

## **DIESEL ENGINE REPAIR, 47.0600.40**

These technical knowledge and skill standards were validated by a Skill Standards Validation Committee on June 21, 2011 and approved by the Arizona Career and Technical Education Quality Commission on May 16, 2012.

### **STANDARD 1.0 PERFORM GENERAL ELECTRICAL SYSTEM DIAGNOSIS AND REPAIR**

- 1.1 Read and interpret electrical/electronic circuits using wiring diagrams
- 1.2 Check continuity in electrical/electronic circuits using appropriate test equipment
- 1.3 Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using appropriate test equipment
- 1.4 Check current flow in electrical/electronic circuits and components using appropriate test equipment
- 1.5 Check resistance in electrical/electronic circuits and components using appropriate test equipment
- 1.6 Locate shorts, grounds, and opens in electrical/electronic circuits
- 1.7 Identify parasitic (key-off) battery drain problems; perform tests; determine needed action
- 1.8 Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed
- 1.9 Check frequency and pulse width signal in electrical/electronic circuits using appropriate test equipment

### **STANDARD 2.0 PERFORM BATTERY DIAGNOSIS AND REPAIR**

- 2.1 Perform battery load test; determine needed action
- 2.2 Determine battery state of charge using an open circuit voltage test
- 2.3 Inspect, clean, and service battery; replace as needed
- 2.4 Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed
- 2.5 Charge battery using slow or fast charge method as appropriate
- 2.6 Inspect, test, and clean battery cables and connectors; repair or replace as needed
- 2.7 Jump start a vehicle using jumper cables and a booster battery or appropriate auxiliary power supply using proper safety procedures

### **STANDARD 3.0 PERFORM STARTING SYSTEM DIAGNOSIS AND REPAIR**

- 3.1 Perform starter circuit cranking voltage and voltage drop tests; determine needed action
- 3.2 Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed
- 3.3 Inspect and test, starter relays and solenoids/switches; replace as needed
- 3.4 Remove and replace starter; inspect flywheel ring gear or flex plate

### **STANDARD 4.0 PERFORM CHARGING SYSTEM DIAGNOSIS AND REPAIR**

- 4.1 Test instrument panel mounted volt meters and/or indicator lamps; determine needed action
- 4.2 Identify causes of a no charge, low charge, or overcharge problems; determine needed action
- 4.3 Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment
- 4.4 Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action
- 4.5 Perform charging circuit voltage drop tests; determine needed action
- 4.6 Remove and replace alternator
- 4.7 Inspect, repair, or replace cables, wires, and connectors in the charging circuit

### **STANDARD 5.0 PERFORM LIGHTING SYSTEM DIAGNOSIS AND REPAIR**

- 5.1 Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action
- 5.2 Identify causes of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation
- 5.3 Test, aim, and replace headlights

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- 5.5 Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components/modules; repair or replace as needed
- 5.6 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
- 5.7 Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, wires, and control components/modules; repair or replace as needed
- 5.8 Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed
- 5.9 Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed
- 5.10 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

**STANDARD 6.0 PERFORM GAUGES AND WARNING DEVICES DIAGNOSIS AND REPAIR**

- 6.1 Interface with vehicle's on-board computer; perform diagnostic procedure using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action
- 6.2 Identify causes of intermittent, high, low, or no gauge readings; determine needed action
- 6.3 Inspect and test gauge circuit sensor/sending units, gauges, connectors, terminals, and wires; repair or replace as needed
- 6.4

**STANDARD 7.0 PERFORM RELATED ELECTRICAL SYSTEMS DIAGNOSIS AND REPAIR**

- 7.1 Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action
- 7.2 Identify causes of constant, intermittent, or no horn operation; determine needed action
- 7.3 Inspect and test horn circuit relays, horns, switches, connectors, wires, and control components/modules; repair or replace as needed
- 7.4 Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, wires and control components/modules; repair or replace as needed
- 7.5 Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed
- 7.6 Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed
- 7.7 Inspect and test side view mirror motors, heater circuit grids, relays, switches, connectors, terminals, wires and control components/modules; repair or replace as needed
- 7.8 Inspect and test heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed
- 7.9 Inspect and test auxiliary power outlet, integral fuse, connectors, terminals, wires, and control components/modules; repair or replace as needed
- 7.10 Identify causes of slow, intermittent, or no power side window operation; determine needed action
- 7.11 Inspect and test motors, switches, relays, connectors, terminals, wires, and control components/modules of power side window circuits; repair or replace as needed
- 7.12 Inspect and test block heaters; determine needed repairs
- 7.13 Inspect and test switches, relays, controllers, actuator/solenoids, connectors, terminals, and wires of electric door lock circuits
- 7.14 Inspect and test engine cooling fan electrical control components/modules; repair or replace as needed

**STANDARD 8.0 PERFORM ENGINE SYSTEM PM**

- 8.1 Check engine starting/operation (including unusual noises, vibrations, exhaust smoke, etc.); record idle and governed rpm
- 8.2 Inspect vibration damper
- 8.3 Inspect belts, tensioners, and pulleys; check and adjust belt tension; check belt alignment
- 8.4 Check engine oil level and condition; check dipstick seal

