

THE OFFICIAL ASE STUDY GUIDE

ASE Medium/Heavy Truck Tests



National Institute for
**AUTOMOTIVE
SERVICE
EXCELLENCE**

ASE MEDIUM/HEAVY TRUCK TESTS

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OVERVIEW

Introduction

The *Official ASE Study Guide for the Medium/Heavy Truck Tests* is designed to help technicians study for the ASE certification tests. It includes detailed information about the technical knowledge that is covered in the Medium/Heavy Truck tests. And if needed, you should find it easier to select additional reference material that will assist you with the test preparation needs.

ASE voluntary certification helps technicians prove their abilities to themselves, to their employers, and to their customers. By passing ASE tests you will earn the most valuable credential available to truck technicians. Because the tests are tough, you'll have the satisfaction of proving to yourself that you are among the elite in your profession. What's more, these credentials are recognized throughout the U.S.

Certified technicians promote customer trust and improve the image of the industry. And trust and professionalism are the first steps to a better, more prosperous business.

ASE encourages you to take the tests and to join the proven pros who wear The ASE Blue Seal of Excellence.®

How Do I Become Certified?

There are eight tests in the Medium/Heavy Truck Technician certification series. Class 4 through Class 8 trucks are covered. Medium duty Class 4–6 is 14,001 to 26,000 lbs. gross vehicle weight (GVW). Heavy duty Class 7–8 is 26,001 and above gross vehicle weight (GVW).

If you pass at least one test and have at least two years of relevant hands-on work experience, you will become certified as an ASE Medium/Heavy Truck Technician. (Appropriate vocational training may be substituted for up to one year of work experience.) If you pass the Diesel Engines Test (T2) and tests T3, T4, T5, T6, T7 and T8 you will earn the certificate of Master Medium/Heavy Truck Technician.

If you are currently certified in Diesel Engines (A9, H2, S2, or T2) and Electrical/Electronic Systems (A6, H6, S6, or T6), you are eligible to take the L2 Electronic Diesel Engine Diagnosis Specialist test.

Your test results will be emailed to you immediately following your testing appointment. Results will not be given over the phone nor will they be released to

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anyone without your written permission. If you fail a test, you must wait 30 days from the test date before you can purchase it again.

Certification credentials are valid for five years. This ensures that certified technicians are recognized as being up-to-date in their profession. If it has been almost five years since you passed a test, it is time to register for the corresponding recertification test. Most recertification tests are about half the length of the regular tests.

Medium/Heavy Truck Tests

This Study Guide contains Test Specifications, task lists, and sample questions for the following ASE tests:

- Gasoline Engines (Test T1)
- Diesel Engines (Test T2)
- Drive Train (Test T3)
- Brakes (Test T4)
- Suspension and Steering (Test T5)
- Electrical/Electronic Systems (Test T6);
- Heating, Ventilation, and Air Conditioning (HVAC) Systems (Test T7)
- Preventive Maintenance Inspection (PMI) (Test T8)

ASE offers certification in areas including Automobile, Truck Equipment, Transit Bus, School Bus, Collision Repair/Refinish, Parts Specialist, and Advanced Level specialties. Separate *Study Guides* are available.

For full information on ASE testing as well as downloadable *Study Guides* and other test preparation resources, visit www.ase.com.

Who Writes the Questions?

The questions, written by service industry experts familiar with all aspects of medium/heavy truck repair, are entirely job-related. They are designed to test the skills that you need to know in servicing trucks; theoretical knowledge is not covered.

Each question has its roots in an ASE “item-writing” workshop where service representatives from medium/heavy truck manufacturers, aftermarket parts and equipment manufacturers, working technicians and technical educators get together to share ideas and translate them into test questions. Each test question written by these experts must survive review by all members of the group. The questions are written to deal with practical problems of diagnosis and repair experienced by technicians in their day-to-day work.

From there, all questions are pretested and quality-checked on a national sample of technicians. Those questions that meet ASE standards of quality and accuracy are included in the tests; the “rejects” are sent back to the drawing board or discarded altogether.

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How Long are the Tests?

M/H Truck Tests 2019		Certification Tests		Recertification Tests	
Test	Name	Number of questions*	Testing time	Number of questions	Testing time
T1	Gasoline Engines	60*	1¼ hrs.	25	30 min.
T2	Diesel Engines	65*	1½ hrs.	28	45 min.
T3	Drive Train	50*	1 hr.	20	30 min.
T4	Brakes	60*	1¼ hrs.	25	30 min.
T5	Suspension and Steering	60*	1¼ hrs.	25	30 min.
T6	Electrical / Electronic Systems	60*	1½ hrs.	25	45 min.
T7	Heating, Ventilation, and A/C	50*	1 hr.	20	30 min.
T8	Preventive Maintenance Inspection	60*	1¼ hrs.	25	30 min.

* ASE certification tests include 10 research questions that are not counted for score. You will not be told which questions these are, so you should answer every question. No research questions are added to recertification tests. You are eligible to take the recertification test only after you have previously passed the corresponding certification test.

How Do I Prepare for the ASE Tests?

Become familiar with test content and question format.

The Test Specifications in this booklet contain a description of the content covered by each test. The Task Lists describe the actual work performed by technicians in each specialty area. Together, these form a “blueprint” for writing and assembling the ASE tests.

Please note that each question on the test is related to a particular or set of tasks in the list. Therefore, review the list, thinking about whether you know how to perform each task listed.

All questions are multiple-choice.. The sample questions in this Study Guide are examples of the five types of questions on the test. Note that some types of questions have extra instructions that you should follow.

Be sure to read each question carefully so that you understand exactly what is being asked. *Each question tests a specific diagnostic or repair problem and has only **one** correct answer.*

To summarize, we suggest the following steps to be taken to prepare for the tests:

OVERVIEW (CONTINUED)

- Step 1.** Carefully read the content list for each test you will attempt.
- Step 2.** Study the list for each area.
- Step 3.** Go over the sample questions to become familiar with each question type. *This is very important!*
- Step 4.** Review steps 1 through 3 above, and identify the skill areas where you need additional study.

Getting Started

Registration information is available on the ASE website at www.ase.com. This site will provide you with the locations that testing is available and other important information, including an electronic version of this and all other ASE *Study Guides*.

While on the ASE website, take the time to create your own **myASE account** (if you do not already have one), which will allow you to register for tests, make your own test appointments, and have direct access to all your personal ASE certification information. And as always, if you have questions that www.ase.com does not answer, contact our helpful customer service staff at contactus@ase.com or 1-800-390-6789.

At the Test Center—Some Tips

Try to be well rested on exam day. Arrive early enough to park and find the Test Center office. Late arrivals may be turned away by Test Center staff. If you cannot take a test because you are late, you will forfeit your test fees.

Bring your Admission Ticket and government-issued photo ID with you. Books, calculators, and other reference material will not be permitted in the test room. You will be assigned a locker to store all your personal items. No electronic devices (including cell phones) are allowed in the test room. Most test centers have airport-level security procedures for all candidates, so be prepared for “wandering” or other security checks.

You will receive scratch paper and pencils, and if you are taking an Advanced Level L1 or L2 test, a Composite Vehicle Reference booklet. Each test appointment begins with a short tutorial on the operation of the testing platform. You can also preview the system online at www.ase.com/asedemo before you arrive at the Test Center.

Bring--

- ✓ Admission Ticket
- ✓ Current Gov't Issued Photo ID

Leave in locker--

- ✓ Books
- ✓ Calculator
- ✓ Coat
- ✓ Cell Phone
- ✓ Wallet
- ✓ Keys

OVERVIEW (CONTINUED)

Each test has a specific time limit, as listed in the chart on page 5. During your test, the computer screen will continuously display the amount of time left. If you finish early, you may review your answers or end the test and continue to the next test (if your appointment includes multiple tests). Once you submit a test for scoring, you cannot go back and review it. If you are taking several tests and need a short break, take it after you have completed a test, when you reach the screen that asks if you are taking additional tests. Do not take a break during your test as the test clock will continue to run.

If a question is difficult, mark the answer that you think is correct and flag the question using the on-screen button. Then go on to the next question. When you have finished the test, you may have time to go back to the flagged questions. Your score is based on the number of correct answers that you give, so you should try to answer every question.

When you finish your last test, you will be given a short customer satisfaction survey. When you complete it, inform the staff and leave. When you check your email, your test results will be waiting for you! If you need a paper copy right away, ask the staff to print your results before you leave the test center.

Test Content and Sample Questions

The following material is designed to help technicians prepare for ASE certification tests.

Each of the sections begins with the Test Specifications, which list the main categories covered and the number of test questions, as well as percentage of the test devoted to each topic.

The Task List describes the work activities a technician should be able to perform. This list was developed by working technicians and technical experts from across the country and will provide a valuable checklist telling you what to study for the test.

Note that the number of tasks in the list does not equal the number of questions on the test. Some tasks are complex and broad in scope and may be covered by several questions. Other tasks are simple and narrow in scope and one question may cover several tasks. The main goal in listing the tasks is to describe accurately what is done on the job, not to match each task to a particular test question. In other words, every question will relate to at least one task, but not every task will be covered on the test.

Sample questions follow the task list. Although these questions will not appear on tests, they are in the same format as actual test questions. Different types of multiple-choice questions are used on the ASE tests. Note the different instructions for some questions. ■

TEST SPECIFICATIONS

GASOLINE ENGINES (TEST T1)

Content Area	Questions in Test	Percentage of Test
A. General Engine Diagnosis	14	28%
B. Cylinder Head and Valve Train Diagnosis and Repair	4	8%
C. Engine Block Diagnosis and Repair	4	8%
D. Lubrication and Cooling Systems Diagnosis and Repair	3	6%
E. Ignition System Diagnosis and Repair	6	12%
F. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair	6	12%
G. Emissions Control Systems Diagnosis and Repair	5	10%
H. Computerized Engine Controls Diagnosis and Repair	8	16%
Total	50	100%

A. General Diagnosis (14 questions)

1. Verify the complaint and/or road test vehicle; review driver/customer interview and past maintenance documents (if available); determine further diagnosis.
2. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, technical service bulletins, and service campaigns/recalls.
3. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine needed action.
4. Diagnose noises and/or vibration problems related to engine performance; determine needed action.
5. Diagnose the cause of unusual exhaust color, odor, and sound; determine needed action.
6. Perform engine manifold vacuum or pressure tests; determine needed action.
7. Perform cylinder power balance test; determine needed action.
8. Perform cylinder compression test; determine needed action.
9. Perform cylinder leakage/leak-down test; determine needed action.
10. Diagnose engine mechanical, electrical, electronic, fuel, and ignition problems with an oscilloscope, engine analyzer, digital multimeter (DMM), and/or scan tool; determine needed action.

T1 LIST (CONTINUED)

11. Inspect engine compartment wiring harness, connectors, seals, locks, vacuum hoses; check for proper routing and condition; determine needed repairs.
12. Observe and interpret instrument panel gauge readings.
13. Read and interpret electrical schematic diagrams and symbols.
14. Test and diagnose emissions or driveability problems caused by battery condition, connections, or excessive key-off battery drain; determine needed repairs.
15. Perform starter current draw test; determine needed action.
16. Perform starter and charging circuit voltage drop tests; determine needed action.
17. Inspect, test, and repair or replace components, connectors, and wires in the starter and charging control circuits.
18. Differentiate between electrical and mechanical problems that cause a slow crank, no-crank, extended cranking, or a cranking noise condition.
19. Test and diagnose engine performance problems resulting from an undercharge, overcharge, or a no-charge condition; determine needed action.
20. Inspect, adjust, and replace alternator (generator) drive belts, pulleys, tensioners, and fans.

