Medium/Heavy Truck

Study Guide

Assessments:
2151 Diesel Engine Repair Technician
2152 Preventative Maintenance Inspection Technician
2153 Electrical Systems Repair Technician
2154 Brakes Technician
2156 Heating, Ventilation, and Air Conditioning Repair Technician

Aligned with the ASE/NATEF standards

Endorsed by the Oklahoma Automobile Dealers Association

Oklahoma Works
Overview

This study guide is designed to help students prepare for the Medium/Heavy Truck assessments. It not only includes information about the assessments, but also the skills standards upon which the assessments are based and test taking strategies.

Each of the four sections in this guide provides useful information for students preparing for the Medium/Heavy Truck assessments.

- CareerTech and Competency-Based Education: A Winning Combination
- Medium/Heavy Truck assessments
  - Assessment Information
  - Standards and Test Content
  - Sample Questions
  - Abbreviations, Symbols, and Acronyms
- Strategies for Test Taking Success
- Notes

These assessments are aligned with the 2014 National Institute for Automotive Service Excellence (ASE)/National Automotive Technicians Education Foundation (NATEF) standards and endorsed by the Oklahoma Automobile Dealers Association (OADA). The assessments measure a student’s ability to apply knowledge of the skills necessary for success in the Medium/Heavy Truck sector.

The NATEF task list was reviewed and updated in 2014. A national committee was assembled to review the standards used in Medium/Heavy Truck certification programs. 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 standards, 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.

For more information about NATEF, go to www.natef.org.

The OADA (405-521-1295) is an association of new car and heavy-duty truck dealers in Oklahoma. Its primary purpose is to promote the common business interests of those engaged in the automotive industry.

Disclaimer
The Oklahoma Department of Career and Technology Education cannot vouch for the accuracy of the information contained in any linked site. Our intent is to simply provide a list of sites that we feel may be useful to you. Some of the links presented here are commercial sites. We do not endorse these sites or their products, and we do not request or accept any fee for inclusion on this list. The Department makes no representations or warranties, express or implied, with respect to the document, or any part thereof, including any warrantees of title, noninfringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.

Equal Opportunity/Non Discrimination Statement
The Oklahoma Department of Career and Technology Education does not discriminate on the basis of race, color, national origin, sex/gender, age, disability, or veteran status. Inquiries concerning application of this policy may be referred to the ODCTE Compliance Coordinator, 1500 W. 7th Ave. Stillwater, OK 74074-4364, or call 1-800 522-5810 or (405) 377-2000.
CareerTech and Competency-Based Education: A Winning Combination

Competency-based education uses learning outcomes that emphasize both the application and creation of knowledge and the mastery of skills critical for success. In a competency-based education system, students advance upon mastery of competencies, which are measurable, transferable outcomes that empower students.

Career and technology education uses industry professionals and certification standards to identify the knowledge and skills needed to master an occupation. This input provides the foundation for development of curriculum, assessments and other instructional materials needed to prepare students for wealth-generating occupations and produce comprehensively trained, highly skilled employees demanded by the work force.

Tools for Success

CareerTech education relies on three basic instructional components to deliver competency-based instruction: skills standards, curriculum materials, and competency assessments.

Skills standards provide the foundation for competency-based instruction and outline the knowledge and skills that must be mastered in order to perform related jobs within an industry. Skills standards are aligned with national skills standards and/or industry certification requirements; therefore, a student trained to the skills standards is equally employable in local, state and national job markets.

Curriculum materials and textbooks contain information and activities that teach students the knowledge and skills outlined in the skills standards. In addition to complementing classroom instruction, curriculum resources include supplemental activities that enhance learning by providing opportunities to apply knowledge and demonstrate skills.

Certification Assessments test the student over material outlined in the skills standards and taught using the curriculum materials and textbooks. When used with classroom performance evaluations, certification assessments provide a means of measuring occupational readiness.

Each of these components satisfies a unique purpose in competency-based education and reinforces the knowledge and skills students need to gain employment and succeed on the job.

