

## TASK LIST AND ASSUMPTIONS

The NATEF task list was reviewed and updated in November 2007. A national committee was assembled in Herndon, Virginia to review the standards used in the Medium/Heavy Truck accreditation program. The committee consisted of individuals representing the major truck manufacturers, truck repair shop owners and technicians, truck instructors and trainers, and truck equipment and parts suppliers.

The committee reviewed the task list, tools and equipment list, program hours, and instructor qualifications. The committee also had the most current National Institute for Automotive Service Excellence (ASE) truck task lists for reference purposes.

All the tasks are assigned a priority number: P-1, P-2, or P-3. Please refer to the Task List Information in the Policies section and Standard 6.5 for additional information on the requirements for instruction on tasks.

Theory instruction and hands-on performance of all the basic tasks will provide initial training for **entry-level** employment in the Medium/Heavy Truck service field or further training in any, or all of the specialty areas. Competency in these tasks will indicate to employers that the graduate is skilled in that area.

1. It is assumed that:

- \* in all areas, appropriate theory, safety, and support instruction will be required in the performance of each task;
- \* this instruction includes identification and use of the appropriate tools and testing and measurement equipment required to accomplish certain tasks;
- \* the student has received the necessary training to locate and use current reference and training materials from accepted industry resources (paper and electronic formats).

2. It is assumed that:

- \* all diagnostic and repair tasks described in this document will be accomplished and verified in accordance with manufacturers' recommended procedures and industry accepted standards/practices.

3. It is assumed that:

- \* individual training programs being evaluated for accreditation will have written and detailed performance standards for each task covered and taught in the curriculum (Standard 6.7);
- \* the learning progress of students will be monitored and evaluated against these performance standards;

- \* a system is in place which informs all students of their individual progress through all phases of the training program (Standard 6.6).
4. It is assumed that:
- \* individual courses of study will differ across medium/heavy truck technician training programs;
  - \* development of appropriate learning delivery systems and tests which monitor student progress will be the responsibility of the individual training program.
5. It is assumed that:
- \* all students will receive instruction in the storage, handling, and use of Hazardous Materials in accordance with Hazard Communication Title 29, Code of Federal Regulation Part 1910.1200, the 'Right to Know Law', and state and local requirements;
  - \* hazardous and toxic materials will be handled, removed, and recycled or disposed of according to federal, state, and local regulations.
6. It is assumed that:
- \* any tool requiring calibration will be calibrated according to the manufacturer's specifications periodically or as needed.
7. It is assumed that:
- \* students are given instruction in communication techniques with the customer.
8. It is assumed that:
- \* all students will be instructed in and will practice recommended precautions when handling electro-static sensitive devices.

**Note:** *The Technology and Maintenance Council (TMC) of the American Trucking Association (ATA) publishes a "Recommended Maintenance Practices Manual" as a resource for industry practices. Contact the TMC at [www.trucking.org](http://www.trucking.org) for more information.*

## **DEFINITIONS – TECHNICAL TERMS**

**ADD** – To increase fluid or pressure to the correct level or amount.

**ADJUST** – To bring components to specified operational settings.

**AIR TEST** – To use air pressure to determine proper action of components.

**ALIGN** – To bring to precise alignment or relative position of components.

**ANALYZE** – To examine the relationship of components of an operation.

**ASSEMBLE (REASSEMBLE)** – To fit together the components of a device.

**BALANCE** – To establish correct linear, rotational or weight relationship.

**BLEED** – To remove air from a closed system.

**CHARGE** – To bring to "full" state; e.g., battery or air conditioning system.

**CHECK** – To verify condition by performing an operational or comparative examination.

**CLEAN** – To rid component of extraneous matter for the purpose of reconditioning, repairing, measuring or reassembling.

**DATA** – Factual information, especially organized for analysis or used to reason or make decisions. Also, numerical or other information represented in a form suitable for processing by computer.

**DEGLAZE** – To restore correct surface finish.

**DETERMINE** – To establish the procedure to be used to effect the necessary repair.

**DETERMINE NECESSARY ACTION** – Indicates that the diagnostic routine(s) is the primary emphasis of a task. The student is required to perform the diagnostic steps and communicate the diagnostic outcomes and corrective actions required addressing the concern or problem. The training program determines the communication method (worksheet, test, verbal communication, or other means deemed appropriate) and whether the corrective procedures for these tasks are actually performed.

**DIAGNOSE** – To locate the root cause or nature of a problem by using the specified procedure.

**DISASSEMBLE** – To separate a component's parts as a preparation for cleaning, inspection, or service.

DISCHARGE – To empty a storage device or system; e.g. static electricity release, battery, or air conditioning system.

DRAIN – To use gravity to empty a container.

EVACUATE – To remove air, fluid or vapor from a closed system by use of a vacuum pump.

FILL (REFILL) – To bring fluid level to specified point or volume.

FIND – To locate a particular problem, e.g. shorts, grounds or opens in an electrical circuit.

FLUSH – To use a fluid to clean an internal system.

HONE – To restore, resize or bore by using rotating cutting stones.

IDENTIFY – To establish the identity of a vehicle or component prior to service; to determine the nature or degree of a problem.

INDICATE – To show as by measuring or recording such as a thermometer. Also, to point out or direct attention to a condition.

INSPECT – (See CHECK)

INSTALL (REINSTALL) – To place a component in its proper position in a system.

INTERFACE – To establish a communications link between an electronic control module and a diagnostic tool or computer.

ISOLATE – A technique where a component or system may be separated from the rest of the component or system.

JUMP START – To use an auxiliary power supply, i.e. battery, battery charger, etc. to assist a vehicle's battery to crank an engine.

LEAK TEST – To locate the source of leaks in a component or system.

LISTEN – To use audible clues in the diagnostic process; to hear the customer's description of a particular problem.

LOAD TEST – The process of creating demand on a system or device and measuring its Response.

LUBRICATE – To employ the correct procedures and materials in performing the prescribed lubrication service.

MEASURE – To compare existing dimensions to specified dimensions by the use of calibrated instruments and gauges.

MOUNT – To attach or place tool or component in proper position.

OBSERVE – To watch, view, or note for a specific purpose.

PERFORM – To accomplish a procedure presented in a single task, at least one of the scenarios must be accomplished.

PERFORM NECESSARY ACTION – Indicates that the student is to perform the diagnostic routine(s) and perform the corrective action item. Where various scenarios (conditions or situations) are presented in a single task, at least one of the scenarios must be accomplished.

PRESSURE TEST – To use air or fluid pressure to determine the condition or operation of a component or system.

PRIORITY RATINGS – Indicates the minimum percentage of tasks, by area, a program must include in its curriculum in order to be accredited in that area.

PURGE – To eliminate an undesired air or fluid from a closed system.

READY – To prepare a system or component for service, installation or operation.

REASSEMBLE – (SEE ASSEMBLE)

RECOVER – To remove a substance, in any condition, from a system and store it in an external container.

REFILL – (SEE FILL)

REINSTALL – (SEE INSTALL)

REMOVE – To disconnect and separate a component from a system.

REPAIR – To restore a malfunctioning component or system to operating condition.

REPLACE – To exchange an unserviceable component with a new or rebuilt component; to reinstall a component.

RESET (SET) – To adjust a variable component to a given, usually initial, specification.

SCAN – To read (data) for use by a computer or computerized device.

**SELECT** – To choose the correct part or setting during assembly or adjustment.

**SERVICE** – To perform a specified procedure when called for in the owner's or service manual.

**TEST** – To verify condition through the use of meters, gauges or instruments.

**TIME** – To adjust the timed relationship between the injection and/or ignition cycle(s) and engine cycle; or to set the operating relationship between two or more components or systems.