B. Cylinder Head and Valve Train Diagnosis and Repair (4 questions)

1. Remove, inspect, disassemble, and clean cylinder head assembly(s).
2. Inspect threaded holes, studs, and bolts for serviceability; service/replace as needed.
3. Measure cylinder head thickness; check mating surfaces for warpage and surface finish; inspect for cracks/damage; check condition of passages; inspect core and gallery plugs; determine serviceability and needed repairs.
4. Inspect valves, guides, seats, springs, retainers, locks, and seals; determine serviceability and needed repairs.
5. Reassemble, check, and install cylinder head assembly(s) and gasket(s) as specified by the manufacturer.
6. Inspect pushrods, rocker arms, rocker arm shafts, electronic wiring harness, and brackets; repair/replace as needed.
7. Inspect, install, and adjust valve lifters and retainers; adjust valve clearance.
8. Inspect, measure, and replace/reinstall overhead camshaft and bearings; measure and adjust endplay.

C. Engine Block Diagnosis and Repair (4 questions)

1. Remove, inspect, service, and install pans, covers, ventilation systems, gaskets, seals, and wear sleeves.
2. Disassemble, clean and inspect engine block for cracks; check mating surfaces and related components for damage or warpage and surface finish; check deck height; check condition of passages, core, and gallery plugs; inspect threaded holes, studs, dowel pins and bolts for serviceability; service/replace as needed.
3. Inspect and measure cylinder walls for wear and damage; determine serviceability and needed repairs.
4. Inspect in-block camshaft bearings for wear and damage; replace as needed.
5. Inspect, measure, and replace/reinstall in-block camshaft; measure/and correct end play; inspect, replace/reinstall, and adjust valve lifters.
6. Clean and inspect crankshaft and journals for surface cracks and damage; check condition of oil passages; check passage plugs; measure journal diameters; check mounting surfaces; determine needed repairs.

T1 LIST (CONTINUED)

7. Diagnose piston, connecting rod bearing, and main bearing wear patterns that indicate connecting rod and crankshaft alignment or bearing bore problems; check bearing bore and bushing condition; determine needed repairs.
8. Determine the proper select-fit components such as pistons, connecting rods, and main bearings.
9. Inspect and replace main bearings; check cap fit and bearing clearances; check and correct crankshaft end play.
10. Remove and/or replace the timing chain and gears; ensure correct timing.
11. Inspect, measure, or replace pistons, pins, and retainers.
12. Measure piston-to-cylinder wall clearance.
13. Check ring-to-groove fit and end gaps; install rings on pistons. Assemble pistons and connecting rods and install in block; install rod bearings and check clearances.
14. Inspect and/or replace crankshaft vibration damper.
15. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks, wear, and runout; determine needed repairs.

D. Lubrication and Cooling Systems Diagnosis and Repair (3 questions)

1. Diagnose engine lubrication system problems; perform oil pressure tests; determine needed repairs.
2. Disassemble and inspect oil pump (includes gears, rotors, housing, and pick-up assembly); measure oil pump clearance; inspect pressure relief devices and pump drive; determine needed repairs.
3. Inspect, clean, test, reinstall/replace oil cooler, by-pass valve, lines and hoses.
4. Change engine oil and filter(s); add proper type, viscosity, and rating of oil.
5. Inspect and reinstall/replace pulleys, tensioners, and drive belts; adjust drive belts and check alignment.
6. Diagnose engine cooling system temperature and pressure problems; determine needed repairs.
7. Inspect, test, and replace thermostat, coolant by-pass, and thermostat housing, seals, hoses, and fittings.
8. Inspect and test coolant; drain, flush, and refill cooling system with recommended coolant; bleed air from cooling system as required.
9. Inspect and replace water pump, housing, and hoses.
10. Inspect and replace radiator, pressure cap, expansion tank, and coolant recovery system.
11. Inspect, test, and repair/replace fan (both electrical and mechanical), fan clutch, fan shroud, air dams, and cooling fan electrical circuits.
12. Verify proper operation of engine related gauges and warning indicators; determine needed repairs.

E. Ignition System Diagnosis and Repair (6 questions)

1. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, reduced fuel economy, and emissions problems; determine root cause; determine needed repairs.
2. Interpret ignition system related diagnostic trouble codes (DTCs); determine needed repairs.
3. Inspect, test, repair, or replace ignition primary circuit wiring and components.

T1 LIST (CONTINUED)

4. Inspect, test, repair, or replace ignition system secondary circuit wiring and components.
5. Inspect, test, and replace ignition coil(s).
6. Inspect, test, and replace ignition system sensors; adjust as necessary.
7. Inspect, test, and/or replace ignition control module (ICM)/powertrain/engine control module (PCM/ECM); reprogram as needed.

F. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair (6 questions)

1. Diagnose fuel system related problems such as no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, reduced fuel economy, and emissions problems; determine root cause; determine needed repairs.
2. Interpret fuel or induction system related diagnostic trouble codes (DTCs); analyze fuel trim and other scan tool data; determine needed repairs.
3. Inspect fuel tank, filler neck, and fuel cap; inspect and replace fuel lines, fittings, and hoses; check fuel for contaminants and quality.
4. Inspect, test, and replace fuel pump(s) and/or fuel pump assembly; inspect, service, and replace fuel filters.
5. Inspect and test electric fuel pump control circuits and components; determine needed repairs.
6. Inspect, test, and repair or replace fuel pressure regulation system and components of fuel injection systems; perform fuel pressure/volume test.
7. Inspect, remove, service or replace throttle body assembly and controls, including electronic throttle actuator control (TAC) systems; make related adjustments.
8. Inspect, test, clean, and replace fuel injectors and fuel rails.
9. Inspect, service, and repair or replace air filtration system components.
10. Inspect air induction system, intake manifold, and gaskets for air/vacuum leaks.
11. Remove, clean, inspect, test, and repair or replace fuel system vacuum and electrical components and connections.
12. Inspect, service, and replace exhaust manifold, gaskets, exhaust pipes, oxygen sensors, mufflers, catalytic converters, resonators, tailpipes, and heat shields.
13. Test for exhaust system restriction or leaks; determine needed repair.

G. Emissions Control Systems Diagnosis And Repair (5 questions)

1. Test and diagnose emissions or driveability problems caused by positive crankcase ventilation (PCV) system.
2. Inspect, service, and replace positive crankcase ventilation (PCV) filter, valve, tubes, orifice/metering device, and hoses.
3. Test and diagnose driveability problems caused by the exhaust gas recirculation (EGR) system.
4. Interpret exhaust gas recirculation (EGR) related scan tool data and diagnostic trouble codes (DTCs); determine needed repairs.
5. Inspect, test, service, and replace components of the exhaust gas recirculation (EGR) system, including EGR valve, tubing, passages, vacuum/pressure controls, filters, hoses, electrical/electronic sensors, controls, solenoids, and wiring of EGR systems.
6. Test and diagnose emissions or driveability problems caused by the secondary air injection or catalytic converter systems.

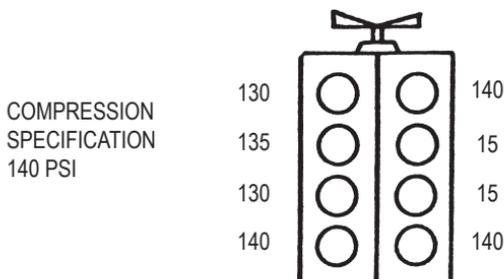
T1 LIST (CONTINUED)

7. Interpret secondary air injection system related scan tool data and diagnostic trouble codes (DTCs); determine needed repairs.
8. Inspect, test, service, and replace mechanical components and electrical/electronically-operated components and circuits of secondary air injection system.
9. Inspect catalytic converter. Interpret catalytic converter related diagnostic trouble codes (DTCs); analyze related scan tool data to determine root cause of DTCs; determine needed repairs.
10. Test and diagnose emissions or driveability problems caused by the evaporative emissions control system.
11. Interpret evaporative emissions-related scan tool data and diagnostic trouble codes (DTCs); determine needed repairs.
12. Inspect, test, and replace canister, lines, hoses, mechanical, and electrical components of the evaporative emissions control system.

H. Computerized Engine Controls Diagnosis And Repair (8 questions)

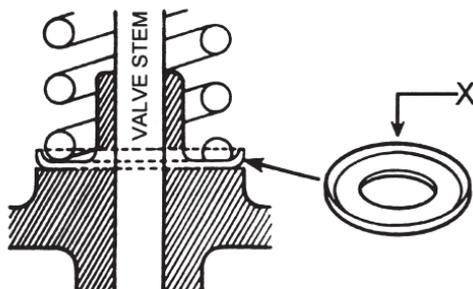
1. Research OBD II system operation to determine the enable criteria for setting and clearing diagnostic trouble codes (DTCs) and malfunction indicator lamp (MIL) operation. Perform appropriate drive cycle to determine system condition and verify repair effectiveness.
2. Interpret OBD II scan tool data stream, diagnostic trouble codes (DTCs), freeze frame data, system monitors, monitor readiness indicators, and trip and drive cycle information.
3. Read and interpret technical literature (service publications and information including wiring schematics).
4. Diagnose the causes of emissions or driveability problems with stored or active diagnostic trouble codes (DTCs).
5. Diagnose the causes of emissions or driveability problems without diagnostic trouble codes (DTCs).
6. Use a scan tool, digital multimeter (DMM), or digital storage oscilloscope (DSO) to inspect or test computerized engine control system sensors, actuators, circuits, and powertrain/engine control module (PCM/ECM); determine needed repairs.
7. Measure and interpret voltage, voltage drop, amperage, and resistance using digital multimeter (DMM) readings.
8. Test, remove, inspect, clean, service, and repair or replace power and ground distribution circuits and connections.
9. Remove and replace the powertrain/engine control module (PCM/ECM); reprogram as needed.
10. Diagnose driveability and emissions problems resulting from failures of interrelated systems (for example: cruise control, security alarms/theft deterrent, torque controls, traction controls, torque management, A/C, and/or non-OEM installed accessories).
11. Clear diagnostic trouble codes (DTCs), run all OBD II monitors, and verify the repair. ■

SAMPLE QUESTIONS GASOLINE ENGINES (TEST T1)



1. Technician A says that the compression test readings shown above could be caused by a blown cylinder head gasket. Technician B says that the compression test readings shown above could be caused by incorrect valve timing. Who is right?

- * (A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B



2. Technician A says that part X shown above is used to improve valve spring rotation. Technician B says that part X shown above is used to correct installed spring height. Who is right?

- (A) A only
* (B) B only
(C) Both A and B
(D) Neither A nor B

T1 SAMPLE QUESTIONS (CONTINUED)

3. An engine is using too much oil.
Technician A says that worn valve guides could be the cause.
Technician B says that tapered cylinder walls could be the cause.
Who is right?
- (A) A only
(B) B only
- * (C) Both A and B
(D) Neither A nor B
4. While performing a cylinder leakage test on an engine, the technician sees air bubbles in the upper radiator tank. Which of these could be the cause?
- (A) Worn piston rings
* (B) A cracked engine block
(C) A cracked overflow bottle
(D) A leaking intake valve
5. Technician A says that main bearing oil clearance can be checked with plastigage.
Technician B says that main bearing oil clearance can be checked with a feeler gauge.
Who is right?
- * (A) A only
(B) B only
- (C) Both A and B
(D) Neither A nor B
6. The technician finds no spark and no injector pulses on a vehicle that will not start. The cause could be a failed:
- (A) mass air flow sensor (MAF).
* (B) crankshaft position sensor (CKP).
(C) throttle position sensor (TPS).
(D) fuel pump module (FP).

