

College of Agriculture and Applied Sciences

Aviation and, Technology Education (ASTE)

Utah State University Eastern

Assessment Plan

*For the Undergraduate Program in
Diesel Equipment Technology*

Fall 2021

Department Profile

Diesel Equipment Technicians repair and maintain diesel engine powered equipment. The diesel equipment technology program at USU Eastern has been designed to prepare a student for a career in either "on highway" or "off road" industry by offering theory and hands on instruction related to the common sub-systems used in both equipment areas. By taking a broad spectrum of classes, a student is able to get a feel for the diesel industry. A student will also be able to focus on a particular emphasis, while the experience in various study areas provides for diversified employment opportunities upon completion. Authentic learning is incorporated into all courses as it becomes available and as it fits into the curriculum (see Appendix 4A)

Students get hands on opportunity to perform preventive maintenance, inspection, adjustments, and repair to air brakes, suspension systems, clutches, transmissions, differentials, and drive line components. Student's will also learn how rebuild inspect and diagnose diesel engines and all related electrical and electronics systems used in heavy duty diesel equipment. Particular attention is given to attendance, quality of work, productivity during class time, and the ability to follow detailed written procedures from service manuals. Shop safety is also stressed.

Program overview

In the past 2 years the diesel technology program has had a dramatic change. A student can get their diesel certificate in one year! We have moved from the standard 2 semester year to 3 semesters teaching summer courses. Students can start on any semester. The diesel program has 2 fulltime instructors. The diesel program is a very rigorous course as a student will be enrolled in 18 credit hours per semester. The diesel program still offers an Associate's of Applied Science degree.

The strategy competency based training moves away from tradition training. Theory is taught 1 hour a day and lab is 2 hours per day. Theory is PowerPoint based and the text book is online and laid out so a student can read a few pages in the chapter then take a 5 question quiz, there is 4 to 6 quizzes in each chapter. When the student finishes the chapter there are end of chapter questions and a chapter test. All tests and quizzes are completed online. As the student progresses through the chapter they will encounter Task Sheets that are required as a lab assignment. Task sheets are hands on and a student will have to show the instructor they can complete the task in a professional manner, then the instructor will either pass the student or have them try again. Tasks are pass or fail.

All tasks, tests, and other assignments have a due date and need to be completed by the due date or receive a zero. The first year we didn't require due dates and it was a disaster, not only because of Covid cutting the semester short, but the students had not been turning in the required work and were playing catch up. This caused a lot of extra work for the instructors as well as the students rushing through the assignments.

The challenging part of competency based training is setting up tasks in the lab for students to complete. We have compensated this by moving away from live work and teaching the task with training stands. The diesel program has numerous training stands and more training aids will be required in the advanced diesel electronics, the mobile electrical course, and in the drive trains course.

Power point presentations can work really well but need to be a guide for the lecture not read to the students. Videos work well to reinforce after the facts of lecture that have been taught..

USU Eastern Diesel Technology has a very strict policy concerning attendance and GPA. Students are required to sign an enrollment contract stating a GPA of 2.7 must be maintained and if more than 5 absents or 5 late to class the student will be dis-enrolled.

Program Support

USU Eastern Diesel Technology has modern equipment in many areas it is a challenge to stay current in engines and electronics areas. These areas are rapidly changing in the industry and teaching equipment becomes out dated in just a few years. The cost of 1 diesel engine can be anywhere from \$10,000 for a light duty engine up to \$30,000 for a heavy duty high speed truck engine. The electronics diagnostics area is becoming expensive with license renewals as high as \$1800 per year

Summer conferences have been helpful in staying current with the industry trends. Working as a diesel technician in the summer really helps to stay current, Funding has been offered by USU to get outside training and is currently in the process of deciding what training would be the best.

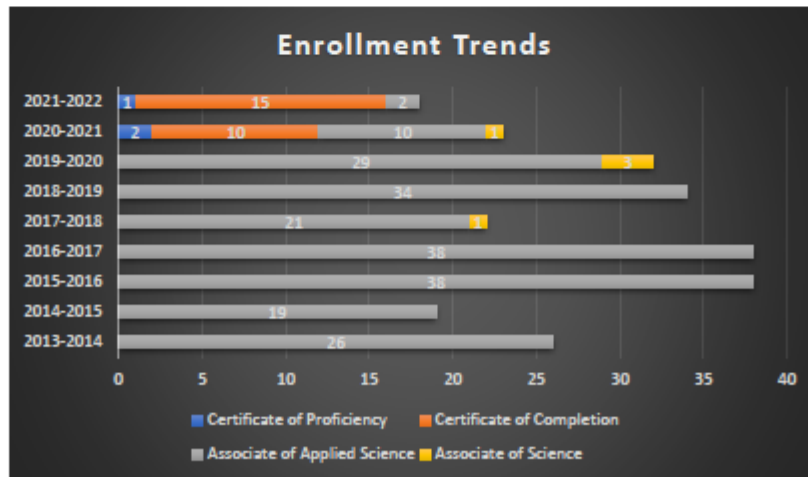
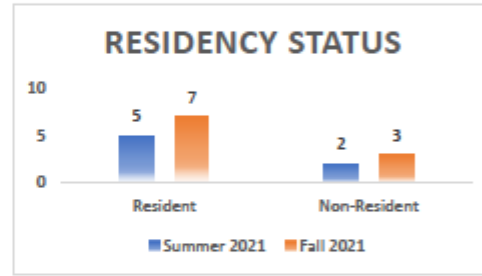
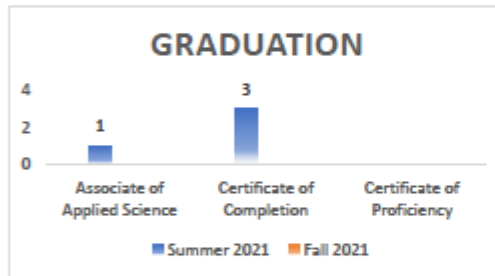
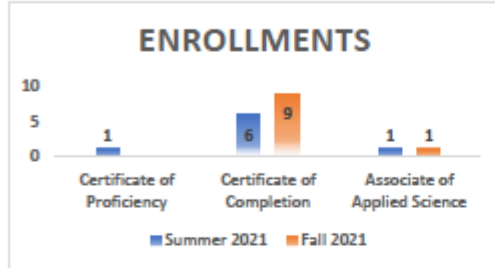
Students

- It is strongly recommended that a student have a minimum ACT score of 16 or higher in both Math & English. Students are required to follow detailed written procedures so good reading comprehension is essential.
- All students are tested to see where their math and reading comprehension skills are at the beginning of the year
- Students that are under prepared are encouraged to attend the ACE lab to get their reading and math skills where they need to be
- Class size, on average, about 16 full time students.
- AAS degree in diesel technology or students can continue on for a AS degree
- Enrolment dropped when CEU was in transition of becoming USUE. Since then it has been up
- 80% of students who start the diesel program finish while only 60% will get the AAS degree and I suspect this number will decrease because of students getting through the course in one year and going to work
- Student placement rates is near 95% in entry level jobs paying \$15.00 to \$25.00 per hour