**TRIM** – (SEE ADJUST)

**TORQUE** – To tighten a fastener to specified degree or tightness (in a given order or pattern if multiple fasteners are involved on a single component).

**VACUUM TEST** – To determine the integrity and operation of a vacuum (negative pressure) operated component and/or system.

**VERIFY** – To establish that a problem exists after hearing the customer's complaint and performing a preliminary diagnosis; or to confirm that completed repairs address the customer complaint or problem.

# NATEF TASK LIST

## DIESEL ENGINES

**For every task in Diesel Engines, the following safety task must be strictly enforced:**

**Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.**

**The first task in Diesel Engines is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.**

### I. DIESEL ENGINES

#### A. General

1. Inspect fuel, oil, and coolant levels, and condition, ; determine needed action. P-1
2. Identify the causes of engine fuel, oil, coolant, air, and other leaks; determine needed action. P-1
3. Listen for engine noises; determine needed action. P-3
4. Observe engine exhaust smoke color and quantity; determine needed action. P-3
5. Identify causes of no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action. P-1
6. Identify causes of surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action. P-1
7. Identify engine vibration problems; determine needed action. P-2
8. Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; verify customer programmable parameters; clear codes; determine further diagnosis. P-1

## **B. Cylinder Head and Valve Train**

1. Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly. P-1
2. Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action. P-1
3. Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action. P-1
4. Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action. P-3
5. Measure valve head height relative to deck and valve face-to-seat contact; determine needed action. P-3
6. Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; determine needed action. P-3
7. Inspect valve train components; determine needed action. P-1
8. Reassemble cylinder head. P-3
9. Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash. P-2
10. Inspect electronic wiring harness and brackets for wear, bending, cracks, and looseness; determine needed action. P-1
11. Adjust valve bridges (crossheads); adjust valve clearances and injector settings. P-1

## **C. Engine Block**

1. Perform crankcase pressure test; determine needed action. P-1
2. Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components. P-2



3. Disassemble, clean, and inspect engine block for cracks/damage; measure mating surfaces for warpage; check condition of passages, core/expansion and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; determine needed action. P-2
4. Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed action. P-2
5. Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action. P-2
6. Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion). P-2
7. Inspect in-block camshaft bearings for wear and damage; determine needed action. P-3
8. Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play. P-3
9. Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action. P-2
10. Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and correct crankshaft end play. P-2
11. Inspect, install, and time gear train; measure gear backlash; determine needed action. P-2
12. Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings; perform needed action. P-2
13. Determine piston-to-cylinder wall clearance; check ring-to-groove fit and end gap; install rings on pistons. P-3
14. Assemble pistons and connecting rods; install in block; install rod bearings and check clearances. P-2
15. Check condition of piston cooling jets (nozzles); determine needed action. P-2
16. Inspect and measure crankshaft vibration damper; determine needed action. P-3

17. Install and align flywheel housing; inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. P-3

18. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action. P-2

#### **D. Lubrication Systems**

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; determine needed action. P-1

2. Check engine oil level, condition, and consumption; determine needed action. P-1

3. Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; check drive gear clearances; determine needed action. P-3

4. Inspect oil pressure regulator valve(s), by-pass and pressure relief valve(s), oil thermostat, and filters; determine needed action. P-3

5. Inspect, clean, and test oil cooler and components; determine needed action. P-3

6. Inspect turbocharger lubrication and cooling systems; determine needed action. P-2

7. Determine proper lubricant and perform oil and filter change. P-1

#### **E. Cooling System**

1. Check engine coolant type, level, condition, and consumption; test coolant for freeze protection and additive package concentration; determine needed action. P-1

2. Test coolant temperature and check operation of temperature and level sensors, gauge, and/or sending unit; determine needed action. P-1

3. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment. P-1

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| 4. | Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed.                                       | P-2 |
| 5. | Recover, flush, and refill with recommended coolant/additive package; bleed cooling system.                       | P-1 |
| 6. | Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed.    | P-1 |
| 7. | Inspect water pump and hoses; replace as needed.  | P-1 |
| 8. | Inspect, clean, and pressure test radiator, pressure cap, tank(s), and recovery systems; determine needed action. | P-1 |
| 9. | Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. | P-1 |

**F. Air Induction and Exhaust Systems**

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| 1.  | Perform air intake system restriction and leakage tests; determine needed action.   | P-1 |
| 2.  | Perform intake manifold pressure (boost) test; determine needed action.   | P-1 |
| 3.  | Perform exhaust back pressure test; determine needed action.  | P-2 |
| 4.  | Inspect turbocharger(s), wastegate, and piping systems; determine needed action.  | P-2 |
| 5.  | Inspect and test turbocharger(s) (variable ratio/geometry VGT), pneumatic, hydraulic, electronic controls, and actuators. | P-3 |
| 6.  | Check air induction system: piping , hoses, clamps, and mounting; service or replace air filter as needed .               | P-1 |
| 7.  | Remove and reinstall turbocharger/wastegate assembly.   | P-3 |
| 8.  | Inspect intake manifold, gaskets, and connections; replace as needed.   | P-3 |
| 9.  | Inspect, clean, and test charge air cooler assemblies; inspect aftercooler assemblies; replace as needed.                 | P-2 |
| 10. | Inspect exhaust manifold, piping, mufflers, and mounting hardware; repair or replace as needed.                           | P-2 |

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| 11. | Inspect exhaust after treatment devices; determine necessary action.  | P-3 |
| 12. | Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action.   | P-2 |
| 13. | Inspect and test exhaust gas recirculation (EGR) system including EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determine needed action. | P-3 |

## **G. Fuel System**

### **1. Fuel Supply System**

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| 1. | Check fuel level, and condition; determine needed action.  | P-1 |
| 2. | Perform fuel supply and return system tests; determine needed action.  | P-1 |
| 3. | Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determine needed action.   | P-1 |
| 4. | Inspect, clean, and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates, and mounting hardware; determine needed action. | P-1 |
| 5. | Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determine needed action.  | P-1 |
| 6. | Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump.  | P-1 |

### **2. Electronic Fuel Management System**

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| 1. | Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage, and resistance readings using a digital multimeter (DMM); determine needed action.                 | P-1 |
| 2. | Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine needed action. | P-1 |
| 3. | Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; clear codes; determine further diagnosis.  | P-1 |
| 4. | Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams).   | P-1 |

5. Inspect and replace electrical connector terminals, seals, and locks. P-1
6. Inspect and test switches, sensors, controls, actuator components, and circuits; adjust or replace as needed. P-1
7. Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), access and interpret customer programmable parameters. P-2
8. Inspect, test, and adjust electronic unit injectors (EUI); determine needed action. P-2
9. Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable). P-2
10. Perform cylinder contribution test utilizing recommended electronic diagnostic tool. P-1
11. Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action. P-2
12. Perform on-engine inspections and tests on hydraulic electronic unit injector high pressure oil supply and control systems; determine needed action. P-2
13. Perform on-engine inspections and tests on common rail type injection systems; determine needed action. P-3
14. Inspect high pressure injection lines, hold downs, fittings and seals; determine needed action. P-3

#### **H. Engine Brakes**

1. Inspect and adjust engine compression/exhaust brakes; determine needed action. P-3
2. Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; repair or replace as needed. P-3
3. Inspect engine compression/exhaust brake housing, valves, seals, lines, and fittings; repair or replace as needed. P-3

## DRIVE TRAIN

**For every task in Drive Train, the following safety task must be strictly enforced:**

**Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.**

**The first task in Drive Train is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.**

### II. DRIVE TRAIN

#### A. Clutch

1. Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action. P-1
2. Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push and pull-type assemblies); check pedal height and travel; perform needed action. P-1
3. Inspect, adjust, repair, or replace hydraulic clutch slave and master cylinders, lines, and hoses; bleed system. P-2
4. Inspect, adjust, lubricate, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals. P-1
5. Inspect, adjust, and replace single-disc clutch pressure plate and clutch disc. P-1
6. Inspect, adjust, and replace two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs. P-1
7. Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; perform needed action. P-1
8. Inspect, adjust, and replace self-adjusting/continuous-adjusting clutch mechanisms. P-1
9. Inspect and replace pilot bearing. P-2