T1 SAMPLE QUESTIONS (CONTINUED)

7. An engine with a return-type fuel injection system has high fuel pressure at idle. Which of these could be the cause?
- * (A) Low manifold vacuum
 - (B) A leaking fuel pump check valve
 - (C) A plugged fuel injector
 - (D) High manifold vacuum
8. A truck has stored “Fuel System Too Lean–Bank 1” and “Fuel System Too Lean–Bank 2” DTCs. Which of these could be the cause?
- (A) A leaking Bank 2 exhaust manifold gasket
 - (B) A failed Bank 1 HO2S
 - (C) A restricted fuel return line
 - * (D) A leaking intake manifold gasket

This question contains the word EXCEPT. Read the question carefully before choosing your answer.

9. Any of these could cause a catalytic converter to overheat EXCEPT:
- (A) a fouled spark plug.
 - * (B) a stuck-closed exhaust gas recirculation (EGR) valve.
 - (C) worn piston rings..
 - (D) a leaking fuel injector.

TEST SPECIFICATIONS AND TASK LIST DIESEL ENGINES (TEST T2)

Content Area	Questions in Test	Percentage of Test
A. General Engine Diagnosis	11	20%
B. Cylinder Head and Valve Train Diagnosis and Repair	4	7%
C. Engine Block Diagnosis and Repair	5	9%
D. Lubrication and Cooling Systems Diagnosis and Repair	6	11%
E. Air Induction and Exhaust Systems Diagnosis and Repair	6	11%
F. Fuel System Diagnosis and Repair	16	29%
G. Starting and Charging System Diagnosis and Repair	4	7%
H. Engine Brakes	3	5%
Total	55	100%

A. General Engine Diagnosis (11 questions)

1. Verify the complaint, and road/dyno test vehicle; review driver/customer interview and past maintenance documents (if available); determine further diagnosis.
2. Identify engine model and serial number to research applicable vehicle and service information, service precautions, service procedures, and technical service bulletins; determine needed actions.
3. Inspect engine assembly and compartment for fuel, oil, coolant, exhaust, or other leaks; determine needed action.
4. Inspect engine compartment wiring harness, connectors, seals, and locks; check for proper routing and condition; determine needed repairs.
5. Isolate and diagnose engine noises; determine needed action.
6. Check engine exhaust for odor, smoke color, and density; determine needed action.
7. Perform fuel supply and return system tests; check fuel for contamination, quality, and consumption; determine needed action.
8. Perform air intake system restriction and leakage tests; determine needed action.
9. Perform intake manifold and system pressure tests; determine needed action.
10. Perform exhaust back pressure and temperature tests; determine needed action.
11. Perform crankcase pressure test; determine needed action.
12. Diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action.

T2 TASK LIST (CONTINUED)

13. Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action.
14. Isolate and diagnose engine related vibration problems; determine needed action.
15. Check cooling system for freeze point, level, contamination, coolant type, temperature, pressure, circulation, conditioner concentration, filtration, and fan operation; determine needed action.
16. Check lubrication system for contamination, oil level, temperature, pressure, filtration, and oil consumption; interpret oil analysis information; determine needed action.
17. Check and record electronic diagnostic codes and trip/operational data; monitor electronic data; verify customer programmable parameters; clear diagnostic trouble codes; verify the repair; determine if further diagnosis is needed.
18. Perform visual inspection for physical damage and missing, modified, or tampered with components; determine needed action.

B. Cylinder Head and Valve Train Diagnosis and Repair (4 questions)

1. Remove, inspect, disassemble, and clean cylinder head assembly(s).
2. Inspect threaded holes, studs, and bolts for serviceability; service/ replace as needed.
3. Measure cylinder head thickness, and check mating surfaces for warpage and surface finish; inspect for cracks/damage; check condition of passages; inspect core and gallery plugs; determine serviceability and needed action.
4. Inspect valves, guides, seats, springs, retainers, rotators, locks and seals; determine serviceability and needed actions.
5. Inspect and/or replace injector sleeves and seals; pressure test to verify repair (if applicable); measure injector tip or nozzle protrusion where specified by manufacturer.
6. Inspect, and/or replace valve bridges (crossheads) and guides; adjust bridges (crossheads) if applicable.
7. Clean components; reassemble, check, and install cylinder head assembly.
8. Inspect pushrods, rocker arms, rocker arm shafts, electronic wiring harness, and brackets for wear, bending, cracks, looseness, and blocked oil passages; repair/ replace as needed.
9. Inspect, install, and adjust cam followers and retainers.
10. Adjust valve clearance and injector settings.
11. Inspect, measure, and replace/reinstall overhead camshaft and bearings; measure and adjust endplay and backlash.

C. Engine Block Diagnosis and Repair (5 questions)

1. Remove, inspect, service, and install pans, covers, ventilation systems, gaskets, seals, and wear rings.
2. Disassemble, clean and inspect engine block for cracks; check mating surfaces and related components for damage or warpage and surface finish; check deck height; check condition of passages, core, and gallery plugs; inspect threaded holes, studs, dowel pins and bolts for serviceability; service/replace as needed.
3. Inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed action.

T2 TASK LIST (CONTINUED)

4. Inspect and measure cylinder walls or liners for wear and damage; determine needed action.
5. Replace/reinstall cylinder liners and seals; check and adjust liner height/protrusion.
6. Inspect in-block camshaft bearings for wear and damage; replace as needed.
7. Inspect, measure, and replace/reinstall in-block camshaft; measure/adjust end play; inspect, replace/reinstall cam followers or lifters (tappets).
8. Clean and inspect crankshaft and journals for surface cracks and damage; check condition of oil passages; check passage plugs; measure journal diameters; check mounting surfaces; determine needed action.
9. Inspect and replace main bearings; verify bearing and cap fit. Verify bearing clearances; check and correct crankshaft end play; determine needed action.
10. Inspect, reinstall, and time the drive gear train (includes checking engine position and speed indicator components, gear wear, and backlash of crankshaft, camshaft, auxiliary, drive, and idler gears; service shafts, bushings, and bearings); determine needed action.
11. Clean, inspect, measure, or replace pistons, pins, and retainers; determine needed action.
12. Measure piston-to-cylinder wall clearance; determine needed action.
13. Check ring-to-groove fit and end gaps; install rings on pistons; determine needed action.
14. Identify piston, connecting rod bearing, and main bearing wear patterns that indicate connecting rod and crankshaft alignment or bearing bore problems; check bearing bore and bushing condition; determine needed action.
15. Assemble pistons and connecting rods and install in block; check piston height/protrusion; replace rod bearings and check clearances; check condition, position, and clearance of piston cooling nozzles.
16. Clean, inspect and measure crankshaft vibration damper; replace as needed.
17. Inspect, install, and align flywheel housing.
18. Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks, wear, and runout; determine needed action.

D. Lubrication and Cooling Systems Diagnosis and Repair (6 questions)

1. Verify engine oil pressure and check operation of pressure sensor/switch and pressure gauge; verify engine oil temperature and check operation of temperature sensor.
2. Inspect, measure, and repair/replace oil pump, housing, drives, pipes, and screens; adjust drive gear clearance (if applicable).
3. Inspect and repair/replace oil pressure regulator valve(s), and by-pass valve(s).
4. Inspect, clean, test, and reinstall/replace oil cooler, by-pass valve, oil thermostat; lines and hoses.
5. Inspect turbocharger lubrication and cooling systems; determine needed action.
6. Perform engine oil and filter service; add proper type and quantity of oil.
7. Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.
8. Verify coolant temperature and check operation of temperature and level sensors/switch, and temperature gauge.
9. Inspect and replace thermostat(s), by-passes, housing(s), seals, and coolant restrictors.
10. Flush and refill cooling system; bleed air from system; recover/recycle coolant.
11. Inspect and repair/replace coolant conditioner/filter, valves, lines, fittings, and housing (if applicable).

T2 TASK LIST (CONTINUED)

12. Inspect and repair/replace water pump, housing, hoses, and idler pulley or drive gear.
13. Inspect radiator, pressure cap(s), and tank(s); determine needed action.
14. Inspect and repair/replace fan, fan hub, fan clutch, fan controls, fan thermostat, fan shroud, and airflow management systems.
15. Pressure test cooling system and pressure cap(s); determine needed repairs.

E. Air Induction and Exhaust Systems Diagnosis and Repair (6 questions)

1. Inspect and service/replace air induction piping, air cleaner, and element; check for inlet air restriction.
2. Inspect, test, and replace fixed and variable turbocharger(s), pneumatic, hydraulic, and electronic controls and actuators; inspect, test, and replace wastegate and wastegate controls.
3. Inspect and repair/replace intake manifold, gaskets, temperature and pressure sensors, and connections.
4. Inspect, test, clean, or replace charge air cooler and piping system.
5. Inspect and repair/replace exhaust manifold, gaskets, piping, mufflers, and mounting hardware.
6. Inspect, test, and repair/replace preheater/inlet air heater, or glow plug system and controls.
7. Inspect, test, and replace exhaust aftertreatment system components and controls, including diesel oxidation catalyst (DOC), selective catalytic reduction (SCR), diesel exhaust fluid (DEF), diesel particulate filter (DPF); check regeneration system operation.
8. Inspect, test, service, and replace exhaust gas recirculation (EGR) system components, including EGR valve, cooler, piping, sensors, controls, and wiring.

F. Fuel System Diagnosis and Repair (16 questions)

1. Inspect, test, and repair/replace fuel system tanks, vents, caps mounts, valves, single/dual supply and return lines, and fittings.
2. Inspect, clean, test, and repair/replace fuel transfer (supply) pump, pump drives, strainers and fuel/water separators, sensors, filters, heaters, coolers, ECM cooling plates, and mounting hardware.
3. Check fuel supply system for air; determine needed repairs; prime and bleed fuel system; check, repair/replace primer pump.
4. Inspect, test, and repair/replace low-pressure regulator systems (check valves, pressure regulator valves and restrictive fittings).
5. Inspect high-pressure injection lines, fittings, transfer tubes, seals, and mounting hardware; determine needed action.
6. Perform on-engine inspections, tests, and replace high-pressure common rail (HPCR) fuel system components and electronic controls; determine needed action.
7. Perform on-engine inspections and tests on hydraulic electronic unit injectors (HEUI) and electronic controls (rail pressure control).
8. Perform on-engine inspections, tests and adjustments on electronic unit injectors (EUI) and electronic controls.
9. Inspect, adjust, and repair/replace electronic throttle/engine speed control devices, circuits, and sensors.
10. Inspect, test, and repair/replace engine protection and automatic shutdown system components.

T2 TASK LIST (CONTINUED)

11. Inspect, test and repair/replace electrical connector terminals, pins, harnesses, seals, and locks.
12. Connect diagnostic scan tool to vehicle/engine; access, verify, and update software calibration settings, injector calibration codes, programmable parameters; perform module re-learn procedures; determine needed action.
13. Connect diagnostic scan tool to vehicle; inspect and test electronic engine control system, sensors, actuators, electronic control modules, and circuits; determine needed actions.
14. Measure and interpret voltage, voltage drop, amperage, and resistance readings using a digital multimeter (DMM) or appropriate test equipment.

G. Starting and Charging System Diagnosis and Repair (4 questions)

1. Perform battery state-of-charge and load or capacitance tests; determine needed action.
2. Charge battery using correct method for application.
3. Start a vehicle using jumper cables or a booster battery.
4. Inspect, clean, and repair/replace batteries, battery cables, and terminal connections.
5. Inspect, test, and reinstall/replace starter relays, safety switch(s), and solenoids.
6. Perform alternator voltage and amperage output tests; determine needed action.
7. Perform starter and charging circuit voltage drop tests; determine needed action.