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- 8.5 Inspect engine mounts for looseness and deterioration
- 8.6 Check engine for oil, coolant, air, fuel, and exhaust leaks (Engine Off and Running)
- 8.7 Check engine compartment wiring harnesses, connectors, and seals for damage and proper routing

**STANDARD 9.0 PERFORM FUEL SYSTEM PM**

- 9.1 Check fuel tanks, mountings, lines, caps, and vents
- 9.2 Drain water from fuel system
- 9.3 Service water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system

**STANDARD 10.0 PERFORM AIR INDUCTION AND EXHAUST SYSTEM PM**

- 10.1 Check exhaust system mountings for looseness and damage
- 10.2 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
- 10.3 Check air induction system: piping, charge air cooler, hoses, clamps, and mountings; check for air restrictions and leaks
- 10.4 Inspect turbocharger for leaks; check mountings and connections
- 10.5 Check operation of engine compression/exhaust brake
- 10.6 Service or replace air filter as needed; check and reset air filter restriction indicator
- 10.7 Inspect and service crankcase ventilation system

**STANDARD 11.0 PERFORM COOLING SYSTEM PM**

- 11.1 Check operation of fan clutch
- 11.2 Inspect radiator (including air flow restriction, leaks, and damage) and mountings
- 11.3 Inspect fan assembly and shroud
- 11.4 Pressure test cooling system and radiator cap
- 11.5 Inspect coolant hoses and clamps
- 11.6 Inspect coolant recovery system
- 11.7 Check coolant for contamination, additive package concentration, and protection level (freeze point)
- 11.8 Service coolant filter
- 11.9 Inspect water pump for leaks and bearing play

**STANDARD 12.0 PERFORM LUBRICATION SYSTEM PM**

- 12.1 Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs
- 12.2 Take an engine oil sample

**STANDARD 13.0 PERFORM INSTRUMENTS AND CONTROLS PM**

- 13.1 Inspect key condition and operation of ignition switch
- 13.2 Check warning indicators
- 13.3 Check instruments; record oil pressure and system voltage
- 13.4 Check operation of electronic power take off (PTO) and engine idle speed controls (if applicable)
- 13.5 Check HVAC controls
- 13.6 Check operation of all accessories
- 13.7 Using diagnostic tool 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)

**STANDARD 14.0 PERFORM SAFETY EQUIPMENT PM**

- 14.1 Check operation of electric/air horns and reverse warning devices
- 14.2 Check condition of spare fuses, triangles, fire extinguisher, and all required decals
- 14.3 Inspect seat belts and sleeper restraints
- 14.4 Inspect wiper blades and arms

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**STANDARD 15.0 PERFORM CAB HARDWARE PM**

- 15.1 Check operation of wiper and washer
- 15.2 Inspect windshield glass for cracks or discoloration; check sun visor
- 15.3 Check seat condition, operation, and mounting
- 15.4 Check door glass and window operation
- 15.5 Inspect steps and grab handles
- 15.6 Inspect mirrors, mountings, brackets, and glass
- 15.7 Record all observed physical damage
- 15.8 Lubricate all cab and hood grease fittings
- 15.9 Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables
- 15.10 Inspect cab mountings, hinges, latches, linkages and ride height; service as needed

**STANDARD 16.0 PERFORM HEATING, VENTILATION, & AIR CONDITIONING (HVAC) SYSTEM PM**

- 16.1 Inspect A/C condenser and lines for condition and visible leaks; check mountings
- 16.2 Inspect A/C compressor and lines for condition and visible leaks; check mountings
- 16.3 Check A/C system condition and operation; check A/C monitoring system, if applicable
- 16.4 Check HVAC air inlet filters and ducts; service as needed

**STANDARD 17.0 PERFORM BATTERY AND STARTING SYSTEM PM**

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

**STANDARD 18.0 PERFORM CHARGING SYSTEM PM**

- 18.1 Inspect alternator, mountings, cable, wiring, and wiring routing; determine needed action
- 18.2 Perform alternator output tests

**STANDARD 19.0 PERFORM LIGHTING SYSTEM PM**

- 19.1 Check operation of interior lights; determine needed action
- 19.2 Check all exterior lights, lenses, reflectors, and conspicuity tape; check headlight alignment; determine needed action
- 19.3 Inspect and test tractor-to-trailer multi-wire connector(s), cable(s), and holder(s); determine needed action

**STANDARD 20.0 PERFORM AIR BRAKE SYSTEM PM**

- 20.1 Check operation of parking brake
- 20.2 Record air governor cut-out setting (psi)
- 20.3 Check operation of air reservoir/tank drain valves
- 20.4 Check air system for leaks (brakes released)
- 20.5 Check air system for leaks (brakes applied)
- 20.6 Test one-way and double-check valves
- 20.7 Check low air pressure warning devices
- 20.8 Check air governor cut-in pressure
- 20.9 Check emergency (spring) brake control/modulator valve, if applicable
- 20.10 Check tractor protection valve
- 20.11 Test air pressure build-up time
- 20.12 Inspect coupling air lines, holders, and glad hands
- 20.13 Check brake chambers and air lines for secure mounting and damage
- 20.14 Check operation of air drier
- 20.15 Inspect and record brake shoe/pad condition, thickness, and contamination

