Inspect service brake chambers, diaphragms, clamps, springs, pushrods, clevises, and mounting brackets; determine needed action
- 8.7 Identify slack adjuster type; inspect slack adjusters; determine needed action
- 8.8 Check camshafts (S-cams), tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; determine needed action
- 8.9 Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action
- 8.10 Inspect, clean, and adjust air disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; perform needed action
- 8.11 Remove brake drum; clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; determine needed action
- 8.12 Inspect and check parking (spring) brake chamber for leaks; determine needed action
- 8.13 Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; determine needed action
- 8.14 Inspect and test parking (spring) brake application and release valve; determine needed action
- 8.15 Manually release (cage) and reset (uncage) parking (spring) brakes
- 8.16 Observe antilock brake system (ABS) warning light operation including trailer and dash mounted trailer ABS warning light
- 8.17 Observe automatic traction control (ATC) and electronic stability control (ESC) warning light operation
- 8.18 Identify steering angle calibration

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## **STANDARD 9.o PERFORM HYDRAULIC BRAKE SYSTEM PM**

- 9.1 Check master cylinder fluid level and condition; determine proper fluid type for application
- 9.2 Inspect hydraulic brake system components for leaks and damage
- 9.3 Check hydraulic brake system operation including pedal travel, pedal effort, and pedal feel
- 9.4 Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action
- 9.5 Inspect and clean disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; determine needed action
- 9.6 Remove brake drum; clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; inspect wheel cylinders; determine needed action
- 9.7 Check parking brake operation; inspect parking brake application and holding devices
- 9.8 Check brake assist/booster system (vacuum) hoses and control valves; check fluid level and condition (if applicable)
- 9.9 Check brake assist/booster system (hydraulic) hoses, accumulator, and control valves; check fluid level and condition (if applicable)
- 9.10 Check operation of emergency (back-up/reserve) brake assist system
- 9.11 Observe antilock brake system (ABS) warning light operation
- 9.12 Observe automatic traction control (ATC) and electronic stability control (ESC) warning light operation
- 9.13 Identify steering angle calibration

## **STANDARD 10.o PERFORM SUSPENSION AND STEERING SYSTEMS PM**

- 10.1 Research vehicle service information, including fluid type, vehicle service history, service precautions, technical service bulletins, special service message(s)
- 10.2 Disable and enable supplemental restraint system (SRS); verify indicator lamp operation
- 10.3 Identify suspension and steering system components and configurations
- 10.4 Check steering wheel for free play, binding, and proper centering; inspect and service steering shaft U-joint(s), slip joint(s), bearings, bushings, and seals; phase steering shaft
- 10.5 Check operation of tilt and telescoping steering column
- 10.6 Check cab mounting
- 10.7 Check power steering pump and gear operation, mountings, lines, and hoses; check fluid level and condition; service filter; inspect system for leaks
- 10.8 Flush and refill power steering system; purge air from system
- 10.9 Inspect tie rod ends, ball joints, kingpins, pitman arms, idler arms, and other steering linkage components; lubricate as needed
- 10.10 Inspect shock absorbers, bushings, brackets, and mounts; determine needed action
- 10.11 Inspect leaf springs, center bolts, clips, pins, bushings, shackles, U-bolts, insulators, brackets, and mounts; determine needed action
- 10.12 Inspect axle and axle aligning devices such as: radius rods, track bars, stabilizer bars, and torque arms; inspect related bushings, mounts, and shims
- 10.13 Inspect tandem suspension equalizer components
- 10.14 Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; check and record ride height
- 10.15 Inspect air springs, mounting plates, springs, suspension arms, and bushings

## **STANDARD 11.o PERFORM TIRE AND WHEEL PM**

- 11.1 Demonstrate understanding of alignment angles
- 11.2 Inspect tire condition; identify tire wear patterns; measure tread depth; verify tire matching (diameter and tread); inspect valve stem and cap; set tire pressure
- 11.3 Identify wheel/tire vibration, shimmy, pounding, and hop (tramp) problems
- 11.4 Check wheel mounting hardware; check wheel condition; remove and install wheel/tire assemblies (steering and drive axle); torque fasteners to manufacturer's specification using torque wrench