H. Engine Brakes (3 questions)

1. Inspect, test, and adjust engine compression and exhaust brakes.
2. Inspect, test, adjust, and repair/replace engine compression and exhaust brake control circuits, switches, actuators, and solenoids; adjust control parameter settings.
3. Inspect and repair/replace engine compression and exhaust brake housing(s), valves, seals, springs, lines, and fittings. ■

SAMPLE QUESTIONS

DIESEL ENGINES (TEST T2)

1. When a diesel engine is operated under a load, coolant continually comes out of the radiator overflow and there are bubbles in the radiator. Which of these could be the cause?
(A) Too much coolant in the cooling system
(B) A clogged radiator
(C) A stuck-open thermostat
* (D) Compression leakage into the cooling system
2. A diesel engine has excessive black smoke when started in the morning. Which of these could be the cause?
* (A) A sticking fuel injection nozzle
(B) A restricted fuel filter
(C) A blocked fuel tank vent
(D) A leaking fuel return line
3. Which of these can cause a no-start condition on a HEUI engine?
(A) High fuel pressure
* (B) Low injection control pressure
(C) High boost pressure
(D) Low boost pressure
4. A diesel engine is hard to start, but runs good after it has been primed and run for a few minutes. This could be caused by a:
(A) leaking injector line.
(B) leaking fuel return line.
(C) plugged fuel tank vent.
* (D) stuck-open transfer pump check valve.
5. A diesel engine with wet cylinder liners has been running too hot, and there is coolant in the crankcase. This could be caused by:
(A) a cracked block.
(B) cracked liners.
* (C) leaking liner seals.
(D) a leaking injector seal.

T2 SAMPLE QUESTIONS (CONTINUED)

6. Diesel engine cylinder liner protrusion (height) can be adjusted by selecting the correct size:
- (A) connecting rod bearing.
 - (B) head gasket.
 - * (C) liner shim.
 - (D) fire ring.

This question contains the word EXCEPT. Read the question carefully before choosing your answer.

7. An electronically-controlled diesel engine will not start. All of these could be the cause EXCEPT a failed:
- (A) camshaft position sensor.
 - (B) engine control module (ECM).
 - (C) ECM ground circuit.
 - * (D) throttle position sensor (TPS).
8. The cause of a logged fault code in an electronic diesel engine has just been repaired.
Technician A says that the codes should be cleared before releasing the vehicle.
Technician B says that the customer's password should be reset before releasing the vehicle.
Who is right?
- * (A) A only
 - (B) B only
 - (C) Both A and B
 - (D) Neither A nor B
9. A diesel engine has low power and low turbocharger boost pressure is found.
Technician A says that a leaking exhaust manifold could be the cause.
Technician B says that a plugged turbocharger oil return line could be the cause.
Who is right?
- * (A) A only
 - (B) B only
 - (C) Both A and B
 - (D) Neither A nor B

TEST SPECIFICATIONS AND LIST

DRIVE TRAIN (TEST T3)

Content Area	Questions in Test	Percentage of Test
A. Clutch Diagnosis and Repair	11	28%
B. Transmission Diagnosis and Repair	13	33%
C. Driveshaft and Universal Joint Diagnosis and Repair	7	18%
D. Drive Axle Diagnosis and Repair	9	23%
Total	40	100%

A. Clutch Diagnosis and Repair (11 questions)

1. Diagnose clutch noise, binding, slippage, pulsation, vibration, grabbing, and chatter problems; determine cause of failure and needed repairs.
2. Inspect, adjust, repair, or replace clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push and pull type assemblies); check pedal height and travel.
3. Inspect, adjust, repair or replace hydraulic clutch slave and master cylinders (including air assist), lines, fittings, and hoses; bleed system.
4. Inspect, adjust, repair or replace electronic/automated clutch actuator.
5. Inspect, or remove and install release (throw out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, fork rollers, shafts, and seals; measure and adjust release (throw out) bearing position.
6. Inspect, or remove and install single-disc clutch pressure plate and clutch disc; adjust free play and release bearing position.
7. Inspect, or remove and install two-plate clutch pressure plate, clutch disc, intermediate plate; determine proper clutch torque rating; adjust free play and release bearing position.
8. Inspect and replace clutch brake assembly; inspect and replace input shaft and bearing retainer.
9. Inspect, or remove and install self-adjusting/continuous-adjusting clutch assembly; perform initial and/or reset adjustment procedure.
10. Inspect and replace pilot bearing.
11. Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play; determine needed repairs.
12. Inspect flywheel (including center plate drive pins/lugs and anti-rattle springs), starter ring gear, and measure flywheel face and pilot bore runout and depth; determine needed repairs.

T3 LIST (CONTINUED)

13. Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed repairs.

B. Transmission Diagnosis and Repair (13 questions)

1. Determine the cause of transmission component wear and failure, both before and during disassembly procedures.
2. Diagnose transmission vibration/noise, shifting, lockup, slipping/ jumping out-of-gear, and overheating problems; determine needed repairs.
3. Inspect, adjust, repair or replace transmission remote shift linkages, cables, brackets, bushings, pivots, and levers.
4. Inspect, test operation, adjust, repair or replace air shift controls, lines, fittings, hoses, valves, regulators, filters, and cylinder assemblies.
5. Inspect, test operation, adjust, repair or replace electronic shift controls, range, shift and splitter actuators, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.
6. Inspect, test operation, repair or replace electronic shift selectors (in-cab controls), air and electrical switches, displays and indicators, wiring harnesses, air lines and fittings.
7. Diagnose electronic transmission control systems using appropriate test equipment, service information, technical service bulletins and schematics; diagnose shorts, grounds, opens and resistance problems in electrical/electronic circuits; check and record diagnostic codes; determine needed repairs.
8. Diagnose electronic (automated mechanical and automatic) transmission problems caused by data link/bus interfaces with related electronic control systems.
9. Remove and replace transmission; inspect and replace transmission mounts, insulators, and mounting bolts.
10. Inspect for leakage; repair or replace transmission cover plates, gaskets, sealants, seals, vents, and cap bolts; inspect seal surfaces.
11. Check transmission fluid level and condition; determine needed service; add proper type and amount of lubricant.
12. Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts.
13. Inspect and replace input shaft, gears, spacers, bearings, retainers, and slingers.
14. Inspect main shaft, gears, sliding clutches, washers, spacers, bushings, bearings, auxiliary drive gear/assembly, retainers/snap rings, and keys; determine needed repairs.
15. Inspect countershafts, gears, bearings, retainers/snap rings, and keys; check bearing preload/end play; verify multiple countershaft gear timing; determine needed repairs.
16. Inspect output shaft, gears, washers, spacers, bearings, retainers/snap rings, and keys; determine needed repairs.
17. Inspect reverse idler shaft(s), gear(s), bushings, bearings, thrust washers, and retainers/snap rings; check reverse idler gear end play; determine needed repairs.
18. Inspect synchronizer hub, sleeve, keys/inserts, springs, blocking rings, synchronizer plates, blocker pins, and sliding clutches; determine needed repairs.

T3 LIST (CONTINUED)

19. Inspect transmission cases and bell housings, including mating surfaces, bores, bushings, pins, studs, nuts, bolts, vents, and magnetic plugs; determine needed repairs.
20. Inspect, service, or replace transmission lubrication system components, pumps, troughs, collectors, slingers, coolers, filters, lines, fittings and hoses.
21. Inspect, test, replace, and adjust electronic speedometer drive components.
22. Inspect, adjust, service, repair or replace power take-off assemblies and controls.
23. Inspect and test operation of backup light, neutral start/crank inhibit, and warning device circuits and switches; determine needed repairs.
24. Inspect and test transmission temperature sending unit/sensor and gauge; determine needed repairs.
25. Inspect, adjust, repair or replace transfer case assemblies and controls.

C. Driveshaft and Universal Joint Diagnosis and Repair (7 questions)

1. Diagnose driveshaft and universal joint noise, vibration, and runout problems; determine cause of failure, and determine needed repairs.
2. Inspect, service, or replace driveshaft, slip joints/yokes, yokes, drive flanges, universal joints, driveshaft boots and seals, and retaining hardware; properly phase yokes.
3. Inspect and replace driveshaft center support bearings, fasteners and mounts.
4. Measure and adjust vehicle ride height; measure and adjust driveline slopes and angles (vehicle loaded and unloaded), including PTO driveshafts.
5. Use appropriate driveline analysis tools and software to diagnose driveline problems.

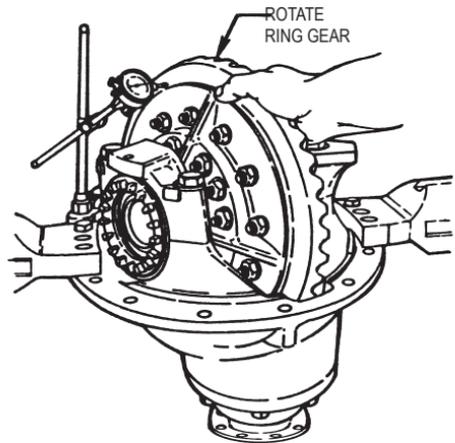
D. Drive Axle Diagnosis and Repair (9 questions)

1. Diagnose drive axle unit noise and overheating problems; determine needed repairs.
2. Check and repair fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals.
3. Check drive axle fluid level and condition; determine needed service (service filter, fluid); add proper type and amount of lubricant using correct fill procedure.
4. Remove and replace differential carrier assembly.
5. Inspect and replace differential case assembly including spider/pinion gears, cross shaft, side gears, thrust washers, case halves, bearings and races.
6. Inspect and replace components of locking differential case assembly.
7. Measure ring gear backlash and runout; determine needed actions.
8. Inspect ring and drive pinion gears, spacers, shims, sleeves, bearings and races. Inspect and adjust bearing preload; determine needed repairs.
9. Check ring and pinion gear tooth contact pattern; interpret pattern and determine needed repairs.
10. Inspect and replace power divider (inter-axle differential) assembly.
11. Inspect, adjust, repair, or replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls.
12. Inspect and measure drive axle housing mating surfaces and alignment; determine needed repairs.

T3 LIST (CONTINUED)

13. Inspect, service or replace drive axle lubrication system components, pump, troughs, collectors, coolers, lines, fittings, slingers, tubes and filters.
14. Inspect and replace drive axle shafts.
15. Check drive axle wheel/hub seal and axle flange gasket for leaks; determine needed repairs.
16. Diagnose drive axle wheel bearing noises and damage; determine needed repairs.
17. Clean, inspect, lubricate, and replace wheel bearings and races/cups; replace seals and wear rings; adjust drive axle wheel bearings (including single and double nut types) to manufacturers' specifications.
18. Test and inspect drive axle temperature sending unit/sensor and gauge; determine needed repairs.
19. Check, test, clean, adjust and/or replace wheel speed sensor(s) and tone-exciter rings.
20. Inspect or replace extended service (preset and unitized) bearing assemblies; perform initial installation procedures to manufacturers' specifications. ■

SAMPLE QUESTIONS DRIVE TRAIN (TEST T3)



1. What operation is being performed in the setup shown?
 - (A) Adjusting tooth contact
 - * (B) Checking ring gear runout
 - (C) Checking ring gear backlash
 - (D) Setting differential bearing preload

2. A truck does not move in any gear. Technician A says that a broken transmission shifter fork could be the cause. Technician B says that a broken transmission output shaft could be the cause. Who is right?
 - (A) A only
 - * (B) B only
 - (C) Both A and B
 - (D) Neither A nor B

3. The shift lever on a 13-speed transmission is hard to move. Which of these could be the cause?
 - (A) Bent shift rails
 - * (B) Galled sliding clutch gears
 - (C) Worn detent springs
 - (D) Too much mainshaft gear end play

4. The air pressure regulator for a transmission is being checked. Technician A says that the tractor air pressure should be at maximum system pressure. Technician B says that the regulator air filter should be cleaned and the system rechecked if the air pressure reading is below normal. Who is right?
 - (A) A only
 - (B) B only
 - * (C) Both A and B
 - (D) Neither A nor B

T3 SAMPLE QUESTIONS (CONTINUED)

5. The driver of a truck says that a grinding noise can be heard when the clutch pedal is depressed. Which of these could be the cause?
- (A) Too little clutch pedal freeplay
 - * (B) A worn clutch release (throwout) bearing
 - (C) A low transmission lubricant level
 - (D) A worn clutch pressure plate
6. A two-plate pull-type clutch engages OK, but the transmission grinds when going into first gear from neutral. Technician A says that a worn clutch brake could be the cause. Technician B says that too little free play could be the cause. Who is right?
- * (A) A only
 - (B) B only
 - (C) Both A and B
 - (D) Neither A nor B

This question contains the word EXCEPT. Read the question carefully before choosing your answer.