Measuring Success

Evaluation is an important component of competency-based education. Pre-training assessments measure the student’s existing knowledge prior to receiving instruction and ensure the student’s training builds upon this knowledge base. Formative assessments administered throughout the training process provide a means of continuously monitoring the student’s progress towards mastery.

Certification assessments provide a means of evaluating the student’s mastery of knowledge and skills. Coaching reports communicate assessment scores to students and provide a breakdown of assessment results by standard area. The coaching report also shows how well the student has mastered skills needed to perform major job functions and identifies areas of job responsibility that may require additional instruction and/or training.
Medium/Heavy Duty Truck Maintenance
Assessment Information

What are the Medium/Heavy Duty Truck Maintenance assessments?
The Diesel Engine Repair Technician, Preventative Maintenance Inspection Technician and Electrical Systems Repair Technician assessments are end-of-program assessments for students in Medium/Heavy Duty Truck Maintenance programs. The assessments provide an indication of student mastery of knowledge and concepts necessary for success in careers in this area.

How were the assessments developed?
The assessments were developed by the CareerTech Testing Center. The assessments and standards align with ASE/NATEF's standards and are endorsed by the Oklahoma Automobile Dealers Association. Items were developed and reviewed by a committee of subject matter experts.

The NATEF committee assigned a priority number, which determines the significance of each task for test development: P-1, P-2, or P-3 to all skills. These priority numbers pertain to requirements for instruction on tasks as follows:

P-1: 95% must be taught in the curriculum.
P-2: 80% must be taught in the curriculum.
P-3: 50% must be taught in the curriculum.

What do the assessments cover?
Specifically, the test includes multiple-choice test items over the following areas:

Diesel Engine Repair Technician (55 questions)
- General Engine Diagnosis 16%
- Cylinder Head and Valve Train Diagnosis and Repair 9%
- Engine Block Diagnosis and Repair 16%
- Lubrication Systems Diagnosis and Repair 7%
- Cooling System Diagnosis and Repair 18%
- Air Induction and Exhaust Systems Diagnosis and Repair 7%
- Fuel System Diagnosis and Repair 24%
- Engine Brakes 2%

Preventative Maintenance Inspection Technician (55 questions)
- Engine System 24%
- Cab and Hood 18%
- Electrical/Electronics 11%
- Frame and Chassis 47%
Electrical/Electronic Systems Repair Technician (55 questions)
General Electrical Systems 24%
Battery 15%
Starting System 7%
Charging System Diagnosis and Repair 15%
Lighting Systems 16%
Gauges and Warning Devices 11%
Related Electrical Systems 12%

Brakes Technician (55 questions)
Air Brakes 56%
Hydraulic Brakes 24%
Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC) 16%
Wheel Bearings 4%

Heating, Ventilation, and Air Conditioning Repair Technician (55 questions)
HVAC Systems 7%
A/C System and Components 47%
Heating and Engine Cooling Systems 20%
Operating Systems and Related Controls 15%
Refrigerant Recovery, Recycling, and Handling 11%

What are the benefits of using these assessments?
Students receive a certificate for each assessment that he/she passes. This certificate may be included in his/her portfolio and used to communicate the student’s mastery of the subject matter to potential employers.

When should the assessment be taken?
The CareerTech Testing Center recommends that students take the assessments as soon as possible after receiving all standards-related instruction, rather than waiting until the end of the school year.

Are the assessments timed?
No. However, most students finish the assessment within one hour.

What resources can students use on these assessments?
Students are allowed to use calculators and scratch paper on CTTC assessments; however, these items must be provided by the testing proctor and returned to the proctor before the student’s exam is submitted for scoring. Calculator apps on cell phones and other devices may not be used on these assessments.
What accommodations can be made for students with Individualized Education Plans (IEPs)?

Accommodations are allowed for students with an Individualized Education Plan. Examples of allowable accommodations include:

- Extended time — This assessment is not timed; therefore, students may take as much time as needed to finish. The assessment must be completed in one testing session.

- Readers — A reader may be used to read the assessment to a student who has been identified as needing this accommodation.