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| 10. | Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play; determine needed action.                              | P-2 |
| 11. | Inspect flywheel, starter ring gear and measure flywheel face and pilot bore runout; determine needed action.  | P-2 |
| 12. | Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action. | P-2 |

**B. Transmission**

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|-----|---|-----|
| 1.  | Identify causes of transmission noise, shifting, lockup, jumping-out-of-gear, overheating, and vibration problems; determine needed action.                       | P-1 |
| 2.  | Inspect, test, repair, or replace air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies.   | P-2 |
| 3.  | Inspect and replace transmission mounts, insulators, and mounting bolts.  | P-1 |
| 4.  | Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; repair as needed.                      | P-1 |
| 5.  | Check transmission fluid level and condition; determine needed service; add proper type of lubricant.   | P-1 |
| 6.  | Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires. | P-2 |
| 7.  | Remove and reinstall transmission.  | P-1 |
| 8.  | Inspect input shaft, gear, spacers, bearings, retainers, and slingers; determine needed action.   | P-3 |
| 9.  | Inspect transmission oil filters and coolers; replace as needed.  | P-2 |
| 10. | Inspect speedometer components; determine needed action.  | P-2 |
| 11. | Inspect and adjust power take-off (P.T.O.) assemblies, controls, and shafts; determine needed action.   | P-3 |
| 12. | Inspect and test function of reverse light, neutral start, and warning device circuits; determine needed action.  | P-1 |

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| 13. | Inspect and test transmission temperature gauge and sensor/sending unit; determine needed action.   | P-2 |
| 14. | Inspect and test operation of automated mechanical transmission and manual electronic shift controls, shift, range and splitter solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses; determine needed action. | P-2 |
| 15. | Inspect and test operation of automated mechanical transmission electronic shift selectors, air and electrical switches, displays and indicators, wiring harnesses, and air lines; determine needed action  | P-2 |
| 16. | Use appropriate diagnostic tools and procedures to diagnose automated mechanical transmission problems; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed action.   | P-1 |
| 17. | Inspect and test operation of automatic transmission electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.  | P-3 |
| 18. | Inspect and test operation of automatic transmission electronic shift selectors, switches, displays and indicators, wiring harnesses.   | P-3 |
| 19. | Use appropriate diagnostic tools and procedures to diagnose automatic transmission problems; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed action.  | P-3 |

**C. Driveshaft and Universal Joint**

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| 1. | Identify causes of driveshaft and universal joint noise and vibration problems; determine needed action.   | P-1 |
| 2. | Inspect, service, or replace driveshaft, slip joints, yokes, drive flanges, and universal joints, driveshaft boots and seals, and retaining hardware; check phasing of all shafts. | P-1 |
| 3. | Inspect driveshaft center support bearings and mounts; determine needed action.  | P-1 |
| 4. | Measure driveline angles; determine needed action.   | P-2 |



## **D. Drive Axle**

1. Identify causes of drive axle(s) drive unit noise and overheating problems; determine needed action. P-2
2. Check and repair fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals. P-1
3. Check drive axle fluid level and condition; determine needed service; add proper type of lubricant. P-1
4. Remove and replace differential carrier assembly. P-2
5. Inspect and replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings. P-3
6. Inspect and replace components of locking differential case assembly. P-3
7. Inspect differential carrier housing and caps, side bearing bores, and pilot (spigot, pocket) bearing bore; determine needed action. P-3
8. Measure ring gear runout; determine needed action. P-3
9. Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cages, and bearings. P-3
10. Measure and adjust drive pinion bearing preload. P-3
11. Measure and adjust drive pinion depth. P-3
12. Measure and adjust side bearing preload and ring gear backlash. P-3
13. Check and interpret ring gear and pinion tooth contact pattern; determine needed action. P-3
14. Inspect, adjust, or replace ring gear thrust block/screw. P-3
15. Inspect power divider (inter-axle differential) assembly; determine needed action. P-3
16. Inspect, adjust, repair, or replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls. P-2

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| 17. | Inspect, repair, or replace drive axle lubrication system: pump, troughs, collectors, slingers, tubes, and filters.   | P-3 |
| 18. | Inspect and replace drive axle shafts.  | P-1 |
| 19. | Remove and replace wheel assembly; check rear wheel seal and axle flange gasket for leaks; perform needed action.   | P-1 |
| 20. | Identify causes of drive axle wheel bearing noise and check for damage; perform needed action.  | P-1 |
| 21. | Inspect and test drive axle temperature gauge and sending unit/sensor; determine needed action.   | P-2 |
| 22. | Clean, inspect, lubricate and replace wheel bearings; replace seals and wear rings; inspect and replace retaining hardware; adjust drive axle wheel bearings. | P-1 |

## **BRAKES**

**For every task in Brakes, the following safety task must be strictly enforced:**

**Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.**

**The first task in Brakes is to listen to and verify the operator’s concern, review past maintenance and repair documents, and determine necessary action.**

### **III. BRAKES**

#### **A. Air Brakes**

##### **1. Air Supply and Service Systems**

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|----|--|-----|
| 1. | Identify poor stopping, air leaks, premature wear, pulling, grabbing, dragging, or balance problems caused by supply and service system malfunctions; determine needed action. | P-1 |
| 2. | Check air system build-up time; determine needed action.   | P-1 |

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| 3.  | Drain air reservoir/tanks; check for oil, water, and foreign material; determine needed action.   | P-1 |
| 4.  | Inspect compressor drive gear and coupling; replace as needed.  | P-3 |
| 5.  | Inspect air compressor inlet;; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed.                                    | P-2 |
| 6.  | Inspect and test air system pressure controls: governor, unloader assembly valves, filters, lines, hoses, and fittings; adjust or replace as needed.                  | P-1 |
| 7.  | Inspect air system lines, hoses, fittings, and couplings; repair or replace as needed.  | P-1 |
| 8.  | Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check valves, manual and automatic drain valves; replace as needed. | P-1 |
| 9.  | Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed.   | P-1 |
| 10. | Inspect and test brake application (foot) valve, fittings, and mounts; check pedal operation; replace as needed.  | P-1 |
| 11. | Inspect and test stop light circuit switches, wiring, and connectors; repair or replace as needed.  | P-1 |
| 12. | Inspect and test hand brake (trailer) control valve, lines, fittings, and mountings; repair or replace as needed.   | P-1 |
| 13. | Inspect and test brake relay valves; replace as needed.   | P-1 |
| 14. | Inspect and test quick release valves; replace as needed.   | P-1 |
| 15. | Inspect and test tractor protection valve; replace as needed.   | P-1 |
| 16. | Inspect and test emergency (spring) brake control/modulator valve(s); replace as needed.  | P-1 |
| 17. | Inspect and test low pressure warning devices, wiring, and connectors; repair or replace as needed.   | P-1 |
| 18. | Inspect and test air pressure gauges, lines, and fittings; replace as needed.   | P-2 |

## 2. Mechanical/Foundation

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. P-1
2. Inspect and test service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed. P-1
3. Inspect and service slack adjusters; perform needed action. P-1
4. Inspect camshafts, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; replace as needed. P-1
5. Inspect, clean, and adjust air disc brake caliper assemblies; determine needed repairs. P-3
6. Inspect and measure brake shoes or pads; perform needed action. P-1
7. Inspect and measure brake drums or rotors; perform needed action. P-1