Table 1: Secondary and post-secondary enrollment and completion

Diesel & Heavy Equipment Mechanics

Summer/Fall 2021



APPENDX 4A

Courses Offered

- **FALL every year; Diesel Engine Over Haul. 8 credits**

Student learn how disassemble engines, clean, measure tolerances down to .0001 of an inch calculate oil clearance on diesel engines. Students also learn what to measure and where to measure the machined surfaces of not only the engine block, but also all other parts of the diesel engine. Student s are then require to assemble the engine The diesel department has 8 to 12 engines on hand for students to rebuild the cost to rebuild engines is high. Sometimes we can sell these engines and get others. The diesel department also brings in some “live work”. Live works is the public having students rebuild light duty diesels, farm tractors and some heavy duty engines. This works out really well because the department doesn’t have to buy parts and the owner gets an engine rebuilt and the students experience real world pressure. Students also learn how to machine the components of the engine. USUE is one of only a few that actually teach engine machining.
- **Fall every Year: Advanced Diesel Engines. 10 credits**

Students learn the theory and how to test and adjust all the sub-systems of the diesel engine including oil pressure, cooling intake, exhaust and most importantly the fuel system which is electronically managed. Getting the very latest diesel engines and equipment to test is a challenge to say the least. To do this we have fair support from the industry in supplying us with the software to communicate electronically with the engine or truck. The department spends around \$3000 a year to keep up with the latest technology out there to test and diagnose diesel equipment not only the engines but all the systems on mobile equipment are becoming computer controlled. USUE has a Trucking and Heavy Equipment program that we partner with to test live equipment in a real world setting. The diesel industry technology is advancing in leaps and bounds and is being driven by the need to clean up the air that we breathe as well as fuel mileage. The need to stay abreast of the current technology is a must not only as a technician but as an instructor as well.
- **Spring every Year; Mobile Electrical and Electronic 8 credits**

Students will study the basic principles of electricity including electron flow in series and parallel circuits, Ohm’s law, magnetism and semiconductor devices related to the mobile industry. The theory and operation of a complete vehicle electrical system and its various components will be discussed in a series of subsystems. These sub-systems include: the battery, starter and starting system, alternator and charging system, gauges and instrument panel, vehicle lighting and accessories, engine electronic sensors, as well as the wiring and connections used in each of these systems. Students have the opportunity to

learn schematic symbols by studying the various types of electrical circuits used in mobile equipment. Students will be introduced to different test instruments such as the digital multi-meter and testing techniques unique to each type of equipment will be presented. Hands-on experience and theory is given to the student. Each individual type of testing equipment is demonstrated as well as techniques given for troubleshooting, servicing and testing electrical systems: Students demonstrate their proficiency using this equipment to test batteries, starters and the starting system, the alternator and charging system, gauges, lights and accessories, engine sensors, as well as the wiring harness and connections used in each of these systems. Particular emphasis is placed on component identification, isolating component failures, and electrical safety procedures for both personal safety as well as preventing electrical system damage. Once again live work is brought into the shop. Students can fix lights test starting and charging systems and fix any problems in the electrical, electronic system

- **Spring Every Year Heavy Duty Chassis and Power Trains 10 credits**
Covers highway truck air systems, foundation brake repair and maintenance, front end, tandem, and trailer axle alignment, heavy duty suspension systems, annual and automatic transmissions, clutches, differentials, and drive lines. Students will calculate drive line angles, gear ratios, and tire size, as well as troubleshoot and analyze tire wear, failures of gears, universal joints, clutches, axles, brakes
- **Summer Year; Fluid Power 7 credits** Classroom instruction is given in the basic fundamental principles of fluid power. Students will discuss and mathematically calculate the relationships between hydraulic pressure, force, area, and resistance as well as rpm, torque, hydraulic horsepower, energy and heat loss. Covers the theory and operation of hydraulic fluid, reservoir design, filters, pumps, actuators, pressure controls, directional controls, and flow controls. Students will have the opportunity to learn schematic symbols through representations of various types of circuit design representing both closed loop and open center systems in industrial as well as mobile applications. Topics discussed will be pressure compensated systems, hydrostatic drive circuits and system troubleshooting. As the course progresses, students will be introduced to methods of troubleshooting hydraulic systems using a flow meter and pressure gauges. Students will also identify and review hydraulic fittings, hose types, and safety. Hands-on experience identifying, testing, troubleshooting, and rebuilding various brands of hydraulic components. Students will have the opportunity to use a flow meter and pressure gauges to troubleshoot hydraulic components as well as test different components on a hydraulic test bench. Particular emphasis is placed on component identification, failure analysis and hydraulic fitting identification. Once again live work is brought into the shop usually a backhoe works best. Students can test pressures and rebuild cylinders in a real world setting.
- **Summer Every Year Mobile Air conditioning 3 credits**
Covers the principles of heat transfer using refrigerant as the medium. Particular attention is given to the identification and operation of individual system components as well as the variations in system design from OEM to OEM. Different types of refrigerants used in the mobile industry as well as recovery, recycling, storage, handling, and disposal will be discussed. Students are taught

methods for R12 to R134A conversion. After EPA laws and guide lines have been taught students are given the hands-on opportunity to locate, identify, test, service, and troubleshoot different types of mobile AC systems using EPA approved equipment and procedures. They will demonstrate their proficiency using recovery recycling, evacuation, and charging equipment for both R-12 and R-134A refrigerants. System conversion from R-12 to R134A is also demonstrated. The student will have the opportunity to test for a MACS recovery and recycling certificate.

o **Summer Every Year Intro to Transportation 4 credits**

This course is designed to instruct the student on shop safety and the proper use of hand tools. The student will also learn how to sharpen drill bits and repair bolts that have been broken off. Attention is also given to parts cleaning methods as well as fasteners & measuring tools, and sealants, gaskets and how to fix oil leaks.

The second part of the course the student will learn how and when to change oil and grease auto and light trucks. Special attention will be given to tires, wheels and front-end alignments

Summer every year Welding 1010 3 credits

Program Outcomes

Critical thinking / problem solving; students will learn and demonstrate the ability to find and solve problems related to the course.

Terminology; DSME courses will introduce students to fundamental terminology used in the diesel industry

Interdisciplinary concepts; DSME courses 1110, 1130, 1340,1360,2210,2230

Teaches students to recognize troubleshoot and solve problems particularly in the fuel systems and electrical and electronics of diesel engines.

Mobile Air Conditioning Theory DSME 2440

To familiarize the student with the identification, theoretical operation, maintenance, failure analysis & testing of air conditioning systems used on mobile equipment in the diesel industry as described in the course description.