- Enlarged text — Students needing this accommodation can activate this feature by clicking the ^A icon in the upper right corner of the screen.

What can students expect on Test Day?

All CTTC assessments are web-based and delivered exclusively by a proctor in the school’s assessment center. The proctor cannot be an instructor or anyone who was involved with the students during instruction.

Assessments are delivered in a question-by-question format. When a question is presented, the student can select a response or leave the question unanswered and advance to the next question. Students may also flag questions to revisit before the test is scored. All questions must be answered before the test can be submitted for scoring.

After the assessment is scored, the student will receive a score report that not only shows the student’s score on the assessment, but also how the student performed in each standard area.

Can students retake the test?

Students may retake the test unless their school or state testing policies prohibit retesting. Students who can retest must wait at least three days between test attempts.
Standards and Test Content
Diesel Engine Repair Technician

General Diagnosis and Repair (9 questions)

1. Inspect fuel, oil, Diesel Exhaust Fluid (DEF) and coolant levels, and condition; determine needed action. (P-1)

2. Identify 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-2)

5. Check engine 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 engine surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action. (P-1)

7. Identify engine vibration problems. (P-2)

8. Check and record electronic diagnostic codes. (P-1)

Cylinder Head and Valve Train Diagnosis and Repair (5 questions)

1. 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-2)

2. Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action. (P-3)

3. Measure valve head height relative to deck and valve face-to-seat contact; determine needed action. (P-3)

4. Inspect injector sleeves and seals; measure injector tip or nozzle protrusion; determine needed action. (P-3)

5. Inspect valve train components; determine needed action. (P-1)

6. Reassemble cylinder head. (P-3)

7. Inspect, measure, and replace/reinstall overhead camshaft; measure/adjust end play and backlash. (P-3)

8. Inspect electronic wiring harness and brackets for wear, bending, cracks, and looseness; determine needed action. (P-1)

9. Adjust valve bridges (crossheads); adjust valve clearances and injector settings. (P-2)
Engine Block Diagnosis and Repair (9 questions)

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 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 run out; determine needed action. (P-3)
18. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure run out; determine needed action. (P-2)

Lubrication Systems Diagnosis and Repair (4 questions)

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 systems; determine needed action. *(P-2)*
7. Determine proper lubricant and perform oil and filter change. *(P-1)*

**Cooling System Diagnosis and Repair (10 questions)**

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)*
4. Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed. *(P-2)*
5. Recover coolant, 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 test 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)*
10. Inspect turbo charger cooling systems; determine needed action. *(P-1)*

**Air Induction and Exhaust Systems Diagnosis and Repair (4 questions)**

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-3)*
3. Check exhaust back pressure; determine needed action. *(P-3)*
4. Inspect turbocharger(s), wastegate, and piping systems; determine needed action. *(P-2)*
5. Inspect turbocharger(s) (variable ratio/geometry VGT), pneumatic, hydraulic, electronic controls, and actuators. *(P-2)*
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; replace as needed. *(P-2)*
10. Inspect exhaust manifold, piping, mufflers, and mounting hardware; repair or replace as needed. (P-2)
11. Inspect exhaust after treatment devices; determine necessary action. (P-2)
12. Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action. (P-2)
13. Inspect exhaust gas recirculation (EGR) system including EGR valve, cooler, piping, filter, electronic sensors, controls, and wiring; determine needed action. (P-2)

**Fuel System Diagnosis and Repair (13 questions)**

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 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)

**Electronic Fuel Management System**

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 electronic service tool(s) (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 electronic service tool(s) access and interpret customer programmable parameters. (P-1)
8. Perform on-engine inspections, tests and adjustments on 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 electronic service tool(s). (P-1)
11. Perform on-engine inspections and tests on hydraulic electronic unit injectors (HEUI) and system electronic controls; determine needed action. *(P-2)*

12. Perform on-engine inspections and tests on hydraulic electronic unit injector (HEUI) high pressure oil supply and control systems; determine needed action. *(P-2)*