## 3. Parking Brakes

1. Inspect and test parking (spring) brake chamber diaphragm and seals; replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations. P-1
2. Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed. P-1
3. Inspect and test parking (spring) brake application and release valve; replace as needed. P-2
4. Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations. P-1

## B. Hydraulic Brakes

### 1. Hydraulic System

1. Identify poor stopping, premature wear, pulling, dragging, balance, or pedal feel problems caused by the hydraulic system; determine needed action. P-2
2. Check brake pedal pushrod length; adjust as needed. P-3

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|----|--|-----|
| 3. | Inspect and test master cylinder for internal/external leaks and damage; replace as needed.  | P-2 |
| 4. | Inspect hydraulic system brake lines, flexible hoses, and fittings for leaks and damage; replace as needed.                                      | P-2 |
| 5. | Inspect and test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; replace as needed.                      | P-3 |
| 6. | Inspect and test brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors; repair or replace as needed. | P-2 |
| 7. | Inspect disc brake caliper assemblies; replace as needed.  | P-2 |
| 8. | Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type.  | P-2 |

## **2. Mechanical/Foundation**

- |    |  |     |
|----|--|-----|
| 1. | Identify poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by mechanical components; determine needed action. | P-2 |
| 2. | Inspect and measure rotors; perform needed action.   | P-2 |
| 3. | Inspect and measure disc brake pads; inspect mounting hardware; perform needed action.   | P-2 |
| 4. | Check parking brake operation; inspect parking brake application and holding devices; adjust and replace as needed.  | P-2 |

## **3. Power Assist Units**

- |    |   |     |
|----|---|-----|
| 1. | Identify stopping problems caused by the brake assist (booster) system; determine needed action.                            | P-3 |
| 2. | Inspect, test, repair, or replace hydraulic brake assist (booster), hoses, and control valves; determine proper fluid type. | P-3 |
| 3. | Check emergency (back-up, reserve) brake assist system.   | P-3 |

### **C. Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC)**

- |    |  |     |
|----|--|-----|
| 1. | Observe antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action.  | P-1 |
| 2. | Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action.      | P-1 |
| 3. | Identify poor stopping and wheel lock-up problems caused by failure of the antilock brake system (ABS); determine needed action.   | P-1 |
| 4. | Test and check operation of antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action.  | P-1 |
| 5. | Test antilock brake system (ABS) wheel speed sensors and circuits ; adjust or replace as needed.   | P-1 |
| 6. | Bleed the ABS hydraulic circuits following manufacturers' procedures.  | P-2 |
| 7. | Observe automatic traction control (ATC) warning light operation; determine needed action.   | P-3 |
| 8. | Diagnose automatic traction control (ATC) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, PC computer); determine needed action. | P-3 |

### **D. Wheel Bearings**

- |    |   |     |
|----|---|-----|
| 1. | Clean, inspect, lubricate and replace wheel bearings and races/cups; replace seals and wear rings; inspect spindle/tube; inspect and replace retaining hardware; adjust wheel bearings. | P-1 |
| 2. | Inspect or replace extended service wheel bearing assemblies.   | P-3 |

## SUSPENSION AND STEERING

**For every task in Suspension and Steering, the following safety task must be strictly enforced:**

**Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.**

**The first task in Suspension and Steering is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.**

### IV. SUSPENSION AND STEERING

#### A. Steering Systems

##### 1. Steering Column

- |    |   |     |
|----|---|-----|
| 1. | Identify causes of fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determine needed action. | P-1 |
| 2. | Inspect and service steering shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft..                                  | P-1 |
| 3. | Check and adjust cab mounting and ride height.  | P-3 |
| 4. | Center the steering wheel as needed.  | P-1 |
| 5. | Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' procedures.                                      | P-1 |

##### 2. Steering Units

- |    |   |     |
|----|---|-----|
| 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. | P-1 |
| 2. | Determine recommended type of power steering fluid; check level and condition; determine needed action.   | P-1 |
| 3. | Flush and refill power steering system; purge air from system.  | P-2 |

- |    |  |     |
|----|--|-----|
| 4. | Perform power steering system pressure, temperature, and flow tests; determine needed action.                  | P-2 |
| 5. | Inspect, service, or replace power steering reservoir including filter, seals, and gaskets.                    | P-2 |
| 6. | Inspect power steering pump drive gear and coupling; replace as needed.  | P-3 |
| 7. | Inspect, adjust, or replace power steering pump, mountings, and brackets.                                      | P-3 |
| 8. | Inspect and replace power steering system cooler, lines, hoses, clamps/mountings, hose routings, and fittings. | P-2 |
| 9. | Inspect, adjust, repair, or replace integral type power steering gear(s) (single and/or dual) and mountings.   | P-1 |

### **3. Steering Linkage**

- |    |   |     |
|----|---|-----|
| 1. | Inspect and align pitman arm; replace as needed.  | P-1 |
| 2. | Check and adjust steering (wheel) stops.          | P-1 |
| 3. | Inspect and lubricate steering arms and linkages. | P-1 |

### **B. Suspension Systems**

- |    |  |     |
|----|--|-----|
| 1. | Inspect front axles and attaching hardware; determine needed action.   | P-1 |
| 2. | Inspect and service kingpin, steering knuckle bushings, locks, bearings, seals, and covers; determine needed action.   | P-1 |
| 3. | Inspect shock absorbers, bushings, brackets, and mounts; replace as needed.  | P-1 |
| 4. | Inspect leaf springs, center bolts, clips, pins and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action.                     | P-1 |
| 5. | Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, torque arms, related bushings, mounts, shims, and cams; determine needed action. | P-1 |
| 6. | Inspect tandem suspension equalizer components; determine needed action.   | P-3 |



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|-----|---|-----|
| 7.  | Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjust, repair or replace as needed. | P-1 |
| 8.  | Inspect air springs, mounting plates, springs, suspension arms, and bushings; replace as needed.  | P-1 |
| 9.  | Measure ride height; determine needed action.   | P-1 |
| 10. | Identify rough ride problems; determine needed action.  | P-3 |

**C. Wheel Alignment Diagnosis, Adjustment, and Repair**

- |    |   |     |
|----|---|-----|
| 1. | Identify causes of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problems; adjust or repair as needed. | P-1 |
| 2. | Check camber; determine needed action.  | P-2 |
| 3. | Check caster; adjust as needed.   | P-2 |
| 4. | Check toe; adjust as needed.  | P-1 |
| 5. | Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed.  | P-2 |
| 6. | Identify turning/Ackerman angle (toe-out-on-turns) problems; determine needed action.   | P-3 |
| 7. | Check front axle alignment (centerline); adjust or repair as needed.  | P-2 |

**D. Wheels and Tires**

- |    |   |     |
|----|---|-----|
| 1. | Identify tire wear patterns, check tread depth and pressure determine needed action.                          | P-1 |
| 2. | Identify wheel/tire vibration, shimmy, pounding, hop (tramp) problems; determine needed action.               | P-2 |
| 3. | Remove and install steering and drive axle wheel/tire assemblies.   | P-1 |
| 4. | Inspect tire for proper application, (size, load range, position, and tread design); determine needed action. | P-3 |
| 5. | Inspect wheel/rims for proper application, load range, size, and design; determine needed action.             | P-3 |

6. Check operation of tire pressure monitoring system; determine needed action. P-3

### **E. Frame and Coupling Devices**

1. Inspect, service, and/or adjust fifth wheel, pivot pins, bushings, locking mechanisms, and mounting hardware. P-2
2. Inspect and service sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls. P-2
3. Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed repairs. P-1
4. Inspect, install, or repair frame hangers, brackets, and cross members in accordance with manufacturers' recommended procedures. P-3
5. Inspect, repair, or replace pintle hooks and draw bars. P-3