DSME 2460 Lab

1. Physically demonstrate the knowledge & ability to execute the procedures necessary to overhaul, test, troubleshoot, & service the vehicular components related to air conditioning as described in the course description.
2. Demonstrate proper and safe use of special service tools & test equipment.

3. Complete the job sheets outlined in the Heating and Air Conditioning Book
4. Demonstrate proficiency in applying the concepts of DSME 2440 to the lab projects

Advanced Diesel Theory DSME 2210

To familiarize students with the identification, theoretical operation, maintenance, failure analysis & testing of diesel engines & their related components and subsystems, including electronic control of diesel fuel systems and emissions and electronic engine sensors, controls & related diagnostic software.

Advanced Diesel Lab DSME 2230

1. Demonstrate knowledge and competency in the testing, tune-up, troubleshooting, and service of diesel engines.
2. Demonstrate proper and safe use of special service tools and test equipment in the shop.
3. Demonstrate proficiency in applying the concepts of DSME 2210 to the shop projects

Heavy Duty Chassis & Power Train Theory DSME 2410

To familiarize the student with the identification, theoretical operation, maintenance, failure analysis and testing of chassis and power train components and air brakes systems used on mobile equipment in the diesel industry as described in the course description.

Heavy Duty Chassis & Power Train Lab - DSME 2430

1. Physically demonstrate the knowledge & ability to execute the procedures necessary to overhaul, test, troubleshoot, & service the vehicular components related to the chassis & power trains of heavy-duty equipment as described in the course description.
2. Demonstrate proper and safe use of special service tools & test equipment.
3. Complete the objectives outlined on each task list.

4. Demonstrate proficiency in applying the concepts of DSME 2410 to the lab projects.

Diesel Engine Overhaul Theory DSME 1110

To familiarize students with the identification, theoretical operation, overhaul, maintenance, failure analysis & testing of diesel engines & their related components & sub-systems.

Diesel Engine Overhaul Lab - DSME 1130

1. Physically demonstrate the knowledge & ability to INDEPENDENTLY execute the procedures necessary to overhaul at least 1 diesel engine during the semester. These engines should meet the same criteria of engines overhauled to industry standards
2. Demonstrate proper and safe use of special service tools & test equipment.
3. Complete all tasks that are found online. .Including employability skills/tasks
4. Demonstrate proficiency in applying the concepts of DSME 1110 to the lab projects.
5. Demonstrate proficiency in problem solving and parts ordering.

Mobile Electrical & Electronics Theory DSME 1340

To familiarize the student with the identification, theoretical operation, maintenance, failure analysis & testing of electrical components & circuitry used on mobile equipment in the diesel industry as described in the course description.

Electrical & Electronics Lab - DSME 1360

1. Demonstrate knowledge and competency in the overhaul, testing, troubleshooting, and service of electrical components and circuits used on heavy-duty diesel equipment.
2. Demonstrate proper and safe use of special service tools and test equipment in the lab.
3. Demonstrate proficiency in applying the concepts of DSME 1340 to the lab projects.

Competencies and tasks

Here is a couple of examples of what the task sheets look like and how the students are graded

Task example #1

Diesel Engines Engine subsystems [some information REPURPOSED FROM cdx
781284041200]

Learning Objective / Task	CDX Tasksheet Number	2014 Edition Rev2/12/16 AED Standard
<ul style="list-style-type: none">• Check condition of piston cooling jets (nozzles); determine needed action.	E0182	5.6
<ul style="list-style-type: none">• Inspect crankshaft vibration damper; determine needed action.	E0183	5.6
<ul style="list-style-type: none">• 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.	E0184	5.6

<ul style="list-style-type: none"> • Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action. 	E0185	5.6
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Materials Required:

- Machine with possible engine concern
- Machine manufacturer’s workshop manual
- Manufacturer-specific tools depending on the concern
- Machine lifting equipment if applicable

Some Safety Issues to Consider

- Diagnosis of this fault may require test driving the machine on the school grounds or on a hoist, both of which carry severe risks. Attempt this task only with full permission from your supervisor/instructor and follow all the guidelines exactly.
- Caution: If you are working in an area where there could be “brake dust” present (may contain asbestos, which has been determined to cause cancer when inhaled or ingested), ensure you wear and use all OSHA-approved asbestos protective/removal equipment.
- Lifting equipment such as machine jacks and stands, machine hoists, and engine hoists are important tools that increase productivity and make the job easier. However, they can also cause severe injury or death if used improperly. Make sure you follow the manufacturer’s operation procedures. Also make sure you have your supervisor/instructor’s permission to use any particular type of lifting equipment.
- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with federal, state, and local regulations.
- Always wear the correct protective eyewear and clothing and use the appropriate safety equipment, as well as fender covers, seat protectors, and floor mat protectors.
- Make sure you understand and observe all legislative and personal safety procedures when carrying out practical assignments. If you are unsure of what these are, ask your supervisor/instructor.

Performance Standard

0—No exposure: No information or practice provided during the program; complete training required

1—Exposure only: General information provided with no practice time; close supervision needed; additional training required

2—Limited practice: Has practiced job during training program; additional training

required to develop skill

3—Moderately skilled: Has performed job independently during training program; limited additional training may be required

4—Skilled: Can perform job independently with no additional training

▷ **TASK** Check condition of piston cooling jets (nozzles); determine needed action.

[AED5.6]

Time off _____

Time on _____

Total time _____

CDX Tasksheet Number: E0182

1. Reference the manufacturer's workshop manual and check the condition of the piston cooling jets (nozzles).
 - a. Meets the manufacturer's specifications: Yes: ___ No: ___
 - b. If no, list your recommendations for any rectifications:

2. Discuss the findings with your instructor.

Performance Rating

CDX Tasksheet Number: E0182

0

1

2

3

4

Supervisor/instructor signature _____ Date _____

Task example #2 POWER TRAINS

Theory and principles of

differentials [some information REPURPOSED FROM cdx 9781284041200_CH05_0703_0856.indd 705]

Learning Objective/Task	CDX Tasksheet Number	2014 Edition Rev2/12/16 AED Standard
Exhibit understanding of basic differential operation by identifying the components and explaining how pinion, ring and bevel gears operate in relationship to each other.	E0142	4.2
Identify each type of differential locking device and explain in detail how each one operates.	E0143	4.2
Given a specific component and proper manuals/information, perform all adjustments on a differential with a new ring and pinion, and also perform all adjustments with original ring and pinion but with new bearings.	E0144	4.2
Identify the most common root causes of failure with differentials.	E0145	4.2

Materials Required

- Machines equipped with differential systems.
- various differential components.
- Equipment manufacturer's workshop manual.
- Basic tool set.
- Manufacturer-specific tools depending on the concern
- Machine lifting equipment, if applicable
- Machine lock-out tag-out equipment, if applicable

Some Safety Issues to Consider

- Activities may require test driving the equipment on the school grounds which carry severe risks. Attempt this task only with full permission from your supervisor/instructor, and follow all the guidelines exactly.
- Lifting equipment such as equipment jacks and stands, hoists, and engine hoists are important tools that increase productivity and make the job easier. However, they can also cause severe injury or death if used improperly. Make sure you follow the manufacturer's operation procedures. Also make sure you have your supervisor/instructor's permission to use any particular type of lifting equipment.
- Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with federal, state, and local regulations.
- Always wear the correct protective eyewear and clothing and use the appropriate safety equipment, as well as fender covers, seat protectors, and floor mat protectors.
- Make sure you understand and observe all legislative and personal safety procedures when carrying out practical assignments. If you are unsure of what these are, ask your supervisor/instructor.