7. An electronic speedometer works intermittently. Any of these could be the cause EXCEPT:
- (A) a loose electrical connection.
 - * (B) improper speedometer calibration.
 - (C) metal debris on the vehicle speed sensor (VSS).
 - (D) improper adjustment of the vehicle speed sensor (VSS).
8. A truck with a single rear axle has too much rear axle noise only when the truck is pulling. Which of these could be the cause?
- (A) Worn axle shaft bearings
 - (B) Worn wheel bearings
 - (C) Worn differential pinion (spider) gears
 - * (D) Worn ring and pinion gears

TEST SPECIFICATIONS AND LIST BRAKES (TEST T4)

Content Area	Questions in Test	Percentage of Test
A. Air Brakes Diagnosis and Repair	33	66%
1. Air Supply and Service Systems (16)		
2. Mechanical/Foundation and Wheel Hub (13)		
3. Parking Brakes (4)		
B. Hydraulic Brakes Diagnosis and Repair	12	24%
C. Air and Hydraulic Antilock Brake Systems (ABS), Automatic Traction Control (ATC), and Electronic Stability Control Systems	5	10%
Total	50	100%

A. Air Brakes Diagnosis and Repair (33 questions)

1. Air Supply and Service Systems (16 questions)

1. Review driver/vehicle inspection report (DVIR); verify the complaint and road test vehicle; review driver/customer interview and past maintenance documents (if available); determine further diagnosis.
2. Check air system build up time; check air system air loss rate (leakage); determine needed repairs.
3. Inspect, test, repair or replace air pressure gauges, in-cab lines, hoses, fittings, and pressure sensors (transducers).
4. Inspect, test, and replace low pressure warning devices.
5. Drain air reservoir tanks; check for oil, water, and foreign material; determine needed repairs.
6. Inspect, adjust, align, and replace compressor drive belts and pulleys.
7. Inspect and replace compressor drive gear and coupling.
8. Inspect, repair, or replace air compressor, air inlet supply, oil supply, water lines, hoses, fittings and mounting brackets.
9. Inspect, test, adjust, and replace system pressure controls (governor/relief valve), unloader assembly, lines, hoses, and fittings.
10. Inspect, repair, or replace air system lines, hoses, fittings, and couplings; check for proper routing and mounting.
11. Inspect, test, clean, and replace air tank relief (pop off) valves, one-way (single) check valves, drain valves, automatic drain (spitter) valves, heaters, wiring, and connectors.

T4 LIST (CONTINUED)

12. Inspect, test, clean, repair, or replace air drier systems, filters, valves, heaters, wiring, and connectors.
13. Inspect, test, and replace brake application (foot) valve, fittings, and mounts; check pedal operation.
14. Inspect, test, repair, or replace stop and parking brake light circuit switches, wiring, and connectors.
15. Inspect, test, repair, or replace hand brake (trailer) control valve, lines, hoses, fittings, and mountings.
16. Inspect, test, and replace brake relay valves, quick relay valves, and anti-compounding circuits.
17. Inspect, test, and replace tractor protection valve.
18. Inspect, test, and replace inversion/emergency (spring) brake control valve(s).
19. Determine if air brake system problem is caused by tractor or trailer supply or service system components.

2. Mechanical/Foundation and Wheel Bearings (13 questions)

1. Diagnose poor stopping, premature wear, brake noise, pulling, grabbing, or dragging problems caused by foundation brake components; determine needed repairs.
2. Inspect, test, and replace service brake chambers, diaphragms, clamps, return springs, pushrods, clevises, and mounting brackets.
3. Inspect, service, and replace automatic slack adjusters.
4. Inspect and replace S-cam brake rollers, bushings, camshafts, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs.
5. Inspect, clean, adjust, and replace air disc brake caliper assemblies.
6. Inspect brake shoes or pads; determine needed repairs.
7. Replace brake shoes or pads; determine correct replacement lining/pad coefficient of friction rating for application.
8. Inspect and replace brake drums or rotors as needed.
9. Clean, inspect, lubricate, and replace wheel hubs, wheel bearings and races/cups; replace seals and wear rings; adjust wheel bearings (including one and two nut types) to manufacturers' specifications.
10. Inspect and replace unitized hub bearing assemblies; perform initial installation and maintenance procedures to manufacturers' specifications.

3. Parking Brakes (4 questions)

1. Inspect and test parking (spring) brake chambers operation to include spring condition, leakage, and installation/mounting.
2. Replace parking (spring) brake chambers; dispose of chambers in accordance with local regulations.
3. Inspect, test, and replace parking (spring) brake valves, lines, hoses, and fittings.
4. Inspect, test, and replace parking (spring) brake dash control valve.
5. Manually release (cage) and set (uncage) parking (spring) brakes.

B. Hydraulic Brakes Diagnosis and Repair (12 questions)

1. Diagnose poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by hydraulic system components; determine needed repairs.
2. Pressure test hydraulic system and inspect for fluid leaks; check system pressure actuator operation, and diagnose fault codes using a PC computer if applicable.

T4 LIST (CONTINUED)

3. Check brake pedal operation and adjust free play.
4. Inspect, test, and replace master cylinder; check pushrod length.
5. Inspect and replace brake lines, flexible hoses, and fittings; check for proper routing and mounting.
6. Inspect, test, and replace metering (hold off), load sensing/ proportioning, proportioning, and combination valves.
7. Inspect, test, repair, or replace brake pressure differential valve and warning light circuits, switches, bulbs, wiring, and connectors.
8. Inspect and replace wheel cylinders.
9. Inspect, service, and replace disc brake caliper assemblies.
10. Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type for application.
11. Diagnose poor stopping, brake noise, premature wear, pulling, grabbing, dragging, or pedal feel problems caused by disc and drum brake mechanical components; determine needed repairs.
12. Inspect and replace brake drums or rotors; resurface rotors if applicable.
13. Inspect, adjust, and replace brake shoes, mounting hardware, adjuster mechanisms, and backing plates.
14. Inspect, service, and replace brake pads, hardware, and mounts.
15. Inspect, adjust, and replace drive line parking brake system components.
16. Diagnose poor stopping complaints caused by brake assist (booster) system problems; determine needed repairs; (includes hydraulic and hydraulic/electric assist systems).
17. Inspect, test, repair, or replace power brake assist (booster), hoses, control valves and filters; determine proper fluid type for application.
18. Test, adjust, repair or replace brake stop light switch, bulbs, wiring, and connectors.

C. Air and Hydraulic Antilock Brake Systems (ABS), Automatic Traction Control (ATC), and Electronic Stability Control Systems (5 questions)

1. Observe antilock brake system (ABS) operation, self test operation and warning light operation; determine if further diagnosis is needed; (includes dash mounted trailer ABS warning light).
2. Diagnose antilock brake system (ABS) electronic controls and components using self-diagnosis (blink codes) and/or specified test equipment (scan tool, PC based software); determine needed repairs.
3. Diagnose poor stopping and wheel lock-up caused by failure of the antilock brake system (ABS); determine needed repairs.
4. Inspect, test, and replace antilock brake system (ABS) air, hydraulic, electrical, and mechanical components.
5. Diagnose automatic traction control (ATC) electronic control(s) and components using self-diagnosis (blink codes) and/or specified test equipment (scan tool, PC based software); determine needed repairs.
6. Diagnose electronic stability control systems and components using self-diagnosis (blink codes) and/or specified test equipment (scan tool, PC based software); determine needed repairs. ■

SAMPLE QUESTIONS BRAKES (TEST T4)

1. The parking brakes fail to apply on a truck with air brakes. Technician A says that low air pressure in the spring brake chamber could be the cause. Technician B says that a ruptured spring brake diaphragm could be the cause. Who is right?

(A) A only
(B) B only
(C) Both A and B
* (D) Neither A nor B
2. A truck equipped with air brakes has an uneven braking problem. Which of these could be the cause?

(A) A binding treadle (foot) valve
(B) Low brake line air pressure
* (C) A bad brake drum
(D) A bad governor
3. A service brake on a truck with an air brake system releases too slowly. Technician A says that low air pressure could be the cause. Technician B says that a kinked air line could be the cause. Who is right?

(A) A only
* (B) B only
(C) Both A and B
(D) Neither A nor B
4. A service brake chamber leaks when the brakes are applied. Which of these could be the cause?

(A) Excessive push rod travel
* (B) A bad chamber diaphragm
(C) A broken chamber return spring
(D) A misaligned push rod

T4 SAMPLE QUESTIONS (CONTINUED)

5. All the wheels on a truck with air brakes lock up when a small amount of pressure is applied to the treadle (foot) valve. Which of these could be the cause?
- * (A) The application valve is bad.
 - (B) The limiting valve is leaking.
 - (C) The compressor regulator is set too high.
 - (D) The brakes are adjusted too high.
6. When an air reservoir tank is drained, there is an excessive amount of moisture. This could be caused by a:
- (A) cracked air compressor bracket.
 - (B) clogged air compressor intake.
 - (C) failed one way check valve.
 - * (D) failed air drier purge valve.
7. All the brakes drag on a truck with hydraulic brakes. Which of these could be the cause?
- (A) Air in the hydraulic system
 - (B) Too high vacuum supply to the power brake booster
 - (C) A leaking secondary cup in the master cylinder
 - * (D) No brake pedal free travel

These questions contains the word EXCEPT. Read the questions carefully before choosing your answer.

8. A truck with hydraulic brakes pulls to one side when the brakes are applied. Any of these could be the cause **EXCEPT** a:
- (A) sticking wheel cylinder piston.
 - (B) grease contaminated brake lining.
 - (C) crimped hydraulic line.
 - * (D) plugged compensating port.
9. The driver of a truck with air brakes says it has poor stopping power. Any of these could be the cause **EXCEPT**:
- * (A) the quick release valve exhaust port is plugged.
 - (B) the air pressure is too low.
 - (C) the application line is restricted.
 - (D) the brakes are out of adjustment.

TEST SPECIFICATIONS AND LIST SUSPENSION AND STEERING (TEST T5)

Content Area	Questions in Test	Percentage of Test
A. Steering System Diagnosis and Repair	12	24%
B. Suspension, Frame, and 5th Wheel Diagnosis and Repair	16	32%
C. Wheel Alignment Diagnosis, Adjustment, and Repair	13	26%
D. Wheels, Tires, and Hub Diagnosis and Repair	9	18%
Total	50	100%

A. Steering System Diagnosis and Repair (12 Questions)

1. Diagnose steering column (tilt, telescoping, or fixed) for noise, looseness, and binding problems; determine needed repairs.
2. Inspect and replace steering shaft U joint(s), slip joints, bearings, bushings, and seals; phase shaft U joints.
3. Check cab mounting and adjust ride height.
4. Remove the steering wheel (includes steering wheels equipped with electrical/electronic controls and components); install and center the steering wheel. Inspect, test, replace, and calibrate steering angle sensors.
5. Diagnose power steering system noise, steering binding, darting/oversteer, reduced wheel cut, steering wheel kick, pulling, non-recovery, turning effort, looseness, hard steering, overheating, fluid leakage, and fluid aeration problems; determine needed repairs.
6. Determine recommended type of power steering fluid; check level and condition; determine needed service.
7. Flush and refill power steering system; purge air from system.
8. Perform power steering system pressure, temperature, and flow tests; determine needed repairs.
9. Inspect, service, or replace power steering reservoir including filter, seals, and gaskets.
10. Inspect and reinstall/replace power steering pump drive belts, pulleys and tensioners; adjust drive belts and check alignment.
11. Inspect, adjust, or replace power steering pump, drive gears/shafts, mountings, and brackets.