## **ELECTRICAL/ELECTRONIC SYSTEMS**

**For every task in Electrical/Electronic Systems, the following safety task must be strictly enforced:**

**Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.**

**The first task in Electrical/Electronic Systems is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.**

## **V. ELECTRICAL/ELECTRONIC SYSTEMS**

### **A. General Electrical Systems**

1. Read and interpret electrical/electronic circuits using wiring diagrams. P-1
2. Check continuity in electrical/electronic circuits using appropriate test equipment. P-1
3. Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using appropriate test equipment. P-1

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|-----|--|-----|
| 4.  | Check current flow in electrical/electronic circuits and components using appropriate test equipment.      | P-1 |
| 5.  | Check resistance in electrical/electronic circuits and components using appropriate test equipment.        | P-1 |
| 6.  | Locate shorts, grounds, and opens in electrical/electronic circuits.                                       | P-1 |
| 7.  | Identify parasitic (key-off) battery drain problems; perform tests; determine needed action.               | P-1 |
| 8.  | Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed.         | P-1 |
| 9.  | Inspect and test spike suppression devices; replace as needed.   | P-3 |
| 10. | Check frequency and pulse width signal in electrical/electronic circuits using appropriate test equipment. | P-3 |

**B. Battery**

- |    |  |     |
|----|--|-----|
| 1. | Perform battery load test; determine needed action.  | P-1 |
| 2. | Determine battery state of charge using an open circuit voltage test.  | P-1 |
| 3. | Inspect, clean, and service battery; replace as needed.  | P-1 |
| 4. | Inspect and clean battery boxes, mounts, and hold downs; repair or replace as needed.  | P-1 |
| 5. | Charge battery using slow or fast charge method as appropriate.  | P-1 |
| 6. | Inspect, test, and clean battery cables and connectors; repair or replace as needed.   | P-1 |
| 7. | Jump start a vehicle using jumper cables and a booster battery or appropriate auxiliary power supply using proper safety procedures. | P-1 |
| 8. | Perform battery capacitance test; determine needed action.   | P-2 |

**C. Starting System**

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|----|---|-----|
| 1. | Perform starter circuit cranking voltage and voltage drop tests; determine needed action. | P-1 |
|----|---|-----|

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|----|---|-----|
| 2. | Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed. | P-2 |
| 3. | Inspect and test, starter relays and solenoids/switches; replace as needed.   | P-2 |
| 4. | Remove and replace starter; inspect flywheel ring gear or flex plate.   | P-2 |

**D. Charging System Diagnosis and Repair**

- |    |   |     |
|----|---|-----|
| 1. | Test instrument panel mounted volt meters and/or indicator lamps; determine needed action.  | P-1 |
| 2. | Identify causes of a no charge, low charge, or overcharge problems; determine needed action.  | P-1 |
| 3. | Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment. | P-1 |
| 4. | Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action.                           | P-1 |
| 5. | Perform charging circuit voltage drop tests; determine needed action.   | P-1 |
| 6. | Remove and replace alternator.  | P-2 |
| 7. | Inspect, repair, or replace cables, wires, and connectors in the charging circuit.  | P-2 |

**E. Lighting Systems**

- |    |  |     |
|----|--|-----|
| 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. | P-1 |
| 2. | Identify causes of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation.   | P-1 |
| 3. | Test, aim, and replace headlights.   | P-1 |
| 4. | Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components/modules; repair or replace as needed.  | P-1 |

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|-----|---|-----|
| 5.  | 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.    | P-1 |
| 6.  | Inspect and test instrument panel light circuit switches, relays, bulbs/LEDs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed.             | P-2 |
| 7.  | Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, wires, and control components/modules; repair or replace as needed.                                    | P-2 |
| 8.  | Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed.   | P-1 |
| 9.  | Inspect, test, and adjust stoplight circuit switches, bulbs/LEDs, sockets, connectors, terminals, wires and control components/modules; repair or replace as needed.                                | P-1 |
| 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.        | P-1 |
| 11. | 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. | P-2 |

**F. Gauges and Warning Devices**

- |    |   |     |
|----|---|-----|
| 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. | P-1 |
| 2. | Identify causes of intermittent, high, low, or no gauge readings; determine needed action.  | P-2 |
| 3. | Identify causes of data bus-driven gauge malfunctions; determine needed action.   | P-3 |
| 4. | Inspect and test gauge circuit sensor/sending units, gauges, connectors, terminals, and wires; repair or replace as needed.   | P-2 |

- 5. Inspect and test warning devices (lights and audible) circuit sensor/sending units, bulbs/LEDs, sockets, connectors, wires, and control components/modules; repair or replace as needed. P-2
- 6. Inspect, test, replace, and calibrate (if applicable) electronic speedometer, odometer, and tachometer systems. P-2

**V. ELECTRICAL/ELECTRONIC SYSTEMS**

**G. Related Electrical Systems**

- 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. P-1
- 2. Identify causes of constant, intermittent, or no horn operation; determine needed action. P-2
- 3. Inspect and test horn circuit relays, horns, switches, connectors, wires, and control components/modules; repair or replace as needed. P-2
- 4. Identify causes of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action. P-2
- 5. Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, wires and control components/modules; repair or replace as needed. P-2
- 6. Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed. P-2
- 7. Inspect and test windshield washer motor or pump/relay assembly, switches, connectors, terminals, wires, and control components/modules; repair or replace as needed. P-3
- 8. Inspect and test side view mirror motors, heater circuit grids, relays, switches, connectors, terminals, wires and control components/modules; repair or replace as needed. P-3
- 9. 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. P-3

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|-----|---|-----|
| 10. | Inspect and test auxiliary power outlet, integral fuse, connectors, terminals, wires, and control components/modules; repair or replace as needed.                  | P-3 |
| 11. | Identify causes of slow, intermittent, or no power side window operation; determine needed action.  | P-3 |
| 12. | Inspect and test motors, switches, relays, connectors, terminals, wires, and control components/modules of power side window circuits; repair or replace as needed. | P-3 |
| 13. | Inspect and test block heaters; determine needed repairs.   | P-2 |
| 14. | Inspect and test cruise control electrical components; repair or replace as needed.   | P-3 |
| 15. | Inspect and test switches, relays, controllers, actuator/solenoids, connectors, terminals, and wires of electric door lock circuits.                                | P-3 |
| 16. | Check operation of keyless and remote lock/unlock devices; determine needed action.   | P-3 |
| 17. | Inspect and test engine cooling fan electrical control components/modules; repair or replace as needed.   | P-2 |
| 18. | Identify causes of data bus communication problems; determine needed action.  | P-2 |

## HEATING, VENTILATION, & AIR CONDITIONING

For every task in Heating, Ventilation, and Air Conditioning, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first task in Heating, Ventilation, & Air Conditioning is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

### VI. HEATING, VENTILATION, & AIR CONDITIONING

All practices and procedures must be performed according to current mandates, standards, and regulations.