► **TASK** Exhibit understanding of basic differential operation by identifying the components and explaining how pinion, ring and bevel gears operate in relationship to each other. *[AED*

4.2]

Time off _____

Time on _____

Total time _____

CDX Tasksheet Number: E0142

1. Research the theory and differential systems used in heavy equipment and identify their components.
 - a. Identify various components that have been labeled and displayed by your instructor.
 - b. List their function in the operation of the differential system in the table below.

Component	Function
1.	
2.	
3.	
4.	
5.	
6.	

7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	

2. Given a differential cutaway describe how power flows through the differential starting with the input shaft and ending at the axle shafts.
 - a. Power flow driving straight:

b. Power flow driving through a turn:

3. Given a differential with power divider cutaway describe how power flows through the differential and power divider starting with the input shaft and ending at the axle shafts and thru shaft.

a. Power flow driving straight:

b. Power flow driving through a turn:

Power flow driving front and rear axle at different speeds:

4. Discuss your findings with the instructor.

Performance Rating

CDX Tasksheet Number: E0142

0

1

2

3

4

Supervisor/instructor signature _____ Date _____

**The following tasks will be completed to achieve a Diesel technology certificate
2018 Master Truck Service Technology (MTST)**

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 eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Diesel Engines are 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. Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.
2. Inspect level and condition of fuel, oil, diesel exhaust fluid (DEF), and coolant.
3. Inspect engine assembly for fuel, oil, coolant, air, and other leaks; determine needed action.
4. Diagnose engine operation (starting and running) including: noise, vibration, smoke, etc.; determine needed action.

5. Use appropriate electronic service tool(s) and procedures to diagnose problems; check, record, and clear diagnostic codes; check and record trip/operational data; reset maintenance monitor (if applicable); interpret digital multimeter (DMM) readings.
6. Identify system components, configurations, and types of the following: cylinder head(s), valve train, engine block, engine lubrication, engine cooling, air induction, exhaust, fuel, and engine braking.
7. Diagnose engine no-crank, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action.
8. Diagnose engine surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and/or shut down problems; determine needed action.

I. DIESEL ENGINES

B. Cylinder Head and Valve Train

1. Inspect electronic wiring harness and brackets for wear, bending, cracks, and proper securement; determine needed action.
2. Inspect cylinder head for cracks/damage; check mating surfaces for warpage; check condition of passages; inspect core/expansion and gallery plugs; determine needed action.
3. Inspect injector sleeves and seals; determine needed action.
4. Inspect valve train components; determine needed action.

5. Inspect, measure, and replace/reinstall camshaft; measure/adjust end play and backlash.
6. Adjust valve bridges (crossheads); adjust valve clearances and injector settings.
7. Disassemble cylinder head; inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action.
8. Measure valve head height relative to deck; measure valve face-to-seat contact; determine needed action.
9. Reassemble cylinder head.
10. Inspect, measure, and replace/reinstall camshaft; measure end play and backlash; determine needed action.

I. DIESEL ENGINES

C. Engine Block

1. Inspect crankshaft vibration damper; inspect engine mounts; determine needed action.
2. Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components; determine needed action.
3. Perform crankcase pressure test; determine needed action.

4. 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.
5. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action.
6. Disassemble and clean engine block; inspect engine block for cracks/damage; measure mating surfaces for warpage; check condition of passages, core/expansion plugs, and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; determine needed action.
7. Inspect cylinder sleeve counter bore and lower bore; check bore distortion; determine needed action.
8. Clean, inspect, and measure cylinder walls or liners for wear and damage; determine needed action.
9. Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion).
10. Inspect camshaft bearings for wear and damage; determine needed action.
11. Inspect, measure, and replace/reinstall camshaft; measure end play and backlash; determine needed action.
12. Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages; check passage plugs; measure journal diameter; determine needed action.

13. Inspect main bearings for wear patterns and damage; replace as needed; check bearing clearances; check and correct crankshaft end play.
14. Inspect, install, and time gear train; measure gear backlash; determine needed action.
15. Inspect connecting rod and bearings for wear patterns; measure pistons, pins, retainers, and bushings; determine needed action.
16. Determine piston-to-cylinder wall clearance; check ring-to-groove fit and end gap; install rings on pistons.
17. Assemble pistons and connecting rods; install in block; install rod bearings and check clearances.
18. Check condition of piston cooling jets (nozzles); determine needed action.

I. DIESEL ENGINES

D. Lubrication Systems

1. Test engine oil pressure; check operation of pressure sensor, gauge, and/or sending unit; test engine oil temperature; check operation of temperature sensor; determine needed action.
2. Check engine oil level, condition, and consumption; take engine oil sample; determine needed action.
3. Determine proper lubricant; perform oil and filter service.

4. Inspect, clean, and test oil cooler and components; determine needed action.
5. Inspect turbocharger lubrication systems; determine needed action.
6. Inspect and measure oil pump, drives, inlet pipes, and pick-up screens; check drive gear clearances; determine needed action.
7. Inspect oil pressure regulator valve(s), by-pass and pressure relief valve(s), oil thermostat, and filters; determine needed action.

I. DIESEL ENGINES

E. Cooling System

1. Check engine coolant type, level, and condition; test coolant for freeze protection and additive package concentration.
2. Test coolant temperature; test operation of temperature and level sensors, gauge, and/or sending unit; determine needed action.
3. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.
4. Recover coolant; flush and refill with recommended coolant/additive package; bleed cooling system.
5. Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed.
6. Inspect water pump, hoses, and clamps; determine needed action.

7. Inspect and pressure test cooling system(s); pressure test cap, tank(s), and recovery systems; inspect radiator and mountings; determine needed action.
8. Inspect, test, and repair thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; determine needed action.
9. Test engine block heater(s); determine needed action.
10. Diagnose engine coolant consumption; determine needed action.
11. Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed.
12. Inspect turbocharger cooling systems; determine needed action.