T5 LIST (CONTINUED)

12. Inspect and replace power steering system cooler, lines, hoses, clamps/mountings, fittings; check hose routing.
13. Inspect, adjust, or replace linkage-assist type power steering cylinder or gear (dual system).
14. Inspect, adjust, repair, or replace integral type power steering gear.
15. Adjust manual and automatic steering gear poppet/relief valves.
16. Inspect, align, and replace pitman arm.
17. Inspect, adjust, and replace drag link (relay rod) and tie rod ends (ball and adjustable socket type).
18. Inspect and replace steering arms.
19. Inspect and replace tie rod cross tube (relay rod/center link), clamps, and retainers; position as needed.
20. Check and adjust wheel stops.

B. Suspension System Diagnosis and Repair (16 Questions)

1. Inspect and replace front axle beam and mounting hardware.
2. Inspect, service, adjust, and replace kingpins, bushings, locks, bearings, seals, and covers.
3. Inspect and replace shock absorbers, bushings, brackets, and mounts.
4. Inspect, repair, and replace (leaf and parabolic) springs, center bolts, clips, spring eye bolts and bushings, shackles, slippers, insulators, brackets, and mounts.
5. Inspect, adjust, and replace axle aligning devices including radius rods/arms, torque rods, transverse torque rods/track bars, stabilizer bars, bushings, mounts, shims, and cams.
6. Inspect and replace walking beams, center (cross) tube, bushings, mounts, load pads, brackets, caps, and mounting hardware.
7. Inspect, test, and replace air suspension springs (bags), mounting plates, and main support beams/springs, pressure regulator and height control valves, linkages, lines, hoses, and fittings.
8. Diagnose, inspect, and replace, auxiliary lift axle components and controls.
9. Measure front and rear vehicle ride heights; determine needed adjustments or repairs.
10. Verify and diagnose vehicle suspension complaints; determine needed repairs.
11. Torque U-bolts to manufacturers' specifications.
12. Check axle load distribution problems on rear suspensions; check axle seat planing angles and pinion angles.
13. Inspect frame and frame members for cracks, breaks, distortion, elongated holes, looseness, and damage; determine needed repairs.
14. Inspect, install, or repair frame hangers, brackets, crossmembers and fasteners in accordance with manufacturers' recommended procedures.
15. Inspect, adjust, service, repair, or replace fifth wheel, pivot pins, bushings, locking jaw mechanisms, and mounting bolts.
16. Inspect, adjust, service, repair, or replace sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.
17. Inspect, install, repair or replace pintle hooks and draw bars.

T5 LIST (CONTINUED)

C. Wheel Alignment Diagnosis, Adjustment, and Repair (13 Questions)

1. Diagnose vehicle wandering, darting, pulling, drifting, shimmy, and steering effort problems; determine needed adjustments and repairs.
2. Check camber and KPI (kingpin inclination); determine needed repairs.
3. Check and adjust caster.
4. Check and adjust toe.
5. Check rear axle(s) alignment (thrustline/centerline) and tracking (lateral offset, parallelism); adjust or determine needed repairs.
6. Check turning/Ackerman angle (toe out on turns) and maximum turning radius (wheel cut); determine needed repairs.

D. Wheels, Tires and Hub Diagnosis and Repair (9 Questions)

1. Diagnose tire wear patterns; determine needed repairs.
2. Diagnose wheel end vibration, shimmy, pounding, hop (tramp) problems; determine needed repairs.
3. Inspect and replace wheels, mounting hardware, studs, and fasteners.
4. Measure wheel and tire radial and lateral runout; determine needed repairs or adjustments
5. Inspect tires; check and adjust air pressure to manufacturers' specifications.
6. Perform static balance of wheel and tire assembly.
7. Perform dynamic balance of wheel and tire assembly.
8. Measure tire diameter and match tires on axles.
9. Remove and reinstall tire/wheel assemblies to manufacturers' specifications.
10. Clean, inspect, lubricate, and replace wheel hubs, wheel bearings and races/cups; replace seals and wear rings; adjust wheel bearings (including one and two nut types) to manufacturers' specifications.
11. Inspect and replace unitized hub bearing assemblies; perform initial installation and maintenance procedures to manufacturers' specifications. ■

SAMPLE QUESTIONS

SUSPENSION AND STEERING (TEST T5)

1. Which of these could cause the front tires of a truck to show a feathered edge wear pattern?

* (A) An incorrect toe setting
(B) An incorrect camber setting
(C) An incorrect caster setting
(D) Incorrect tire pressures

2. The drive axles on a truck with a walking beam suspension are out of alignment.
Technician A says that incorrect length torque rods could be the cause.
Technician B says that worn walking beam bushings could be the cause.
Who is right?

(A) A only
* (B) B only
(C) Both A and B
(D) Neither A nor B

3. The driver of a truck that has just had its front springs and hangers replaced says that it is hard to keep in a straight ahead position.
Technician A says that this could be caused by installing the caster shims backwards.
Technician B says that this could be caused by installing forward spring hangers which are too short.
Who is right?

* (A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

4. The driver of a truck says that it is hard to steer and the steering wheel return is poor.
Technician A says that binding kingpins could be the cause.
Technician B says that too much toe-in could be the cause.
Who is right?

* (A) A only
(B) B only
(C) Both A and B
(D) Neither A nor B

T5 SAMPLE QUESTIONS (CONTINUED)

5. Rust streaks coming from around the stud holes of a disc wheel could be caused by:
- (A) an overloaded condition.
 - (B) overtorqued lug/cap nuts.
 - (C) an out-of-balance condition.
 - * (D) loose lug/cap nuts.
6. A truck has a history of springs breaking at the center bolt holes. Technician A says that loose U-bolts could be the cause. Technician B says that loose spring shackles could be the cause. Who is right?
- * (A) A only
 - (B) B only
 - (C) Both A and B
 - (D) Neither A nor B
7. A constant buzzing noise is coming from the power steering pump. Technician A says air in the system could be the cause. Technician B says that a stuck-open relief valve could be the cause. Who is right?
- * (A) A only
 - (B) B only
 - (C) Both A and B
 - (D) Neither A nor B
8. The tandem rear axle air suspension ride height rises above normal as the vehicle is unloaded. Which of these could be the cause?
- (A) A kinked air spring (bag) supply line
 - (B) A leaking height control valve
 - * (C) A plugged height control valve exhaust port
 - (D) A leaking pressure protection valve

This question contains the word EXCEPT. Read the question carefully before choosing your answer.

9. All of these should be checked before aligning the front wheels on a truck **EXCEPT**:
- (A) tire pressure.
 - (B) ride height.
 - (C) wheel bearing adjustment.
 - * (D) tire balance.

TEST SPECIFICATIONS AND LIST ELECTRICAL/ELECTRONIC SYSTEMS (TEST T6)

Content Area	Questions in Test	Percentage of Test
A. General Electrical/ Electronic System Diagnosis	14	28%
B. Battery and Starting System Diagnosis and Repair	11	22%
C. Charging System Diagnosis and Repair	7	14%
D. Lighting Systems Diagnosis and Repair	6	12%
E. Related Vehicle Systems Diagnosis and Repair	12	24%
Total	50	100%

A. General Electrical/Electronic System Diagnosis (14 questions)

1. Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using digital multimeter (DMM), or appropriate test equipment.
2. Check current flow in electrical/electronic circuits and components using a digital multimeter (DMM), clamp-on ammeter, or appropriate test equipment.
3. Check continuity and resistance in electrical/electronic circuits and components using digital multimeter (DMM), or appropriate test equipment.
4. Find shorts, grounds, and opens in electrical/electronic circuits.
5. Diagnose key-off battery drain (parasitic draw) problems; determine needed repairs.
6. Inspect and test fusible links, circuit breakers, fuses, and other circuit protection devices; include reset when required.
7. Inspect and test spike suppression diodes/resistors and capacitors.
8. Inspect and test relays and solenoids (including solid state devices).
9. Read and interpret electrical schematic diagrams and symbols.
10. Diagnose failures in the multiplexed data communications bus network; determine needed repairs.
11. Diagnose vehicle electronic control systems using appropriate diagnostic tools, software, and service information; check and record diagnostic codes; access and verify parameters and calibration settings; determine needed repairs.
12. Check electronic circuit waveforms; interpret readings and determine needed repairs.

B. Battery and Starting System Diagnosis and Repair (11 questions)

1. Determine battery state of charge by measuring terminal post voltage using a digital multimeter (DMM).
2. Perform battery tests (load and capacitance); determine needed service.
3. Inspect, clean, service, or replace battery, cables, and terminal connections.
4. Inspect, clean, repair or replace battery boxes, mounts, and hold downs.

T6 LIST (CONTINUED)

5. Charge battery using appropriate method for battery type (absorbed glass mat, lead acid and super capacitors).
6. Jump-start a vehicle using jumper cables and a booster battery or appropriate auxiliary power supply.
7. Diagnose low voltage disconnect (LVD) systems; determine needed repairs.
8. Test/monitor battery and starting system voltage during cranking; determine needed repairs.
9. Perform starting circuit voltage drop tests; determine needed repairs.
10. Inspect, test, and replace starter control circuit switches, relays, connectors, terminals and wires (including over crank protection).
11. Diagnose starter cranking inhibit systems; determine needed repairs.
12. Inspect, test, and replace starter, relays and solenoids/switches including integrated MAG switch (IMS).
13. Inspect, clean, repair, or replace cranking control circuit wires, connectors, and terminals.
14. Verify starter operation; remove and replace starter as needed; inspect flywheel ring gear or flex plate.
15. Differentiate between electrical and/or mechanical problems that cause a slow crank, intermittent crank, no-crank, extended cranking, or a cranking noise condition.

C. Charging System Diagnosis and Repair (7 questions)

1. Verify operation of charging system circuit indicators; determine needed repairs.
2. Diagnose the cause of no charge, low charge, or overcharge conditions; determine needed repairs.
3. Inspect, adjust, and replace alternator, drive belts/gears, pulleys, fans, mounting brackets, and tensioners.
4. Test charging system voltage (AC and DC) and amperage output; determine needed repairs.
5. Perform charging circuit voltage drop tests; determine needed repairs.
6. Inspect, repair, or replace charging circuit connectors, terminals, and wires.
7. Inspect and test generator (alternator) and control components including control modules/regulators; determine needed actions.

D. Lighting Systems Diagnosis and Repair (6 questions)

1. Diagnose the cause of brighter than normal, intermittent, or no operation of exterior lighting including daytime running light (DRL) operation; determine needed repairs.
2. Inspect, replace, and aim/adjust headlights and auxiliary lights.
3. Inspect, test, repair, or replace headlight switches, dimmer switches, control components, relays, sockets, connectors, terminals, and wires.
4. Inspect, test, repair, or replace truck and trailer lighting circuit switches/electronic control components, bulbs, light-emitting diodes (LEDs), sockets, relays, connectors, terminals, and wires.
5. Inspect, test, repair, or replace instrumentation light circuit switches, bulbs, LEDs, sockets, circuit boards, connectors, terminals, and wires.
6. Inspect, test, repair, or replace interior cab light circuit switches, electronic control components, bulbs, LEDs, sockets, connectors, terminals, and wires.
7. Inspect, test, adjust, repair, or replace stoplight circuit switches, electronic control components, relays, bulbs, LEDs, sockets, connectors, terminals, and wires.
8. Diagnose the cause of turn signal and hazard light system malfunctions; determine needed repairs.
9. Inspect, test, repair, or replace turn signal and hazard circuit flashers or electronic control components, switches, relays, bulbs, LEDs, sockets, connectors, terminals, and wires.