#### A. HVAC Systems

1. Verify the need for service or repair of HVAC systems based on unusual operating noises; determine needed action. P-1
2. Verify the need for service or repair of HVAC systems based on unusual visual, smell, and touch conditions; determine needed action. P-1
3. Identify system type and components (cycling clutch orifice tube – CCOT, expansion valve) and conduct performance test(s) on HVAC systems; determine needed action. P-1
4. Retrieve diagnostic codes; determine needed action. P-3

#### B. A/C System and Components

##### 1. A/C System - General

1. Identify causes of temperature control problems in the A/C system; determine needed action. P-1
2. Identify refrigerant and lubricant types; check for contamination; determine needed action. P-1



3. Identify A/C system problems indicated by pressure gauge and temperature readings; determine needed action. P-1
4. Identify A/C system problems indicated by visual, audible, smell, and touch procedures; determine needed action. P-1
5. Perform A/C system leak test; determine needed action. P-1
6. Recover, evacuate, and recharge A/C system using appropriate equipment. P-1
7. Identify contaminated A/C system components and hoses; determine needed action. P-3

## **2. Compressor and Clutch**

1. Identify A/C system problems that cause protection devices (pressure, thermal, and electronic) to interrupt system operation; determine needed action. P-1
2. Inspect, test, and replace A/C system pressure, thermal, and electronic protection devices. P-2
3. Inspect and replace A/C compressor drive belts, pulleys, and tensioners; adjust belt tension and check alignment. P-1
4. Inspect, test, service, or replace A/C compressor clutch components or assembly. P-2
5. Inspect and correct A/C compressor lubricant level (if applicable). P-2
6. Inspect, test, or replace A/C compressor. P-2
7. Inspect, repair, or replace A/C compressor mountings and hardware. P-2

## **3. Evaporator, Condenser, and Related Components**

1. Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses. P-1
2. Inspect A/C system hoses, lines, filters, fittings, and seals; determine needed action. P-1
3. Inspect A/C condenser for proper air flow. P-1

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|-----|---|-----|
| 4.  | Inspect and test A/C system condenser and mountings; determine needed action.   | P-2 |
| 5.  | Inspect and replace receiver/drier or accumulator/drier.  | P-1 |
| 6.  | Inspect and test cab/sleeper refrigerant solenoid, expansion valve(s); check placement of thermal bulb (capillary tube); determine needed action. | P-3 |
| 7.  | Remove and replace orifice tube.  | P-1 |
| 8.  | Inspect and test cab/sleeper evaporator core; determine needed action.  | P-3 |
| 9.  | Inspect, clean, or repair evaporator housing and water drain; inspect and service/replace evaporator air filter.                                  | P-1 |
| 10. | Identify and inspect A/C system service ports (gauge connections); determine needed action.   | P-1 |
| 11. | Identify the cause of system failures resulting in refrigerant loss from the A/C system high pressure relief device; determine needed action.     | P-2 |

**C. Heating and Engine Cooling Systems**

- |    |   |     |
|----|---|-----|
| 1. | Identify causes of outlet air temperature control problems in the HVAC system; determine needed action.   | P-1 |
| 2. | Identify window fogging problems; determine needed action.  | P-2 |
| 3. | Perform engine cooling system tests for leaks, protection level, contamination, coolant level, coolant type, temperature, and conditioner concentration; determine needed action. | P-1 |
| 4. | Inspect engine cooling and heating system hoses, lines, and clamps; determine needed action.  | P-1 |
| 5. | Inspect and test radiator, pressure cap, and coolant recovery system (surge tank); determine needed action.   | P-1 |
| 6. | Inspect water pump for leaks and bearing play; determine needed action.   | P-2 |
| 7. | Inspect and test thermostats, by-passes, housings, and seals; determine needed repairs.   | P-2 |
| 8. | Recover, flush, and refill with recommended coolant/additive package; bleed cooling system.   | P-1 |

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|-----|---|-----|
| 9.  | Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed. | P-2 |
| 10. | Inspect and test heating system coolant control valve(s) and manual shut-off valves; determine needed action.     | P-2 |
| 11. | Inspect and flush heater core; determine needed action.   | P-3 |

**D. Operating Systems and Related Controls**

**1. Electrical**

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|----|--|-----|
| 1. | Identify causes of HVAC electrical control system problems; determine needed action.   | P-1 |
| 2. | Inspect and test HVAC blower motors, resistors, switches, relays, modules, wiring, and protection devices; determine needed action.                | P-2 |
| 3. | Inspect and test A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices; determine needed action.        | P-2 |
| 4. | Inspect and test A/C related electronic engine control systems; determine needed action.   | P-2 |
| 5. | Inspect and test engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring, and protection devices; determine needed action. | P-2 |
| 6. | Inspect and test electric actuator motors, relays/modules, switches, sensors, wiring, and protection devices; determine needed action.             | P-3 |
| 7. | Inspect and test HVAC system electrical/electronic control panel assemblies; determine needed action.  | P-3 |

**2. Air/ Mechanical**

- |    |  |     |
|----|--|-----|
| 1. | Identify causes of HVAC air and mechanical control problems; determine needed action.                          | P-3 |
| 2. | Inspect and test HVAC system air and mechanical control panel assemblies; determine needed action.             | P-3 |
| 3. | Inspect, test, and adjust HVAC system air and mechanical control cables and linkages; determine needed action. | P-3 |

4. Inspect and test HVAC system actuators and hoses; determine needed action. P-3
5. Inspect, test, and adjust HVAC system ducts, doors, and outlets; determine needed action. P-3

**E. Refrigerant Recovery, Recycling, and Handling**

**NOTE: Tasks 1 through 5 should be accomplished in accordance with appropriate EPA regulations and SAE “J” standards.**

1. Maintain and verify correct operation of certified equipment. P-1
2. Identify and recover A/C system refrigerant. P-1
3. Recycle or properly dispose of refrigerant. P-1
4. Handle, label, and store refrigerant. P-1
5. Test recycled refrigerant for non-condensable gases. P-1

## PREVENTIVE MAINTENANCE AND INSPECTION

For every task in Preventive Maintenance and Inspection, the following safety task must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The tasks included in the Preventive Maintenance and Inspection area are entry-level technician inspection tasks designed to introduce the student to correct procedures and practices of vehicle inspection in a teaching/learning environment. They are not intended to satisfy the Annual Federal Vehicle Inspection requirement as prescribed in the *Federal Motor Carrier Safety Regulations, Part 396, Appendix G to Subchapter B, Minimum Periodic Inspection Standards*.

The first task in Preventive Maintenance is to listen to and verify operator's concern, review past maintenance documents, and record condition on appropriate document.

### VII. PREVENTIVE MAINTENANCE and INSPECTION

#### A. Engine System

##### 1. Engine

1. Check engine starting/operation (including unusual noises, vibrations, exhaust smoke, etc.); record idle and governed rpm. P-1
2. Inspect vibration damper. P-1
3. Inspect belts, tensioners, and pulleys; check and adjust belt tension; check belt alignment. P-1
4. Check engine oil level and condition; check dipstick seal. P-1
5. Inspect engine mounts for looseness and deterioration. P-1
6. Check engine for oil, coolant, air, fuel, and exhaust leaks (Engine Off and Running). P-1
7. Check engine compartment wiring harnesses, connectors, and seals for damage and proper routing. P-1

## **2. Fuel System**

1. Check fuel tanks, mountings, lines, caps, and vents. P-1
2. Drain water from fuel system. P-1
3. Service water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system. P-1

## **3. Air Induction and Exhaust System**

1. Check exhaust system mountings for looseness and damage. P-1
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. P-1
3. Check air induction system: piping, charge air cooler, hoses, clamps, and mountings; check for air restrictions and leaks. P-1
4. Inspect turbocharger for leaks; check mountings and connections. P-1
5. Check operation of engine compression/exhaust brake. P-1
6. Service or replace air filter as needed; check and reset air filter restriction indicator. P-1
7. Inspect and service crankcase ventilation system. P-1

## **4. Cooling System**

1. Check operation of fan clutch. P-1
2. Inspect radiator (including air flow restriction, leaks, and damage) and mountings. P-1
3. Inspect fan assembly and shroud. P-1
4. Pressure test cooling system and radiator cap. P-1
5. Inspect coolant hoses and clamps. P-1
6. Inspect coolant recovery system. P-1

- 7. Check coolant for contamination, additive package concentration, and protection level (freeze point). P-1
- 8. Service coolant filter. P-1
- 9. Inspect water pump for leaks and bearing play. P-1