I. DIESEL ENGINES

F. Air Induction and Exhaust Systems

1. Inspect turbocharger(s), wastegate(s), and piping systems; determine needed action
2. Diagnose air induction system problems; inspect, clean, and/or replace cooler assembly, piping, hoses, clamps, and mountings; replace air filter as needed; reset restriction indicator (if applicable).
3. Inspect intake manifold, gaskets, and connections; determine needed action.

4. Inspect engine exhaust system, exhaust gas recirculation (EGR) system, and exhaust aftertreatment system for leaks, mounting, proper routing, and damaged or missing components; determine needed action.
5. Inspect crankcase ventilation system; service as needed.
6. Diagnose problems/faults in the exhaust gas recirculation (EGR) system including: EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determine needed action.
7. Perform air intake system restriction and leakage tests; determine needed action.
8. Perform intake manifold pressure (boost) test; determine needed action.
9. Check exhaust back pressure; determine needed action.
10. Inspect variable ratio geometry turbocharger (VGT), controls, and actuators (pneumatic, hydraulic, and electronic); determine needed action.
11. Demonstrate knowledge of charge air cooler operation and testing.
12. Diagnose exhaust aftertreatment system performance problems; determine needed action.
13. Diagnose preheater/inlet air heater or glow plug system and controls: determine needed action.

I. DIESEL ENGINES

G. Fuel System

1. Check fuel level and condition; determine needed action.
2. Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, hoses, lines, and fittings; determine needed action.
3. Inspect low pressure fuel system components (fuel pump, pump drives, screens, fuel/water separators/indicators, hoses, lines, filters, heaters, coolers, ECM cooling plates, check valves, pressure regulator valves, restrictive fittings, and mounting hardware); determine needed action.
4. Replace fuel filter; prime and bleed fuel system.
5. Inspect high pressure fuel system components (fuel pump, pump drives, hoses, injection lines, filters, hold-downs, fittings, seals, and mounting hardware).
6. Demonstrate knowledge and understanding of the different types of fuel systems.
7. Perform fuel supply and return system tests; determine needed action.
8. Perform cylinder contribution test using electronic service tool(s).
9. Demonstrate knowledge of how to set performance parameters using electronic service tools and service information system access.

I. DIESEL ENGINES

H. Engine Brakes

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

DRIVE TRAIN

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

Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

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

II. DRIVE TRAIN

A. General

1. Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.

2. Identify drive train components, transmission type, and configuration.
3. Use appropriate electronic service tool(s) and procedures to diagnose problems; check, record, and clear diagnostic codes; interpret digital multimeter (DMM) readings.

II. DRIVE TRAIN

B. Clutch

1. Inspect and adjust clutch, clutch brake, linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push-type and pull-type); check pedal height and travel; determine needed action.
2. Inspect clutch master cylinder fluid level; check clutch master cylinder, slave cylinder, lines, and hoses for leaks and damage; determine needed action.
3. Inspect, adjust, repair, and/or replace hydraulic clutch slave and master cylinders, lines, and hoses; bleed system.
4. Inspect, adjust, lubricate, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals.
5. Inspect, adjust, and/or replace single-disc clutch pressure plate and clutch disc.
6. Inspect, adjust, and/or replace two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs.

7. Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; determine needed action.
8. Inspect, adjust, and/or replace self-adjusting/continuous-adjusting clutch mechanisms.
9. Inspect and/or replace pilot bearing.
10. Identify causes of clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action.
11. Remove and install flywheel; inspect mounting area on crankshaft; inspect rear main oil seal; measure crankshaft end play; determine needed action.
12. Inspect flywheel and starter ring gear; measure flywheel face; measure pilot bore runout; determine needed action.
13. Inspect flywheel housing-to-transmission housing/engine mating surface(s); measure flywheel housing face and bore runout; determine needed action.

II. DRIVE TRAIN

C. Transmission

1. Inspect transmission shifter and linkage; inspect and/or replace transmission mounts, insulators, and mounting bolts.
2. Inspect transmission for leakage; determine needed action.

3. Replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; determine needed action.
4. Check transmission fluid level and condition; determine needed action.
5. Inspect transmission breather; inspect transmission oil filters, coolers, and related components; determine needed action.
6. Inspect speedometer components; determine needed action.
7. Inspect and test function of REVERSE light, NEUTRAL start, and warning device circuits; determine needed action.
8. Inspect, adjust, and replace transmission covers, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires.
9. Identify causes of transmission noise, shifting concerns, lockup, jumping out-of-gear, overheating, and vibration problems; determine needed repairs.
10. Inspect, test, repair, and/or replace air shift controls, lines, hoses, valves, regulators, filters, and cylinder assemblies.
11. Remove and reinstall transmission.
12. Inspect input shaft, gear, spacers, bearings, retainers, and slingers; determine needed action.
13. Inspect and adjust power take-off (PTO) assemblies, controls, and shafts; determine needed action.

14. Inspect and test transmission temperature gauge, wiring harnesses, and sensor/sending unit; determine needed action.

15. Inspect and test operation of automatic transmission, components, and controls; diagnose automatic transmission system problems; determine needed action.

16. Inspect and test operation of automated mechanical transmission, components, and controls; diagnose automated mechanical transmission system problems; determine needed action.

II. DRIVE TRAIN

D. Driveshaft and Universal Joints

1. Inspect, service, and/or replace driveshafts, slip joints, yokes, drive flanges, support bearings, universal joints, boots, seals, and retaining/mounting hardware; check phasing of all shafts.

2. Identify causes of driveshaft and universal joint noise and vibration problems; determine needed action.

3. Inspect driveshaft center support bearings and mounts; determine needed action.

4. Measure driveline angles; determine needed action.

II. DRIVE TRAIN

E. Drive Axles

1. Check and repair fluid leaks; inspect drive axle housing assembly, cover plates, gaskets, seals, vent/breather, and magnetic plugs.

2. Check drive axle fluid level and condition; check drive axle filter; determine needed action.
3. Inspect, adjust, repair, and/or replace air-operated power divider (inter-axle differential) assembly including: diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls.
4. Inspect drive axle shafts; determine needed action.
5. Remove and replace wheel assembly; check rear wheel seal and axle flange for leaks; determine needed action.
6. Inspect, repair, or replace drive axle lubrication system pump, troughs, collectors, slingers, tubes, and filters.
7. Identify causes of drive axle(s) drive unit noise and overheating problems; determine needed action.
8. Inspect and test drive axle temperature gauge, wiring harnesses, and sending unit/sensor; determine needed action.
9. Remove and replace differential carrier assembly.
10. Identify causes of drive axle wheel bearing noise and check for damage; determine needed action.
11. Inspect and/or replace components of differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearings.