13. Perform on-engine inspections and tests on high pressure common rail (HPCR) type injection systems; determine needed action. *(P-2)*

14. Inspect high pressure injection lines, hold downs, fittings and seals; determine needed action. *(P-2)*

**Engine Brakes (1 question)**

1. Inspect and adjust engine compression/exhaust brakes; determine needed action. *(P-2)*

2. Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; determine needed action. *(P-3)*

3. Inspect engine compression/exhaust brake housing, valves, seals, lines, and fittings; repair or replace as needed. *(P-3)*
Standards and Test Content
Preventive Maintenance Inspection Technician

Engine System (13 questions)

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)

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)

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-2)
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)
8. Inspect diesel exhaust fluid (DEF) system, to include tanks, lines, gauge pump, and filter. (P-1)
9. Inspect selective catalyst reduction (SCR) system; including diesel exhaust fluid (DEF) for proper levels, leaks, mounting and connections. (P-2)
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, aeration, and protection level (freeze point). (P-1)
8. Service coolant filter. (P-1)
9. Inspect water pump. (P-1)

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 for analysis. (P-2)

Cab and Hood (10 questions)

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-2)
5. Check HVAC controls. (P-1)
6. Check operation of all accessories. (P-1)
7. Using electronic service tool(s) 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)

Safety Equipment
1. Check operation of electric/air horns and reverse warning devices. (P-1)
2. Check condition of spare fuses, safety 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)
**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-2)
8. Lubricate all cab and hood grease fittings. (P-3)
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)

**Heating, Ventilation & Air Conditioning (HVAC)**

1. Inspect A/C condenser and lines for condition and visible leaks; check mountings. (P-2)
2. Inspect A/C compressor and lines for condition and visible leaks; check mountings. (P-2)
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)

**Electrical/Electronics (6 questions)**

**Battery and Starting Systems**

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

**Charging System**

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

Frame and Chassis (26 questions)

Air Brakes
1. Check operation of parking brake. (P-1)
2. Record air governor cut-in and 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)
7. Check low air pressure warning devices. (P-1)
8. Check emergency (spring) brake control/modulator valve, if applicable. (P-1)
9. Check tractor protection valve. (P-1)
10. Test air pressure build-up time. (P-1)
11. Inspect coupling air lines, holders, and glad hands. (P-1)
12. Check brake chambers and air lines for secure mounting and damage. (P-1)
13. Check operation of air dryer. (P-1)
14. Inspect and record brake shoe/pad condition, thickness, and contamination. (P-1)
15. Inspect and record condition of brake drums/rotors. (P-1)
16. Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing. (P-1)
17. Check operation and adjustment of brake automatic slack adjusters (ASA); check and record push rod stroke. (P-1)
18. Lubricate all brake component grease fittings. (P-1)
19. Check condition and operation of hand brake (trailer) control valve, if applicable. (P-2)
20. Perform antilock brake system (ABS) operational system self-test. (P-1)
21. Drain air tanks and check for contamination. (P-1)
22. Check condition of pressure relief (safety) valves. (P-1)
Hydraulic Brakes

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)
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. (P-1)
5. Inspect calipers for leakage, binding 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)

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, lines 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, drive shafts, boot 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)
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/screen, if applicable; 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, if applicable; check and clean magnetic plugs. (P-2)
17. Check interaxle differential lock operation. (P-1)
18. Check transmission range shift operation. (P-1)
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 kingpins 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 axle locating components (radius, torque, and/or track rods). (P-1)

Tires and Wheels
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; determine needed action. (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 wheel mounting hardware condition; determine needed action. (P-1)
7. Inspect wheels for cracks, damage and proper hand hold alignment. (P-1)
8. Check tire matching (diameter and tread) on single and dual tire applications. (P-1)

Frame and Fifth Wheel
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, if applicable. (P-2)
5. Lubricate all fifth wheel grease fittings and plate, if applicable. (P-1)
6. Inspect frame and frame members for cracks and damage. (P-1)
Standards and Test Content
Electrical Systems Repair Technician