T6 LIST (CONTINUED)

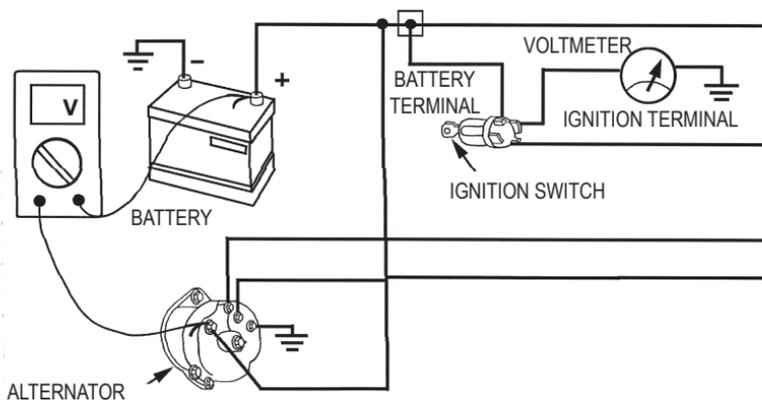
10. Inspect, test, adjust, repair, or replace backup light and warning devices, circuit switches, bulbs, LEDs, sockets, connectors, terminals, and wires.
11. Inspect and test trailer light cord connector and cable; determine needed repairs.

E. Related Vehicle Systems Diagnosis and Repair (12 questions)

1. Diagnose the cause of intermittent, inaccurate, or no gauge readings; determine needed repairs.
2. Diagnose the cause of high, low, intermittent, or no readings on electronic instrument cluster gauges; determine needed repairs.
3. Inspect, test, adjust, repair, or replace gauge circuit sending units, sensors, gauges, connectors, terminals, and wires.
4. Inspect, test, repair, or replace warning devices (lights and audible) circuit sending units, sensors, circuit boards/control modules, bulbs, audible component, sockets, connectors, terminals, and wires.
5. Inspect, test, and replace electronic instrumentation systems; verify proper calibration for vehicle application.
6. Diagnose the cause of constant, intermittent, or no horn operation; determine needed repairs.
7. Inspect, test, repair, or replace airbag circuit, clock spring, connectors, terminals, and wires.
8. Diagnose the cause of constant, intermittent, or no wiper operation; wiper speed control and/or park problems; determine needed repairs.
9. Inspect, test, and replace wiper motor and transmission mechanical linkage, arms, and blades, in addition to relays, switches, connectors, terminals, and wires.
10. Inspect, test, repair, or replace windshield washer motor or pump/relay assembly, switches, connectors, terminals, and wires.
11. Inspect, test, repair, or replace sideview mirror motors, heater circuit grids, relays, switches, connectors, terminals, and wires.
12. Inspect, test, repair, or replace heater and A/C electrical components including: A/C clutches, motors, resistors, sensors, relays, switches, control modules, connectors, terminals, and wires.
13. Inspect, test, repair, or replace cigarette lighter and/or auxiliary power outlet, integral fuse, connectors, terminals, and wires.
14. Diagnose the cause of slow, intermittent, or no power window operation; determine needed repairs.
15. Inspect, test, repair, or replace power window motors, switches, relays, connectors, terminals, and wires.
16. Diagnose inverter/shore/auxiliary/HVAC auxiliary power units (APU) and controls; determine needed repairs.
17. Diagnose the cause of poor, intermittent, or no operation of electric door locks; determine needed repairs.
18. Inspect, test, repair, or replace electric door lock circuit switches, relays, controllers, actuators/solenoids, connectors, terminals, and wires.
19. Inspect, test, and replace cruise control electrical controls and components.
20. Inspect, test, and replace engine cooling fan electrical control components.
21. Inspect, test, and replace electric fuel supply/transfer pump control components.
22. Inspect, test, repair, or replace telematics/electronic logging devices (ELD), controls, and components.
23. Diagnose operation of safety systems and related circuits (speed control, collision avoidance, backup cameras, etc.); determine needed repairs. ■

SAMPLE QUESTIONS

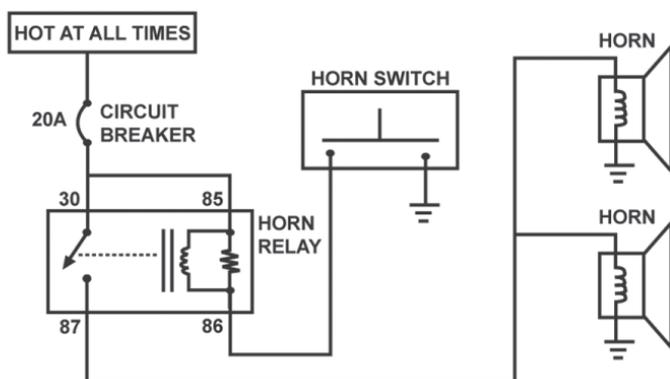
ELECTRICAL/ELECTRONIC SYSTEMS (TEST T6)



1. In the charging system shown, the meter reading will show:
 - (A) charging output voltage.
 - (B) regulator operating voltage.
 - * (C) charging circuit voltage drop.
 - (D) ignition switch voltage drop.

2. A truck's cab heater blower motor operates at low speed only. Which of these could be the cause?
 - (A) An open blower switch ground
 - * (B) A bad blower switch
 - (C) A binding blower cage
 - (D) A short to power at the blower motor

T6 SAMPLE QUESTIONS (CONTINUED)



3. The horns in the circuit shown only blow when a jumper wire is connected between terminals 30 and 87 of the horn relay. Technician A says that a failed horn relay could be the cause. Technician B says that a short to ground in the circuit between the horn relay and the horn button could be the cause. Who is right?
- * (A) A only (C) Both A and B
(B) B only (D) Neither A nor B

This question contains the word EXCEPT. Read the question carefully before choosing your answer.

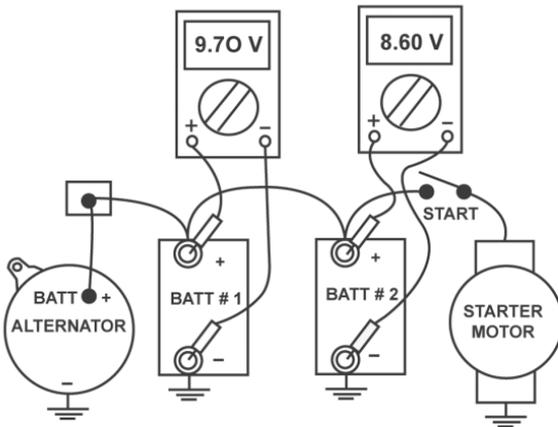
4. Any of these may cause low alternator output EXCEPT:
- (A) a loose alternator output terminal.
(B) a slipping alternator belt.
* (C) shorted-to-ground stators.
(D) high resistance at the alternator ground.
5. A driver complains that the trailer marker lights are dim at night while braking. Which of these could be the cause?
- (A) Low battery voltage
(B) One burned out brake light bulb
* (C) A poor ground in the trailer light cord
(D) Too much grease on the 5th wheel

T6 SAMPLE QUESTIONS (CONTINUED)

6. Both headlights on a vehicle are dim in high beam and normal in low beam. Technician A says that a poor headlight ground could be the cause. Technician B says that a shorted headlight switch could be the cause. Who is right?

(A) A only
(B) B only

(C) Both A and B
* (D) Neither A nor B



7. The voltage readings shown were taken while cranking the engine. Which of these is indicated by the readings?
- (A) Battery #2 has resistance in the ground cable.
* (B) Battery #2 is weaker than battery #1.
(C) Battery #1 is low on electrolyte.
(D) Battery #2 should be replaced.

TEST SPECIFICATIONS AND TASK LIST HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) SYSTEMS (TEST T7)

Note: ASE HVAC certifications (A7, T7, H7 or S7) do not provide the necessary credentials to satisfy EPA requirements for Section 609 refrigerant management. The ASE Refrigerant Recovery and Recycling Review and Quiz program meets Section 609 requirements and can be taken online and in print. Details are at www.ase.com/cfc.

Content Area	Questions in Test	Percentage of Test
A. HVAC Systems Diagnosis, Service, and Repair	6	15%
B. A/C System and Component Diagnosis, Service, and Repair	20	50%
C. Heating and Engine Cooling Systems Diagnosis, Service, and Repair	6	15%
D. Operating Systems and Related Controls Diagnosis and Repair	8	20%
Total	40	100%

A. HVAC Systems Diagnosis, Service, and Repair (6 questions)

1. Verify the complaint, road test the vehicle, review driver/customer interview and past maintenance documents (if available); determine further diagnosis.
2. Verify the need for service or repair of HVAC systems based on unusual operating noises; determine appropriate action.
3. Diagnose HVAC system problems indicated by sight, sound, smell, and component temperature conditions; determine appropriate action.
4. Identify system type and components (cycling clutch orifice tube—CCOT, thermal expansion valve—TXV), and conduct performance test(s) on HVAC systems (vent outlet temperature, air flow, and verify system pressures); determine appropriate action.
5. Identify HVAC control system type; check and record electronic diagnostic codes/indicator lights; determine further diagnosis.

B. A/C System and Component Diagnosis, Service, and Repair (20 questions)

► A/C System—General

1. Diagnose the cause of temperature control problems in the A/C system; determine needed repairs.
2. Identify refrigerant and lubricant type and check for contamination; determine appropriate action.
3. Diagnose A/C system problems indicated by pressure gauge readings and sight glass/moisture indicator conditions (where applicable); compare gauge readings to ambient temperature/pressure chart; determine needed service or repairs.

T7 LIST (CONTINUED)

4. Perform A/C system leak test (UV dye, electronic tester, pressure); determine needed repairs.
5. Recover A/C system refrigerant; determine amount of refrigerant and oil removed; determine appropriate action.
6. Evacuate A/C system using appropriate equipment.
7. Determine if contaminated A/C system components can be cleaned and reused or require replacement.
8. Charge A/C system with correct type and quantity of refrigerant and lubricant.
9. Recycle refrigerant.
10. Handle, label and store refrigerant.
11. Test refrigerant cylinders for non-condensable gases; identify refrigerant.
12. Maintain and verify correct operation of certified equipment.

► Compressor and Clutch

13. Diagnose A/C system problems that cause protection devices (pressure, thermal, and electronic) to interrupt compressor operation; determine needed repairs.
14. Inspect, test, and replace A/C system pressure, thermal and electronic protection devices.
15. Inspect and replace A/C compressor drive belts, pulleys, idlers, and tensioners, mountings, and hardware; adjust drive belts if applicable. Check belt alignment.
16. Inspect, test, service, and replace A/C compressor clutch components or assembly. Verify clutch air gap setting and adjust if needed.
17. Inspect and correct A/C compressor lubricant level.
18. Inspect, test, and replace A/C compressor.

► Evaporator, Condenser, and Related Components

19. Correct system lubricant level when replacing the evaporator, condenser, receiver/drier or accumulator/drier, and hoses.
20. Inspect, repair, or replace A/C system hoses, lines, filters, fittings, service ports and caps, O-rings and seals.
21. Inspect A/C condenser for proper air flow, including air flow control devices.
22. Inspect, test, and replace A/C system condenser and mountings.
23. Inspect and replace receiver/drier or accumulator/drier.
24. Inspect, test, and replace cab or sleeper expansion valve(s) and thermostatic switch (thermistors); check placement of thermal bulb (capillary tube).
25. Inspect and replace orifice tube.
26. Inspect, test, and replace cab or sleeper evaporator core.
27. Inspect, clean, and repair evaporator housing and water drain; check for proper evaporator air flow; inspect and service/replace evaporator air filter.
28. Diagnose system failures resulting in refrigerant loss from the A/C system high pressure relief device.