**5. Lubrication System**

- 1. Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs. P-1
- 2. Take an engine oil sample. P-1

**B. Cab and Hood**

**1. Instruments and Controls**

- 1. Inspect key condition and operation of ignition switch. P-1
- 2. Check warning indicators. P-1
- 3. Check instruments; record oil pressure and system voltage. P-1
- 4. Check operation of electronic power take off (PTO) and engine idle speed controls (if applicable). P-1
- 5. Check HVAC controls. P-1
- 6. Check operation of all accessories. P-1
- 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). P-1

**2. Safety Equipment**

- 1. Check operation of electric/air horns and reverse warning devices. P-1
- 2. Check condition of spare fuses, triangles, fire extinguisher, and all required decals. P-1
- 3. Inspect seat belts and sleeper restraints. P-1

4. Inspect wiper blades and arms. P-1

### **3. Hardware**

1. Check operation of wiper and washer. P-1
2. Inspect windshield glass for cracks or discoloration; check sun visor. P-1
3. Check seat condition, operation, and mounting. P-1
4. Check door glass and window operation. P-1
5. Inspect steps and grab handles. P-1
6. Inspect mirrors, mountings, brackets, and glass. P-1
7. Record all observed physical damage. P-1
8. Lubricate all cab and hood grease fittings. P-1
9. Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables. P-1
10. Inspect cab mountings, hinges, latches, linkages and ride height; service as needed. P-1

### **4. Heating, Ventilation, & Air Conditioning (HVAC)**

1. Inspect A/C condenser and lines for condition and visible leaks; check mountings. P-1
2. Inspect A/C compressor and lines for condition and visible leaks; check mountings. P-1
3. Check A/C system condition and operation; check A/C monitoring system, if applicable. P-1
4. Check HVAC air inlet filters and ducts; service as needed. P-1

## **C. Electrical/Electronics**

### **1. Battery and Starting Systems**

1. Inspect battery box(es), cover(s), and mountings. P-1



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|----|--|-----|
| 2. | Inspect battery hold-downs, connections, cables, and cable routing; service as needed. | P-1 |
| 3. | Check/record battery state-of-charge (open circuit voltage) and condition.             | P-1 |
| 4. | Perform battery test (load and/or capacitance).  | P-1 |
| 5. | Inspect starter, mounting, and connections.  | P-1 |
| 6. | Engage starter; check for unusual noises, starter drag, and starting difficulty.       | P-1 |

**2. Charging System**

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|----|--|-----|
| 1. | Inspect alternator, mountings, cable, wiring, and wiring routing; determine needed action. | P-1 |
| 2. | Perform alternator output tests.   | P-1 |

**3. Lighting System**

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|----|--|-----|
| 1. | Check operation of interior lights; determine needed action.   | P-1 |
| 2. | Check all exterior lights, lenses, reflectors, and conspicuity tape; check headlight alignment; determine needed action. | P-1 |
| 3. | Inspect and test tractor-to-trailer multi-wire connector(s), cable(s), and holder(s); determine needed action.           | P-1 |

**D. Frame and Chassis**

**1. Air Brakes**

- |    |   |     |
|----|---|-----|
| 1. | Check operation of parking brake.                   | P-1 |
| 2. | Record air governor cut-out setting (psi).          | P-1 |
| 3. | Check operation of air reservoir/tank drain valves. | P-1 |
| 4. | Check air system for leaks (brakes released).       | P-1 |
| 5. | Check air system for leaks (brakes applied).        | P-1 |
| 6. | Test one-way and double-check valves.               | P-1 |

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|-----|--|-----|
| 7.  | Check low air pressure warning devices.  | P-1 |
| 8.  | Check air governor cut-in pressure.  | P-1 |
| 9.  | Check emergency (spring) brake control/modulator valve, if applicable.                                     | P-1 |
| 10. | Check tractor protection valve.  | P-1 |
| 11. | Test air pressure build-up time.   | P-1 |
| 12. | Inspect coupling air lines, holders, and gladhands.  | P-1 |
| 13. | Check brake chambers and air lines for secure mounting and damage.   | P-1 |
| 14. | Check operation of air drier.  | P-1 |
| 15. | Inspect and record brake shoe/pad condition, thickness, and contamination.                                 | P-1 |
| 16. | Inspect and record condition of brake drums/rotors.  | P-1 |
| 17. | Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing.        | P-1 |
| 18. | Check operation and adjustment of brake automatic slack adjusters (ASA); check and record push rod stroke. | P-1 |
| 19. | Lubricate all brake component grease fittings.   | P-1 |
| 20. | Check condition and operation of hand brake (trailer) control valve.                                       | P-1 |
| 21. | Perform antilock brake system (ABS) operational system self-test.  | P-1 |
| 22. | Drain air tanks and check for contamination.   | P-1 |
| 23. | Check condition of pressure relief (safety) valves.  | P-1 |

## **2. Hydraulic Brakes**

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|----|---|-----|
| 1. | Check master cylinder fluid level and condition.                                | P-1 |
| 2. | Inspect brake lines, fittings, flexible hoses, and valves for leaks and damage. | P-1 |

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|----|---|-----|
| 3. | Check parking brake operation; inspect parking brake application and holding devices; adjust as needed.     | P-1 |
| 4. | Check operation of hydraulic system: pedal travel, pedal effort, pedal feel (drift).                        | P-1 |
| 5. | Inspect calipers for leakage and damage.  | P-1 |
| 6. | Inspect brake assist system (booster), hoses and control valves; check reservoir fluid level and condition. | P-1 |
| 7. | Inspect and record brake lining/pad condition, thickness, and contamination.                                | P-1 |
| 8. | Inspect and record condition of brake rotors.   | P-1 |
| 9. | Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing.         | P-1 |

### **3. Drive Train**

- |     |  |     |
|-----|--|-----|
| 1.  | Check operation of clutch, clutch brake, and gearshift.  | P-1 |
| 2.  | Check clutch linkage/cable for looseness or binding, if applicable.  | P-1 |
| 3.  | Check hydraulic clutch slave and master cylinders, lines, fittings, and hoses, if applicable.  | P-1 |
| 4.  | Check clutch adjustment; adjust as needed.   | P-1 |
| 5.  | Check transmission case, seals, filter, hoses, and cooler for cracks and leaks.  | P-1 |
| 6.  | Inspect transmission breather.   | P-1 |
| 7.  | Inspect transmission mounts.   | P-1 |
| 8.  | Check transmission oil level, type, and condition.   | P-1 |
| 9.  | Inspect U-joints, yokes, driveshafts, boots/seals, center bearings, and mounting hardware for looseness, damage, and proper phasing. | P-1 |
| 10. | Inspect axle housing(s) for cracks and leaks.  | P-1 |

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|-----|--|-----|
| 11. | Inspect axle breather(s).  | P-1 |
| 12. | Lubricate all drive train grease fittings.   | P-1 |
| 13. | Check drive axle(s) oil level, type, and condition.  | P-1 |
| 14. | Change drive axle(s) oil and filter; check and clean magnetic plugs.                       | P-1 |
| 15. | Check transmission wiring, connectors, seals, and harnesses for damage and proper routing. | P-1 |
| 16. | Change transmission oil and filter; check and clean magnetic plugs.                        | P-1 |
| 17. | Check interaxle differential lock operation.   | P-1 |
| 18. | Check range shift operation.   | P-1 |