General Electrical Systems (13 questions)

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)
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)

Battery (8 questions)

1. Identify battery type; 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 appropriate method for battery type. (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 using proper safety procedures. (P-1)
8. Perform battery capacitance test; determine needed action. (P-2)
9. Identify and test low voltage disconnect (LVD) systems; determine needed repair. (P-2)
Starting System (4 questions)

1. Perform starter circuit cranking voltage and voltage drop tests; determine needed action. *(P-1)*
2. Inspect and test components (key switch, push button and/or magnetic switch) and wires and harnesses in the starter control circuit; replace as needed. *(P-2)*
3. Inspect and test, starter relays and solenoid/switches; replace as needed. *(P-1)*
4. Remove and replace starter; inspect flywheel ring gear or flex plate. *(P-1)*

Charging System Diagnosis and Repair (8 questions)

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-1)*
7. Inspect, repair, or replace cables, wires, and connectors in the charging circuit. *(P-1)*

Lighting Systems (9 questions)

1. Interface with vehicle’s on-board computer; perform diagnostic procedures using recommended electronic service tool(s) (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)*
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, low voltage disconnect (LVD), connectors, terminals, wires, and control components/modules; repair or replace as needed. *(P-2)*
7. Inspect and test interior cab light circuit switches, bulbs/LEDs, 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.  \((P-1)\)

Gauges and Warning Devices (6 questions)

1. Interface with vehicle’s on-board computer; perform diagnostic procedure, verify instrument cluster operations using recommended electronic service tool(s) (including PC based software and/or data scan tools); determine needed action.  \((P-1)\)
2. Identify the 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.  \((P-1)\)
6. Inspect, test, replace and calibrate (if applicable) electronic speedometer, odometer, and tachometer systems.  \((P-1)\)

Related Electrical Systems (7 questions)

1. Interface with vehicle’s on-board computer; perform diagnostic procedures using recommended electronic service tool(s) (including PC based software and/or data scan tools); determine needed action.  \((P-1)\)
2. Diagnose the causes of constant, intermittent, or no horn operation; determine needed action.  \((P-2)\)
3. Inspect and test horn circuit relays, horns, switches, connectors, wires, clock springs, and control components/modules; repair or replace as needed.  \((P-2)\)
4. Identify the 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)

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 the causes of slow, intermittent, or no power 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 buss communication problems; determine needed action. (P-2)
Standards and Test Content
Brakes Technician

Air Brakes (31 questions)

Air Supply and Service Systems

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)

3. Drain air reservoir/tanks; check for oil, water, and foreign material; determine needed action. (P-1)

4. Inspect air compressor drive gear, belts, and coupling, adjust or 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-1)

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/treadle) 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)
Mechanical/Foundation

19. 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)

20. Inspect and test service brake chambers, diaphragm, clamp, spring, pushrod, clevis, and mounting brackets; repair or replace as needed. (P-1)

21. Identify type, inspect and service slack adjusters; perform needed action. (P-1)

22. Inspect camshafts, tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; replace as needed. (P-1)

23. Inspect, clean, and adjust air disc brake caliper assemblies; determine needed repairs. (P-2)

24. Inspect and measure brake shoes or pads; perform needed action. (P-1)

25. Inspect and measure brake drums or rotors; perform needed action. (P-1)

Parking Brakes

26. 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)

27. Inspect and test parking (spring) brake check valves, lines, hoses, and fittings; replace as needed. (P-1)

28. Inspect and test parking (spring) brake application and release valve; replace as needed. (P-1)

29. Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers’ recommendations. (P-1)

30. Identify and test anti compounding brake function (P-1)

Hydraulic Brakes (13 questions)

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. Inspect and test master cylinder for internal/external leaks and damage; replace as needed. (P-1)

3. Inspect hydraulic system brake lines, flexible hoses, and fittings for leaks and damage; replace as needed. (P-1)

4. Inspect and test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; replace as needed. (P-3)

5. Inspect and test brake pressure differential valve and warning light circuit switch, bulbs/LEDs, wiring, and connectors; repair or replace as needed. (P-2)