12. Inspect and replace components of locking differential case assembly.
13. Inspect differential carrier housing and caps, side bearing bores, and pilot (spigot, pocket) bearing bore; determine needed action.
14. Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cages, and bearings.
15. Measure ring gear runout; determine needed action.
16. Measure and adjust drive pinion bearing preload.
17. Measure and adjust drive pinion depth.
18. Measure and adjust side bearing preload and ring gear backlash.
19. Check and interpret ring gear and pinion tooth contact pattern; determine needed action.
20. Inspect, adjust, or replace ring gear thrust block/screw.

BRAKES

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

Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Brakes are to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

III. BRAKES

A. General

1. Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.
2. Identify brake system components and configurations (including air and hydraulic systems, parking brake, power assist, and vehicle dynamic brake systems).
3. Identify brake performance problems caused by the mechanical/foundation brake system (air and hydraulic).
4. Use appropriate electronic service tool(s) and procedures to diagnose problems; check, record, and clear diagnostic codes; interpret digital multimeter (DMM) readings.

III. BRAKES

B. Air Brakes: Air Supply and Service Systems

1. Inspect, test, repair, and/or replace air supply system components such as compressor, governor, air drier, tanks, and lines; inspect service system components such as lines, fittings, mountings, and valves (hand brake/trailer control, brake relay, quick release, tractor protection, emergency/spring brake control/modulator, pressure relief/safety); determine needed action.

2. Test gauge operation and readings; test low pressure warning alarm operation; perform air supply system tests such as pressure build-up, governor settings, and leakage; drain air tanks and check for contamination; determine needed action.
3. Demonstrate knowledge and understanding of air supply and service system components and operations.
4. Inspect air compressor drive gear components (gears, belts, tensioners, and/or couplings); determine needed action.
5. Inspect air compressor inlet; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed.
6. Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check valves, manual and automatic drain valves; determine needed action.
7. Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; determine needed action.
8. Inspect and test brake application (foot/treadle) valve, fittings, and mounts; check pedal operation; determine needed action.

III. BRAKES

C. Air Brakes: Mechanical/Foundation Brake System

1. Inspect, test, repair, and/or replace service brake chambers, diaphragms, clamps, springs, pushrods, clevises, and mounting brackets; determine needed action.

2. Identify slack adjuster type; inspect slack adjusters; perform needed action.
3. Check camshafts (S-cam), tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; perform needed action.
4. Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action.
5. Inspect, clean, and adjust air disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; perform needed action.
6. Remove brake drum; clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; determine needed action.
7. Diagnose concerns related to the mechanical/foundation brake system including poor stopping, brake noise, premature wear, pulling, grabbing, or dragging; determine needed action.

III. BRAKES

D. Air brakes: Parking Brake System

1. Inspect, test, and/or replace parking (spring) brake chamber.
2. Inspect, test, and/or replace parking (spring) brake check valves, lines, hoses, and fittings.

3. Inspect, test, and/or replace parking (spring) brake application and release valve.
4. Manually release (cage) and reset (uncage) parking (spring) brakes.
5. Identify and test anti-compounding brake function; determine needed action.

III. BRAKES

E. Hydraulic Brakes: Hydraulic System

1. Check master cylinder fluid level and condition; determine proper fluid type for application.
2. Inspect hydraulic brake system for leaks and damage; test, repair, and/or replace hydraulic brake system components.
3. Check hydraulic brake system operation including pedal travel, pedal effort, and pedal feel; determine needed action.
4. Diagnose poor stopping, premature wear, pulling, dragging, imbalance, or poor pedal feel caused by problems in the hydraulic system; determine needed action.
5. Test master cylinder for internal/external leaks and damage; replace as needed.
6. Test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; determine needed action.

7. Test brake pressure differential valve; test warning light circuit switch, bulbs/LEDs, wiring, and connectors; determine needed action.
8. Bleed and/or flush hydraulic brake system.

III. BRAKES

F. Hydraulic Brakes: Mechanical/Foundation Brake System

1. Clean and inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine necessary action.
2. Inspect and clean disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; perform needed action.
3. Remove, clean and inspect brake drums; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; inspect wheel cylinders; determine serviceability.
4. Check disc brake caliper assembly mountings and slides; replace as needed.

III. BRAKES

G. Hydraulic Brakes: Parking Brake System

1. Check parking brake operation; inspect parking brake application and holding devices; adjust, repair, and/or replace as needed.

III. BRAKES

H. Power Assist Systems

1. Check brake assist/booster system (vacuum or hydraulic) hoses and control valves; check fluid level and condition (if applicable).
2. Check operation of emergency (back-up/reserve) brake assist system.
3. Identify concerns related to the power assist system (vacuum or hydraulic), including stopping problems caused by the brake assist (booster) system; determine needed action.
4. Inspect, test, repair, and/or replace hydraulic brake assist/booster systems, hoses, and control valves.

III. BRAKES

I. Vehicle Dynamic Brake Systems (Air and Hydraulic): Antilock Brake System (ABS), Automatic Traction Control (ATC) System, and Electronic Stability Control (ESC) System

1. Observe antilock brake system (ABS) warning light operation including trailer and dash mounted trailer ABS warning light; determine needed action.
2. Observe automatic traction control (ATC) and electronic stability control (ETC) warning light operation; determine needed action.
3. Identify stopping concerns related to the vehicle dynamic brake systems: ABS, ATC, and ESC; determine needed action.
4. Diagnose problems in the vehicle dynamic brake control systems; determine needed action.

5. Check and test operation of vehicle dynamic brake system (air and hydraulic) mechanical and electrical components; determine needed action.
6. Test vehicle/wheel speed sensors and circuits; adjust, repair, and/or replace as needed.
7. Bleed ABS hydraulic circuits.
8. Verify power line carrier (PLC) operation.

III. BRAKES

J. Wheel Bearings

1. Clean, inspect, lubricate, and/or replace wheel bearings and races/cups; replace seals and wear rings; inspect spindle/tube; inspect and replace retaining hardware; adjust wheel bearings; check hub assembly fluid level and condition; verify end play with dial indicator method.
2. Identify, inspect, and/or replace unitized/preset hub bearing assemblies.

SUSPENSION AND STEERING

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

Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose

of fuels/chemicals/materials in accordance with federal, state, and local regulations.

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

IV. SUSPENSION AND STEERING SYSTEMS

A. General

1. Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.
2. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation.
3. Identify suspension and steering system components and configurations.
4. Use appropriate electronic service tool(s) and procedures to diagnose problems; check, record, and clear diagnostic codes; interpret digital multimeter (DMM) readings.

IV. SUSPENSION AND STEERING SYSTEMS

B. Steering Column

1. Check steering wheel for free play, binding, and proper centering; inspect and service steering shaft U-joint(s), slip joint(s), bearings, bushings, and seals; phase steering shaft.

2. Diagnose causes of fixed and driver adjustable steering column and shaft noise, looseness, and binding problems.
3. Check cab mounting and adjust cab ride height.
4. Remove the steering wheel (includes steering wheels equipped with electrical/electronic controls and components); install and center the steering wheel.
5. Inspect, test, replace, and calibrate steering angle sensor.