#### **4. Suspension and Steering Systems**

- |     |   |     |
|-----|---|-----|
| 1.  | Check steering wheel operation for free play or binding.  | P-1 |
| 2.  | Check power steering pump, mounting, and hoses for leaks, condition, and routing; check fluid level.                    | P-1 |
| 3.  | Change power steering fluid and filter.   | P-1 |
| 4.  | Inspect steering gear for leaks and secure mounting.  | P-1 |
| 5.  | Inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, and linkages. | P-1 |
| 6.  | Check kingpin for wear.   | P-1 |
| 7.  | Check wheel bearings for looseness and noise.   | P-1 |
| 8.  | Check oil level and condition in all non-drive hubs; check for leaks.   | P-1 |
| 9.  | Inspect springs, pins, hangers, shackles, spring U-bolts, and insulators.   | P-1 |
| 10. | Inspect shock absorbers for leaks and secure mounting.  | P-1 |
| 11. | Inspect air suspension springs, mounts, hoses, valves, linkage, and fittings for leaks and damage.                      | P-1 |
| 12. | Check and record suspension ride height.  | P-1 |

- |     |   |     |
|-----|---|-----|
| 13. | Lubricate all suspension and steering grease fittings.              | P-1 |
| 14. | Check toe setting.  | P-1 |
| 15. | Check tandem axle alignment and spacing.                            | P-1 |
| 16. | Check axle locating components (radius, torque, and/or track rods). | P-1 |

### **5. Tires and Wheels**

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|----|--|-----|
| 1. | Inspect tires for wear patterns and proper mounting.   | P-1 |
| 2. | Inspect tires for cuts, cracks, bulges, and sidewall damage.   | P-1 |
| 3. | Inspect valve caps and stems; replace as needed.   | P-1 |
| 4. | Measure and record tread depth; probe for imbedded debris.   | P-1 |
| 5. | Check and record air pressure; adjust air pressure in accordance with manufacturers' specifications. | P-1 |
| 6. | Check for loose lugs; check mounting hardware condition; service as needed.                          | P-1 |
| 7. | Retorque lugs in accordance with manufacturers' specifications.                                      | P-1 |
| 8. | Inspect wheels for cracks or damage.   | P-1 |
| 9. | Check tire matching (diameter and tread) on dual tire installations.                                 | P-1 |

### **6. Frame and Fifth Wheel**

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|----|--|-----|
| 1. | Inspect fifth wheel mounting, bolts, air lines, and locks.         | P-1 |
| 2. | Test operation of fifth wheel locking device; adjust if necessary. | P-1 |
| 3. | Check quarter fenders, mud flaps, and brackets.                    | P-1 |
| 4. | Check pintle hook assembly and mounting.                           | P-1 |
| 5. | Lubricate all fifth wheel grease fittings and plate.               | P-1 |
| 6. | Inspect frame and frame members for cracks and damage.             | P-1 |

# HYDRAULICS

For every task in Hydraulics, the following safety task must be strictly enforced:

**Comply with personal and environmental safety practices associated with clothing; eye protection; hand protection; proper lifting practices; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of fuels/chemicals/materials in accordance with federal, state, and local regulations.**

**The first task in Hydraulics is to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.**

## VIII. HYDRAULICS

### A. General System Operation

1. Identify system type (closed and open) and verify proper operation. P-1
2. Read and interpret system diagrams and schematics. P-1
3. Perform system temperature, pressure, flow, and cycle time tests; determine needed action. P-1
4. Verify placement of equipment /component safety labels and placards; determine needed action. P-1

### B. Pumps

1. Identify system fluid type. P-1
2. Identify causes of pump failure, unusual pump noises, temperature, flow, and leakage problems; determine needed action. P-2
3. Determine pump type, rotation, and drive system. P-2
4. Remove and install pump; prime and/or bleed system. P-2
5. Inspect pump inlet for restrictions and leaks; determine needed action. P-2
6. Inspect pump outlet for restrictions and leaks; determine needed action. P-2

### C. Filtration/ Reservoirs (Tanks)

1. Identify type of filtration system; verify filter application and flow direction. P-1

2. Service filters and breathers. P-1
3. Identify causes of system contamination; determine needed action. P-2
4. Take a hydraulic oil sample. P-2
5. Check reservoir fluid level and condition; determine needed action. P-1
6. Inspect and repair or replace reservoir, sight glass, vents, caps, mounts, valves, screens, supply and return lines. P-2

**D. Hoses, Fittings, and Connections**

1. Diagnose causes of component leakage, damage, and restriction; determine needed action. P-2
2. Inspect hoses and connections (length, size, routing, bend radii, and protection); repair or replace as needed. P-1
3. Assemble hoses, tubes, connectors, and fittings in accordance with manufacturers' specifications; use proper procedures to avoid contamination. P-2
4. Inspect and replace fitting seals and sealants. P-2

**E. Control Valves**

1. Pressure test system safety relief valve; determine needed action. P-2
2. Perform control valve operating pressure and flow tests; determine needed action. P-2
3. Inspect, test, and adjust valve controls (electrical/electronic, mechanical, and pneumatic). P-2
4. Identify causes of control valve leakage problems (internal/external); determine needed action. P-2
5. Inspect pilot control valve linkages, cables, and PTO controls; adjust, repair, or replace as needed. P-1

## F. Actuators

**Comply with manufacturers' and industry accepted safety practices associated with equipment lock out/tag out; pressure line release; implement/support (blocked or resting on ground); and articulated cylinder devices/machinery safety locks.**

- |    |   |     |
|----|---|-----|
| 1. | Identify actuator type (single/double acting, multi-stage/telescopic, and motors)..                                   | P-1 |
| 2. | Identify the cause of seal failure; determine needed repairs.   | P-2 |
| 3. | Identify the cause of incorrect actuator movement and leakage (internal and external); determine needed repairs.      | P-2 |
| 4. | Inspect actuator mounting, frame components, and hardware for looseness, cracks, and damage; determine needed action. | P-2 |
| 5. | Remove, repair, and/or replace actuators in accordance with manufacturers' recommended procedures.                    | P-2 |
| 6. | Inspect actuators for dents, cracks, damage, and leakage; determine needed action.                                    | P-2 |
| 7. | Purge and/or bleed system in accordance with manufacturers' recommended procedures.                                   | P-1 |



**Task List Priority Item Totals (by area)**

<p>I. Diesel Engines</p> <p>    P-1 = 39      95% = 37 tasks</p> <p>    P-2 = 26      70% = 18 tasks</p> <p>    P-3 = 24      25% = 6 tasks</p>	<p>V. Electrical/Electronic Systems</p> <p>    P-1 = 31      95% = 29 tasks</p> <p>    P-2 = 21      70% = 15 tasks</p> <p>    P-3 = 12      25% = 3 tasks</p>
<p>II. Drive Train</p> <p>    P-1 = 23      95% = 22 tasks</p> <p>    P-2 = 17      70% = 12 tasks</p> <p>    P-3 = 17      25% = 4 tasks</p>	<p>VI. Heating, Ventilation, &amp; Air Conditioning</p> <p>    P-1 = 29      95% = 28 tasks</p> <p>    P-2 = 16      70% = 11 tasks</p> <p>    P-3 = 12      25% = 3 tasks</p>
<p>III. Brakes</p> <p>    P-1 = 30      95% = 29 tasks</p> <p>    P-2 = 14      70% = 10 tasks</p> <p>    P-3 = 10      25% = 3 tasks</p>	<p>VII. Preventative Maintenance Inspection</p> <p>    P-1 = 145      95% = 138 tasks</p> <p>    P-2 = 0</p> <p>    P-3 = 0</p>
<p>IV. Suspension &amp; Steering</p> <p>    P-1 = 23      95% = 22 tasks</p> <p>    P-2 = 11      70% = 8 tasks</p> <p>    P-3 = 11      25% = 3 tasks</p>	<p>VIII. Hydraulics</p> <p>    P-1 = 12      95% = 11 tasks</p> <p>    P-2 = 20      70% = 14 tasks</p> <p>    P-3 = 0</p>