6. Inspect disc brake caliper assemblies; replace as needed. (P-1)

7. Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type. (P-1)
Mechanical/Foundation Brakes

8. Identify poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by mechanical components; determine needed action. (P-2)

9. Inspect and measure rotors; perform needed action. (P-1)

10. Inspect and measure disc brake pads; inspect mounting hardware; perform needed action. (P-1)

11. Check parking brake operation; inspect parking brake application and holding devices; adjust and replace as needed. (P-2)

Power Assist Units

12. Identify stopping problems caused by the brake assist (booster) system; determine needed action. (P-3)

13. Inspect, test, repair, or replace hydraulic brake assist (booster), hoses, and control valves; determine proper fluid type. (P-3)

14. Check emergency (back-up, reserve) brake assist system. (P-3)

Air and Hydraulic Antilock Brake Systems (ABS) and Automatic Traction Control (ATC) (9 questions)

1. Observe antilock brake system (ABS) warning light operation (includes trailer and 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 electronic service tool(s); 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. (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)

9. Verify power line carrier (PLC) operations. (P-2)

Wheel Bearings (2 questions)

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. Verify end play with dial indicator method. (P-1)

2. Identify, inspect or replace unitized/preset hub bearing assemblies. (P-2)
Standards and Test Content
Heating, Ventilation, and Air Conditioning Repair Technician

HVAC Systems (4 questions)

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)

A/C System and Components (26 questions)

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 contamination in the A/C system components; determine needed action. (P-3)
8. Interface with vehicle’s on-board computer; perform diagnostic procedures using recommended electronic service tool(s)(including PC based software and/or data scan tools); determine needed action. (P-2)

Compressor and Clutch

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

**Evaporator, Condenser, and Related Components**

16. Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses. (P-1)
17. Inspect A/C system hoses, lines, filters, fittings, and seals; determine needed action. (P-1)
18. Inspect and test A/C system condenser. Check for proper airflow and mountings; determine needed action. (P-1)
19. Inspect and replace receiver/drier or accumulator/drier. (P-1)
20. Inspect and test cab/sleeper refrigerant solenoid, expansion valve(s); check placement of thermal bulb (capillary tube); determine needed action. (P-3)
21. Remove and replace orifice tube. (P-1)
22. Inspect and test cab/sleeper evaporator core; determine needed action. (P-3)
23. Inspect, clean, or repair evaporator housing and water drain; inspect and service/replace evaporator air filter. (P-1)
24. Identify and inspect A/C system service ports (gauge connections); determine needed action. (P-1)
25. Identify the cause of system failures resulting in refrigerant loss from the A/C system high pressure relief device; determine needed action. (P-2)

**Heating and Engine Cooling Systems (11 questions)**

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; determine needed action. (P-1)
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)
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)
Operating Systems and Related Controls (8 questions)

Electrical
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-2)
7. Inspect and test HVAC system electrical/electronic control panel assemblies; determine needed action. (P-2)
8. Interface with vehicle’s on-board computer; perform diagnostic procedures using recommended electronic service tool(s) (including PC based software and/or data scan tools); determine needed action. (P-2)

Air/Mechanical
9. Identify causes of HVAC air and mechanical control problems; determine needed action. (P-3)
10. Inspect and test HVAC system air and mechanical control panel assemblies; determine needed action. (P-3)
11. Inspect, test, and adjust HVAC system air and mechanical control cables and linkages; determine needed action. (P-3)
12. Inspect and test HVAC system actuators and hoses; determine needed action. (P-3)
13. Inspect, test, and adjust HVAC system ducts, doors, and outlets; determine needed action. (P-3)

Refrigerant Recovery, Recycling, and Handling (6 questions)

**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)
Sample Questions

1. If the engine oil level is over the full mark, Technician A says the cause could be coolant leaking into the oil. Technician B says the cause could be fuel leaking into the oil. Who is correct?
   a. Technician A
   b. Technician B
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

2. What is indicated by a dull knock when the engine is under load?
   a. broken piston ring
   b. excessive valve lash
   c. worn main bearing
   d. worn timing gears

3. The purpose of valve rotators is to:
   a. assist in lubrication of the valve stem.
   b. automatically adjust valve lash.
   c. prolong life of the valve and seat.
   d. seal the valve stem.