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- 20.16 Inspect and record condition of brake drums/rotors
- 20.17 Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing
- 20.18 Check operation and adjustment of brake automatic slack adjusters (ASA); check and record push rod stroke
- 20.19 Lubricate all brake component grease fittings
- 20.20 Check condition and operation of hand brake (trailer) control valve
- 20.21 Perform antilock brake system (ABS) operational system self-test
- 20.22 Drain air tanks and check for contamination
- 20.23 Check condition of pressure relief (safety) valves

**STANDARD 21.0 PERFORM HYDRAULIC BRAKE SYSTEM PM**

- 21.1 Check master cylinder fluid level and condition
- 21.2 Inspect brake lines, fittings, flexible hoses, and valves for leaks and damage
- 21.3 Check parking brake operation; inspect parking brake application and holding devices; adjust as needed
- 21.4 Check operation of hydraulic system: pedal travel, pedal effort, pedal feel (drift)
- 21.5 Inspect calipers for leakage and damage
- 21.6 Inspect brake assist system (booster), hoses and control valves; check reservoir fluid level and condition
- 21.7 Inspect and record brake lining/pad condition, thickness, and contamination
- 21.8 Inspect and record condition of brake rotors
- 21.9 Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing

**STANDARD 22.0 PERFORM DRIVE TRAIN PM**

- 22.1 Check operation of clutch, clutch brake, and gearshift
- 22.2 Check clutch linkage/cable for looseness or binding, if applicable
- 22.3 Check hydraulic clutch slave and master cylinders, lines, fittings, and hoses, if applicable
- 22.4 Check clutch adjustment; adjust as needed
- 22.5 Check transmission case, seals, filter, hoses, and cooler for cracks and leaks
- 22.6 Inspect transmission breather
- 22.7 Inspect transmission mounts
- 22.8 Check transmission oil level, type, and condition
- 22.9 Inspect U-joints, yokes, driveshafts, boots/seals, center bearings, and mounting hardware for looseness, damage, and proper phasing
- 22.10 Inspect axle housing(s) for cracks and leaks
- 22.11 Inspect axle breather(s)
- 22.12 Lubricate all drive train grease fittings
- 22.13 Check drive axle(s) oil level, type, and condition
- 22.14 Change drive axle(s) oil and filter; check and clean magnetic plugs
- 22.15 Check transmission wiring, connectors, seals, and harnesses for damage and proper routing
- 22.16 Change transmission oil and filter; check and clean magnetic plugs
- 22.17 Check interaxle differential lock operation
- 22.18 Check range shift operation

**STANDARD 23.0 PERFORM SUSPENSION AND STEERING SYSTEMS PM**

- 23.1 Check steering wheel operation for free play or binding
- 23.2 Check power steering pump, mounting, and hoses for leaks, condition, and routing; check fluid level
- 23.3 Change power steering fluid and filter
- 23.4 Inspect steering gear for leaks and secure mounting
- 23.5 Inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, and linkages
- 23.6 Check kingpin for wear
- 23.7 Check wheel bearings for looseness and noise
- 23.8 Check oil level and condition in all non-drive hubs; check for leaks
- 23.9 Inspect springs, pins, hangers, shackles, spring U-bolts, and insulators
- 23.10 Inspect shock absorbers for leaks and secure mounting

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- 23.11 Inspect shock absorbers for leaks and secure mounting
- 23.12 Check and record suspension ride height
- 23.13 Lubricate all suspension and steering grease fittings
- 23.14 Check toe setting
- 23.15 Check tandem axle alignment and spacing
- 23.16 Check axle locating components (radius, torque, and/or track rods)

**STANDARD 24.0 PERFORM TIRE AND WHEEL PM**

- 24.1 Inspect tires for wear patterns and proper mounting
- 24.2 Inspect tires for cuts, cracks, bulges, and sidewall damage
- 24.3 Inspect valve caps and stems; replace as needed
- 24.4 Measure and record tread depth; probe for imbedded debris
- 24.5 Check and record air pressure; adjust air pressure in accordance with manufacturers' specifications
- 24.6 Check for loose lugs; check mounting hardware condition; service as needed
- 24.7 Retorque lugs in accordance with manufacturers' specifications
- 24.8 Inspect wheels for cracks or damage
- 24.9 Check tire matching (diameter and tread) on dual tire installations

**STANDARD 25.0 PERFORM FRAME AND FIFTH WHEEL PM**

- 25.1 Inspect fifth wheel mounting, bolts, air lines, and locks
- 25.2 Test operation of fifth wheel locking device; adjust if necessary
- 25.3 Check quarter fenders, mud flaps, and brackets
- 25.4 Check pintle hook assembly and mounting
- 25.5 Inspect frame and frame members for cracks and damage

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