IV. SUSPENSION AND STEERING SYSTEMS

C. Steering Pump and Gear Units

1. Check power steering pump and gear operation, mountings, lines, and hoses; check fluid level and condition; service filter; inspect system for leaks.
2. Flush and refill power steering system; purge air from system.
3. Diagnose causes of power steering system noise, binding, darting/oversteer, reduced wheel cut, steering wheel kick, pulling, non-recovery, turning effort, looseness, hard steering, overheating, fluid leakage, and fluid aeration problems.
4. Inspect, service, and/or replace power steering reservoir, seals, and gaskets.
5. Inspect and/or replace power steering system cooler, lines, hoses, clamps, mountings, and fittings.

6. Inspect and/or replace power steering gear(s) (single and/or dual) and mountings.

IV. SUSPENSION AND STEERING

D. Steering Linkage

1. Inspect, service, repair, and/or replace tie rod ends, ball joints, kingpins, pitman arms, idler arms, and other steering linkage components.

IV. SUSPENSION AND STEERING

E. Suspension Systems

1. Inspect, service, repair, and/or replace shock absorbers, bushings, brackets, and mounts.
2. Inspect, repair, and/or replace leaf springs, center bolts, clips, pins, bushings, shackles, U-bolts, insulators, brackets, and mounts.
3. Inspect, repair, and/or replace axle and axle aligning devices such as: radius rods, track bars, stabilizer bars, and torque arms; inspect related bushings, mounts, shims and attaching hardware; determine needed action.
4. Inspect, repair, and/or replace tandem suspension equalizer components; determine needed action.
5. Inspect, repair, and/or replace air springs, mounting plates, springs, suspension arms, and bushings.

6. Inspect, test, repair, and/or replace air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; check and record ride height.
7. Inspect and service kingpins, steering knuckle bushings, locks, bearings, seals, and covers.
8. Measure, record and adjust ride height; determine needed action.
9. Diagnose rough ride problems; determine needed action.

IV. SUSPENSION AND STEERING

F. Wheel Alignment Diagnosis and Repair

1. Demonstrate understanding of alignment angles.
2. Diagnose causes of vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problems.
3. Check, record, and adjust camber.
4. Check, record, and adjust caster.
5. Check, record, and adjust toe settings.
6. Check rear axle(s) alignment (thrustline/centerline) and tracking.
7. Identify turning/Ackerman angle (toe-out-on-turns) problems.
8. Check front axle alignment (centerline).

IV. SUSPENSION AND STEERING

G. Wheels and Tires

1. Inspect tire condition; identify tire wear patterns; measure tread depth; verify tire matching (diameter and tread); inspect valve stem and cap; set tire pressure; determine needed action.
2. Diagnose wheel/tire vibration, shimmy, pounding, and hop (tramp) problems; determine needed action.
3. Check wheel mounting hardware; check wheel condition; remove and install wheel/tire assemblies (steering and drive axle); torque fasteners to manufacturer's specification using torque wrench.
4. Inspect tire and wheel for proper application (size, load range, position, and tread design); determine needed action.

IV. SUSPENSION AND STEERING

H. Frame and Coupling Devices

1. Inspect, service, and/or adjust fifth wheel, pivot pins, bushings, locking mechanisms, mounting hardware, air lines, and fittings.
2. Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed action.
3. Inspect, install, and/or replace frame hangers, brackets, and cross members; determine needed action.

4. Inspect, repair, or replace pintle hooks and draw bars (if applicable).
5. Inspect, service, and/or adjust sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.

ELECTRICAL & ELECTRONIC SYSTEMS

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

Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Electrical/Electronic Systems are 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

1. Research vehicle service information, including vehicle service history, service precautions, and technical service bulletins.
2. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law).
3. Demonstrate proper use of test equipment when measuring source voltage, voltage drop (including grounds), current flow, continuity, and resistance.

4. Demonstrate knowledge of the causes and effects of shorts, grounds, opens, and resistance problems in electrical/electronic circuits; identify and locate faults in electrical/electronic circuits.
5. Use wiring diagrams during the diagnosis (troubleshooting) of electrical/electronic circuit problems.
6. Measure parasitic (key-off) battery drain; determine needed action.
7. Demonstrate knowledge of the function, operation, and testing of fusible links, circuit breakers, relays, solenoids, diodes, and fuses; perform inspection and testing; determine needed action.
8. Inspect, test, repair (including solder repair), and/or replace components, connectors, seals, terminal ends, harnesses, and wiring; verify proper routing and securement; determine needed action.
9. Use appropriate electronic service tool(s) and procedures to diagnose problems; check, record, and clear diagnostic codes; interpret digital multimeter (DMM) readings.
10. Diagnose faults in the data bus communications network; determine needed action.
11. Identify electrical/electronic system components and configuration.
12. Check frequency, pulse width, and waveforms of electrical/electronic signals using appropriate test equipment; interpret readings; determine needed repairs.

13. Understand the process for software transfer, software updates, and/or reprogramming of electronic modules.

V. ELECTRICAL/ELECTRONIC SYSTEMS

B. Battery System

1. Identify battery type and system configuration.
2. Confirm proper battery capacity for application; perform battery state-of-charge test; perform battery capacity test, determine needed action.
3. Inspect battery, battery cables, connectors, battery boxes, mounts, and hold-downs; determine needed action.
4. Charge battery using appropriate method for battery type.
5. Jump-start vehicle using a booster battery and jumper cables or using an appropriate auxiliary power supply.
6. Check low voltage disconnect (LVD) systems; determine needed action.
7. Inspect, clean, and service battery; replace as needed.
8. Inspect and clean battery boxes, mounts, and hold-downs; repair or replace as needed.
9. Test, and clean battery cables and connectors; repair or replace as needed.

10. Identify electrical/electronic modules, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery.

V. ELECTRICAL/ELECTRONIC SYSTEMS

C. Starting System

1. Demonstrate understanding of starter system operation.
2. Perform starter circuit cranking voltage and voltage drop tests; determine needed action.
3. Inspect and test starter control circuit switches (key switch, push button, and/or magnetic switch), relays, connectors, terminals, wires, and harnesses (including over-crank protection); determine needed action.
4. Diagnose causes of no-crank or slow crank condition; differentiate between electrical and engine mechanical problems; determine needed action.
5. Perform starter current draw tests; determine needed action.
6. Remove and replace starter; inspect flywheel ring gear or flex plate.

V. ELECTRICAL/ELECTRONIC SYSTEMS

D. Charging System

1. Identify and understand operation of the generator (alternator).

2. Test instrument panel mounted voltmeters and/or indicator lamps; determine needed action.
3. Inspect, adjust, and/or replace generator (alternator) drive belt; check pulleys and tensioners for wear; check fans and mounting brackets; verify proper belt alignment; determine needed action.
4. Inspect cables, wires, and connectors in the charging circuit.
5. Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action.
6. Perform charging circuit voltage drop tests; determine needed action.
7. Remove, inspect, and/or replace generator (alternator).