4. Valve clearance can be adjusted when the piston of the cylinder to be adjusted is at:
   a. BDC on the exhaust stroke.
   b. TDC on the compression stroke.
   c. TDC on the exhaust stroke.
   d. TDC on the intake stroke.

5. The purpose of a thrust main bearing is to:
   a. absorb clutch pressure and establish crankshaft end play.
   b. keep the crankshaft from slipping off main bearings.
   c. locate the crankshaft front pulley.
   d. raise oil pressure.

6. Plastigage is used for measuring:
   a. camshaft end clearances.
   b. crankshaft bearing clearances.
   c. crankshaft thrust bearing clearance.
   d. valve clearance.
7. A fan belt that is too tight on a truck can cause:
   a. bearing failure in the water pump.
   b. fan blade failure.
   c. fan speeding.
   d. water pump slippage.

8. Most electrical grounds in the vehicle wiring system are attached to the chassis so that current can pass through to ground and back to the:
   a. grounded battery terminal.
   b. isolated battery terminal.
   c. load source terminal.
   d. positive battery terminal.

9. Approximately how many volts can each cell of a battery produce?
   a. 1.2
   b. 2.1
   c. 3.0
   d. 6.0

10. Technician A says that the low pressure switch keeps the A/C clutch from engaging. Technician B says the high pressure switch keeps the A/C clutch from engaging. Who is correct?
    a. Technician A
    b. Technician B
    c. Both Technician A and Technician B
    d. Neither Technician A nor Technician B
Sample Questions — Key

1. If the engine oil level is over the full mark, Technician A says the cause could be coolant leaking into the oil. Technician B says the cause could be fuel leaking into the oil. Who is correct?
   a. Technician A Wrong, but plausible
   b. Technician B Wrong, but plausible
   c. Both Technician A and Technician B Correct
   d. Neither Technician A nor Technician B Wrong, but plausible

2. What is indicated by a dull knock when the engine is under load?
   a. broken piston ring Wrong, but plausible
   b. excessive valve lash Wrong, but plausible
   c. worn main bearing Correct
   d. worn timing gears Wrong, but plausible

3. The purpose of valve rotators is to:
   a. assist in lubrication of the valve stem. Wrong, but plausible
   b. automatically adjust valve lash. Wrong, but plausible
   c. prolong life of the valve and seat. Correct
   d. seal the valve stem. Wrong, but plausible

4. Valve clearance can be adjusted when the piston of the cylinder to be adjusted is at:
   a. BDC on the exhaust stroke. Wrong, but plausible
   b. TDC on the compression stroke. Correct
   c. TDC on the exhaust stroke. Wrong, but plausible
   d. TDC on the intake stroke. Wrong, but plausible

5. The purpose of a thrust main bearing is to:
   a. absorb clutch pressure and establish crankshaft end play. Correct
   b. keep the crankshaft from slipping off main bearings. Wrong, but plausible
   c. locate the crankshaft front pulley. Wrong, but plausible
   d. raise oil pressure. Wrong, but plausible

6. Plastigage is used for measuring:
   a. camshaft end clearances. Wrong, but plausible
   b. crankshaft bearing clearances. Correct
   c. crankshaft thrust bearing clearance. Wrong, but plausible
   d. valve clearance. Wrong, but plausible
7. A fan belt that is too tight on a truck can cause:
   a. bearing failure in the water pump.  Correct
   b. fan blade failure.  Wrong, but plausible
   c. fan speeding.  Wrong, but plausible
   d. water pump slippage.  Wrong, but plausible

8. Most electrical grounds in the vehicle wiring system are attached to the chassis so that current can pass through to ground and back to the:
   a. grounded battery terminal.  Correct
   b. isolated battery terminal.  Wrong, but plausible
   c. load source terminal.  Wrong, but plausible
   d. positive battery terminal.  Wrong, but plausible