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## **STANDARD 12.0 PERFORM FRAME AND FIFTH WHEEL PM**

- 12.1 Inspect, service, and/or adjust fifth wheel, pivot pins, bushings, locking mechanisms, mounting hardware, air lines, and fittings
- 12.2 Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, poor weld conditions, and damage
- 12.3 Inspect frame hangers, brackets, and cross members
- 12.4 Check pintle hook, eye wear, and mounting (if applicable)
- 12.5 Identify trailer kingpin wear

## **STANDARD 13.0 PERFORM GENERAL ELECTRICAL/ELECTRONIC SYSTEM DIAGNOSIS AND REPAIR**

- 13.1 Research vehicle service information, including vehicle service history, service precautions, and technical service bulletins
- 13.2 Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law)
- 13.3 Demonstrate proper use of test equipment when measuring source voltage, voltage drop (including grounds), current flow, continuity, and resistance
- 13.4 Demonstrate knowledge of the causes and effects of shorts, grounds, opens, and resistance problems in electrical/electronic circuits
- 13.5 Use wiring diagrams to trace electrical/electronic circuits
- 13.6 Measure parasitic (key-off) battery drain
- 13.7 Demonstrate knowledge of the function, operation, and testing of fusible links, circuit breakers, relays, solenoids, diodes, and fuses
- 13.8 Inspect, repair (including solder repair), and/or replace connectors, seals, terminal ends, and wiring; verify proper routing and securement
- 13.9 Use appropriate electronic service tool(s) and procedures to check, record, and clear diagnostic codes; interpret digital multimeter (DMM) readings
- 13.10 Check for malfunctions caused by faults in the data bus communications network
- 13.11 Identify electrical/electronic system components and configuration

## **STANDARD 14.0 PERFORM BATTERY DIAGNOSIS AND REPAIR**

- 14.1 Identify battery type and system configuration
- 14.2 Confirm proper battery capacity for application; perform battery state-of-charge test; perform battery capacity test, determine needed action
- 14.3 Inspect battery, battery cables, connectors, battery boxes, mounts, and hold-downs; determine needed action
- 14.4 Charge battery using appropriate method for battery type
- 14.5 Jump-start vehicle using a booster battery and jumper cables or using an appropriate auxiliary power supply
- 14.6 Identify low voltage disconnect (LVD) systems

## **STANDARD 15.0 PERFORM STARTING SYSTEM DIAGNOSIS AND REPAIR**

- 15.1 Demonstrate understanding of starter system operation
- 15.2 Perform starter circuit cranking voltage and voltage drop tests
- 15.3 Inspect starter control circuit switches, relays, connectors, terminals, wires, and harnesses (including over-crank protection)

## **STANDARD 16.0 PERFORM CHARGING SYSTEM DIAGNOSIS AND REPAIR**

- 16.1 Identify and understand operation of the generator (alternator)
- 16.2 Check instrument panel mounted voltmeters and/or indicator lamps
- 16.3 Inspect generator (alternator) drive belt condition; check pulleys and tensioners for wear; check fans and mounting brackets; verify proper belt alignment
- 16.4 Inspect cables, wires, and connectors in the charging circuit
- 16.5 Perform charging system voltage and amperage output tests; perform AC ripple test

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## STANDARD 17.0 PERFORM LIGHTING SYSTEM DIAGNOSIS AND REPAIR

- 17.1 Inspect for brighter-than-normal, intermittent, dim, or no-light operation; determine needed action
- 17.2 Test, replace, and aim headlights
- 17.3 Inspect cables, wires, and connectors in the lighting systems
- 17.4 Inspect tractor-to-trailer multi-wire connectors, cables, and holders

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