V. ELECTRICAL/ELECTRONIC SYSTEMS

E. Lighting Systems

1. Diagnose causes of brighter-than-normal, intermittent, dim, or no-light operation; determine needed action.
2. Test, replace, and aim headlights.
3. Inspect cables, wires, and connectors in the lighting systems.
4. Diagnose faults in tractor-to-trailer multi-wire connector(s), cables, and holders; determine needed action.

5. Diagnose faults in switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, and control components/modules of exterior lighting systems; determine needed action.

6. Diagnose faults in switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, and control components/modules of interior lighting systems; determine needed action.

7. Diagnose faults in switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, and control components/modules of auxiliary lighting circuits; determine needed action.

V. ELECTRICAL/ELECTRONIC SYSTEMS

F. Instrument Cluster and Driver Information Systems

1. Check gauge and warning indicator operation.
2. Diagnose faults in the sensor/sending units, gauges, switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, printed circuits, and control components/modules of the instrument cluster, driver information systems, and warning systems; determine needed action.
3. Inspect, test, replace, and calibrate (if applicable) electronic speedometer, odometer, and tachometer systems.

V. ELECTRICAL/ELECTRONIC SYSTEMS

G. Cab and Chassis Electrical Systems

1. Diagnose operation of horn(s), wiper/washer, and occupant restraint systems.

2. Understand operation of safety systems and related circuits (such as: speed control, collision avoidance, lane departure, and camera systems).
3. Understand operation of comfort and convenience systems and related circuits (such as: power windows, power seats, power locks, remote keyless entry, steering wheel controls, and cruise control).
4. Understand operation of entertainment systems and related circuits (such as: radio, DVD, navigation, speakers, antennas, and voice-activated accessories).
5. Understand the operation of power inverter, protection devices, connectors, terminals, wiring, and control components/modules of auxiliary power systems.
6. Understand operation of telematics systems.
7. Diagnose faults in engine block and engine oil heater(s); determine needed action.

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

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

Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

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

VI. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

A. General

1. Research vehicle service information, including refrigerant/oil type, vehicle service history, service precautions, and technical service bulletins.
2. Identify heating, ventilation, and air conditioning (HVAC) components and configuration.
3. Use appropriate electronic service tool(s) and procedures to diagnose problems; check, record, and clear diagnostic codes; interpret digital multimeter (DMM) readings.
4. Diagnose heating and air conditioning problems; determine needed action.
5. Identify refrigerant type; test for contamination; select and connect proper gauge set/test equipment; record temperature and pressure readings.
6. Perform A/C system performance test; determine needed action.
7. Perform A/C system leak test; determine needed action.
8. Inspect condition of refrigerant oil removed from A/C system; determine needed action.

9. Determine oil and oil capacity for system application and/or component replacement.

VI. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

B. Refrigeration System Components

1. Inspect, remove, and replace A/C compressor drive belts, pulleys, and tensioners; verify proper belt alignment.
2. Check A/C system operation including system pressures; visually inspect A/C components for signs of leaks; check A/C monitoring system (if applicable).
3. Inspect A/C condenser for airflow restrictions; determine needed action.
4. Inspect, test, service, and/or replace A/C compressor and clutch assembly; check compressor clutch air gap; determine needed action.
5. Inspect, service, and/or replace A/C system hoses, lines, fittings, O-rings, seals, and service valves.
6. Inspect, remove, and/or replace receiver/drier or accumulator/drier.
7. Inspect, remove, and/or replace expansion valve or orifice (expansion) tube.
8. Inspect evaporator housing water drain; perform needed action.

9. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and/or control module) to interrupt system operation; determine needed action.

10. Determine procedure to remove and reinstall evaporator.

11. Determine procedure to inspect and/or replace condenser.

VI. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

C. Heating, Ventilation, and Engine Cooling Systems

1. Inspect engine cooling system and heater system hoses and pipes; determine needed action.

2. Inspect HVAC system heater ducts, doors, hoses, cabin filters, and outlets; determine needed action.

3. Identify the source of A/C system odors; determine needed action.

4. Diagnose temperature control problems in the HVAC system; determine needed action.

5. Determine procedure to remove, inspect, reinstall, and/or replace engine coolant and heater system components.

VI. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

D. Operating Systems and Related Controls

1. Verify HVAC system blower motor operation; confirm proper air distribution; confirm proper temperature control; determine needed action.
2. Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action.
3. Diagnose A/C compressor clutch control systems; determine needed action.
4. Diagnose malfunctions in the vacuum, mechanical, and electrical components and controls of the HVAC system; determine needed action.

VI. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

E. Refrigerant Recovery, Recycling, and Handling

1. Understand correct use and maintenance of refrigerant handling equipment.
2. Understand how to identify A/C system refrigerant; test for sealants; recover, evacuate, and charge A/C system; add refrigerant oil as required.
3. Understand how to recycle, label, and store refrigerant.

CAB

For every task in Cab the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Cab are to listen to and verify operator's concern, review past maintenance documents, and record condition on appropriate document.

VII. CAB

A. General

1. Research vehicle service information, including vehicle service history, service precautions, and technical service bulletins.
2. Use appropriate electronic service tool(s) and procedures to diagnose problems; check, record, and clear diagnostic codes; check and record trip/operational data; reset maintenance monitor (if applicable); interpret digital multimeter (DMM) readings.

VII. CAB

A. Instruments and Controls

1. Inspect mechanical key condition; check operation of ignition switch; check operation of indicator lights, warning lights and/or alarms; check instruments; record oil pressure and system voltage; check operation of electronic power take-off (PTO) and engine idle speed controls (if applicable).
2. Check operation of all accessories.

3. Understand operation of auxiliary power unit (APU)/electric power unit (EPU).

VII. CAB

B. Safety Equipment

1. Test operation of horns (electric and air); test warning device operation (reverse, air pressure, etc.); check condition of spare fuses, safety triangles, fire extinguisher, and all required decals; inspect seat belts and sleeper restraints; inspect condition of wiper blades, arms, and linkage; determine needed action.

VII. CAB

C. Hardware

1. Test operation of wipers and washer; inspect windshield glass for cracks or discoloration; check sun visor; check seat condition, operation, and mounting; check door glass and window operation; verify operation of door and cab locks; inspect steps and grab handles; inspect mirrors, mountings, brackets, and glass; determine needed action.
2. Record all physical damage.
3. Lubricate all cab grease fittings; inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables.
4. Inspect cab mountings, hinges, latches, linkages, and ride height; determine needed action.

5. Inspect quarter fender, mud flaps, and brackets; determine needed action.