9. Approximately how many volts can each cell of a battery produce?
   a. 1.2  Wrong, but plausible
   b. 2.1  Correct
   c. 3.0  Wrong, but plausible
   d. 6.0  Wrong, but plausible

10. Technician A says that the low pressure switch keeps the A/C clutch from engaging. Technician B says the high pressure switch keeps the A/C clutch from engaging. Who is correct?
    a. Technician A  Wrong, but plausible
    b. Technician B  Wrong, but plausible
    c. Both Technician A and Technician B  Correct
    d. Neither Technician A nor Technician B  Wrong, but plausible
Abbreviations, Symbols and Acronyms

When abbreviations, symbols or acronyms are more commonly used in written and verbal communications within the automotive industry than the words they represent, they will also be used on the written examination required for competency. The following is a list of abbreviations, symbols and acronyms used on the automotive examinations.

' Feet
" Inches
° Degrees
$ Dollars
O₂ Oxygen
% Percent
2K a coating that needs a hardener
ABS anti-lock brake system
AC alternating current
A/C air conditioning
ASE Automotive Service Excellence
ATF automatic transmission fluid
BCM body control module
CAN/BUS Controller Area Network
CCA cold cranking amp
CV constant-velocity
CVT continuously variable transmission
DC direct current
DEF diesel exhaust fluid
DMM digital multimeter
DTC diagnostic trouble code
DVOM digital volt/ohm meter
ECM electronic control module
EGR exhaust gas recirculation
EVAP evaporative emission
Ft feet
FWD front wheel drive
GTX a name of a GE developed plastic (Noryl GTX)
HEPA high-efficiency particulate arrestance
Hg Mercury
HVAC heating, ventilation, and air conditioning
IAC idle air control
ID inside diameter
In inch
IP instrument panel
ISO International Organization for Standardization
kV kilovolts
MIG metal inert gas
MIL malfunction indicator lamp
mm millimeter
MPH miles per hour
MSDS  material safety data sheet  
NATEF  National Automotive Technicians Education Foundation  
NIOSH  National Institute for Occupational Safety and Health  
OBD  On-Board Diagnostics  
OEM  original equipment manufacturer  
OSHA  Occupational Safety and Health Administration  
PAG  polyalkylene glycol  
PCV  positive crankcase ventilation  
PM  permanent generator  
POA  pilot operated absolute  
PSI  pounds per square inch  
RPM  revolutions per minute  
SAI  steering axis inclination  
SMC  sheet moulded compound  
SRS  supplemental restraint system  
STRSW  squeeze type resistance spot welding  
TDC  top dead center  
TEO  thermoplastic elastomeric olefin  
TIG  tungsten inert gas  
TPS  throttle position sensor  
TSB  Transportation Safety Bulletin  
TV  throttle valve  
USB  universal serial bus  
V  volt  
VOC  volatile organic compounds
Test Taking Strategies

This section of the study guide contains valuable information for testing success and provides a common-sense approach for preparing for and performing well on any test.

General Testing Advice

1. Get a good night’s rest the night before the test — eight hours of sleep is recommended.
2. Avoid junk food and “eat right” several days before the test.
3. Do not drink a lot or eat a large meal prior to testing.
4. Be confident in your knowledge and skills!
5. Relax and try to ignore distractions during the test.
6. Focus on the task at hand — taking the test and doing your best!
7. Listen carefully to the instructions provided by the exam proctor. If the instructions are not clear, ask for clarification.

Testing Tips

1. Read the entire question before attempting to answer it.
2. Try to answer the question before reading the choices. Then, read the choices to determine if one matches, or is similar, to your answer.
3. Do not change your answer unless you misread the question or are certain that your first answer is incorrect.
4. Answer questions you know first, so you can spend additional time on the more difficult questions.
5. Check to make sure you have answered every question before you submit the assessment for scoring — unanswered questions are marked incorrect.