C. Heating and Engine Cooling Systems Diagnosis, Service, and Repair (6 questions)

1. Diagnose the cause of outlet air temperature control problems in the HVAC system; determine needed repairs.
2. Diagnose window fogging problems; determine needed repairs.
3. Perform engine cooling system tests for leaks, protection level, contamination, coolant level, temperature, coolant type, and conditioner concentration; determine needed repairs.

T7 LIST (CONTINUED)

4. Inspect and replace engine cooling and heating system hoses, lines, fittings, and clamps.
5. Inspect, test, and/or replace radiator, pressure cap, and coolant recovery system components (expansion/surge tank).
6. Inspect and/or replace water pump and drive system.
7. Inspect, test, and/or replace thermostats, by-passes, housings, and seals.
8. Flush, refill, and bleed air from cooling system.
9. Inspect, test, and repair or replace engine cooling fan, hub, clutch, controls, thermostat, shroud, and air flow control devices.
10. Inspect, test, and replace heating system coolant control valve(s) and manual shut-off valves.
11. Inspect, check for proper air flow, flush and/or replace heater core.

D. Operating Systems and Related Controls Diagnosis and Repair (8 questions)

1. Diagnose the cause of failures in HVAC electrical, air and mechanical control systems; determine needed repairs.
2. Inspect, test, repair, and replace HVAC heater blower motors, resistors, switches, relays, modules, wiring, and protection devices.
3. Inspect, test, repair, and replace A/C compressor clutch relays, modules, wiring, sensors, switches, diodes, and protection devices.
4. Inspect and test HVAC-related electronic engine and body control systems (ECM, BCM); determine needed repairs.
5. Inspect, test, repair, and replace engine cooling/condenser fan motors, relays, modules, switches, sensors, wiring, and protection devices.
6. Inspect, test, repair, and replace electric and air actuator motors, relays/modules, switches, sensors, wiring, and protection devices.
7. Inspect, test, repair, or replace HVAC system electrical, air, or mechanical control panel assemblies.
8. Inspect, test, adjust, calibrate, repair, or replace HVAC system ducts, doors, outlets, control cables, linkages, and actuators/motors.
9. Diagnose constant/automatic temperature control system problems; determine needed repairs.
10. Inspect, test, and replace constant/automatic temperature control modules.
11. Diagnose HVAC control system operation, record diagnostic trouble codes (DTC) and perform system tests with appropriate electronic service tool.
12. Diagnose shore/auxiliary/HVAC auxiliary power units (APU) and controls; determine needed repairs. ■

SAMPLE QUESTIONS

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) SYSTEMS (TEST T7)

1. A truck's A/C system does not cool properly due to an icing evaporator problem.
Technician A says that a stuck-closed cycling switch could be the cause. Technician B says that a refrigerant overcharge could be the cause. Who is right?

* (A) A only (C) Both A and B
(B) B only (D) Neither A nor B

2. The sleeper A/C unit is not cooling. A system check shows all pressures are normal. Which of these could be the cause?

(A) A plugged receiver drier
(B) A stuck-open expansion valve
(C) A shorted high pressure switch
* (D) A stuck-closed refrigerant solenoid valve

3. An A/C system has a low discharge pressure. Which of these could be the cause?

* (A) A leaking compressor seal
(B) A restricted refrigerant flow in the condenser
(C) A restricted air flow over the condenser
(D) A compressor clutch that will not engage

4. During replacement, it is noticed that the tubes on the inlet and outlet of a heater core are ruptured. The cause could be:

(A) a low coolant level.
(B) air in the cooling system.
* (C) incorrect coolant protection.
(D) a bad heater control valve.

T7 SAMPLE QUESTIONS (CONTINUED)

5. No air is flowing from a truck's HVAC ducts. Technician A says that a failed blower motor could be the cause. Technician B says that a stuck recirculation air door could be the cause. Who is right?
- * (A) A only (C) Both A and B
(B) B only (D) Neither A nor B
6. A recovery/recycle machine has been used to recycle a vehicle's refrigerant. The moisture indicator on the machine shows that moisture is present. The cause could be a:
- (A) full refrigerant storage tank.
(B) faulty air purge valve.
* (C) saturated filter/drier.
(D) faulty storage tank pressure switch.

This question contains the word EXCEPT. Read the question carefully before choosing your answer.

7. A truck's A/C system has just been repaired and filled with the proper amount of refrigerant. The system blows cool, but not cold air. The high-side pressure is 250 psi, and the low-side pressure is 50 psi. Any of these could be the cause **EXCEPT**:
- (A) the cooling fan is inoperative.
* (B) a partially restricted expansion valve.
(C) a system overcharged with oil.
(D) a missing radiator fan shroud.

TEST SPECIFICATIONS AND TASK LIST

PREVENTIVE MAINTENANCE AND INSPECTION (PMI) (TEST T8)

Content Area	Questions in Test	Percentage of Test
A. Engine Systems	10	20%
B. Cab and Hood	5	10%
C. Electrical/Electronics	10	20%
D. Frame and Chassis	22	44%
1. Brakes (10)		
2. Drivetrain (4)		
3. Steering, Tires, and Wheels (4)		
4. Suspension, Frame, and 5th Wheel (4)		
E. Road/Operational Test	3	6%
Total	50	100%

A. Engine Systems (10 questions)

1. Review past maintenance/repair documents, driver vehicle condition reports, and brake/tire wear report. Check and record electronic diagnostic codes and trip/operational data. Clear codes and data.
2. Check engine operation (including unusual noises, vibration, and excessive exhaust smoke); record idle rpm, governed rpm, and PTO rpm (if applicable).
3. Inspect vibration damper.
4. Inspect condition of belt(s), tensioner(s), and pulley(s); check and adjust belt tension.
5. Check engine for oil, coolant, air, and fuel leaks (Engine Off and Engine Running).
6. Inspect engine mounts for looseness and deterioration.
7. Check engine oil level and condition; check dipstick seal and fill cap seal.
8. Check engine compartment wiring, harnesses, connectors, and seals for damage, mounting, and proper routing.
9. Check fuel tanks, vents, mountings, lines, caps, and seals; check anti-siphon device (if applicable).
10. Inspect water separator/fuel heater; drain water from separator; replace fuel filter(s); prime and bleed fuel system.
11. Inspect crankcase ventilation system.
12. Check exhaust system mountings for looseness and damage.
13. Check engine exhaust system for leaks, excessive noise, proper routing, and missing or damaged components (heat shields and guards).
14. Check air induction system piping, charge air cooler, hoses, clamps, mountings, proper routing, and indicators; check for air restrictions and leaks.

T8 LIST (CONTINUED)

15. Inspect turbocharger(s) for noise, oil and exhaust leaks; check mountings and connections; check wastegate, variable geometry turbocharger (VGT), linkages, and hoses.
16. Service or replace air filter(s) as needed.
17. Inspect diesel emission control systems, including exhaust gas recirculation (EGR), exhaust gas recirculation (EGR) cooler, diesel particulate filter (DPF), and/or catalytic converter.
18. Check fan clutch/hub operation, bearing condition and noise (including viscous/thermostatic, air, and electric fan types); inspect fan assembly and shroud for missing and damaged components.
19. Inspect radiator (including air flow restriction, missing/corroded fins, leaks, and damage) and mountings.
20. Pressure test cooling system and radiator cap.
21. Inspect coolant hoses and clamps for leaks, damage, and proper routing.
22. Inspect coolant recovery system.
23. Identify coolant type; check coolant for contamination, supplemental coolant additives (SCAs), and protection level (freeze point).
24. Service coolant filter/conditioner.
25. Drain and refill cooling system; bleed air from system; recover coolant.
26. Inspect water pump for leaks and bearing play.
27. Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs.
28. Take an engine oil sample.

B. Cab and Hood (5 questions)

1. Inspect key condition and check operation of ignition switch.
2. Check operation of indicator lights, warning lights and/or alarms.
3. Check operation of instruments/gauges and panel lighting.
4. Check operation of electronic power take off (PTO) and engine idle speed controls (if applicable).
5. Check operation of defroster, heater, ventilation, and A/C (HVAC) controls.
6. Check operation of all accessories.
7. Use diagnostic tool or on-board diagnostic system to read current and historic diagnostic trouble codes from electronic modules (including engine, transmission, brake, supplemental restraint, traction control and body control systems).
8. Check operation of electric and air horns.
9. Check condition of safety equipment, including flares, spare fuses, reflective triangles, fire extinguisher, and all required decals.
10. Inspect seat belts, seat tethers, and sleeper restraints.
11. Check supplemental restraint system (SRS) for proper warning light operation and diagnostic trouble codes (if applicable).
12. Inspect wiper blades and arms.
13. Check wiper and washer operation.
14. Check for all required vehicle permits, registration, decals, and inspection papers.
15. Inspect windshield glass for cracks, chips, clarity, discoloration/glazing, or other damage; check sun visor operation.

T8 LIST (CONTINUED)

16. Check seat condition, operation, mounting, and suspension components.
17. Check door glass and window operation.
18. Inspect steps and grab handles.
19. Inspect mirror mountings, brackets, glass, heaters, and motors.
20. Inspect and record all observed physical damage.
21. Lubricate all cab and hood grease fittings.
22. Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, linkages, and cables.
23. Inspect cab mountings, hinges, latches, linkages; service as needed.
24. Inspect tilt cab hydraulic pump, lines, and cylinders for leakage; inspect tilt cab safety devices; service as needed.
25. Check accelerator, clutch, and brake pedal operation and condition.
26. Check cab ride height; inspect cab air suspension springs, mounts, hoses, valves, shock absorbers, and fittings for leaks and damage.
27. Inspect front bumper, fairings, and mounts.
28. Inspect A/C condenser and lines for condition and visible leaks; check mountings.
29. Inspect A/C compressor and lines for condition and visible leaks; check clutch; check mountings.
30. Check A/C system condition and operation.
31. Check HVAC air inlet filters and ducts; service as needed.
32. Check auxiliary power unit (APU) operation and mounting; inspect for damage, leaks, and belt tension.

C. Electrical/Electronics (10 questions)

1. Inspect battery box(es), cover(s), and mountings.
2. Inspect battery hold downs, connections, cables, and cable routing; service as needed.
3. Check and record battery state of charge (open circuit voltage) and condition.
4. Perform battery test (load and capacitance).
5. Inspect starter, mounting, connections, cables, and cable routing.
6. Engage starter; check for unusual noises, starter drag, and starting difficulty.
7. Inspect alternator, mounting, wiring, and wiring routing.
8. Perform alternator current output test.
9. Perform alternator voltage output test.
10. Check operation of interior lights; service as needed.
11. Check all exterior lights, lenses, and reflectors; check headlight alignment; service as needed.
12. Inspect and test trailer power cord connector, cable, and holder; service as needed.

D. Frame and Chassis (22 questions)

1. Brakes (10 questions)

1. Check air parking brake operation.
2. Check and record air governor cut-in and cut-out settings (psi).
3. Service air drier as needed. Check air drier purge valve operation and air drier heater, if equipped.
4. Check air system for leaks (brakes released).
5. Check air system for leaks (brakes applied).
6. Drain air tanks; test one-way and double-check valves.

T8 LIST (CONTINUED)

7. Check low air pressure warning devices.
8. Check spring brake inversion/emergency (spring) brake control valve, if equipped.
9. Check tractor protection valve, if equipped.
10. Test air pressure build-up time.
11. Check condition and operation of hand brake (trailer) control valve, if equipped.
12. Perform antilock brake system (ABS) operational system self-test. Perform automatic traction control (ATC) operational system self-test, if equipped.
13. Inspect coupling air lines, holders, and gladhands.
14. Check brake chambers and air lines for secure mountings, damage, and missing caging plugs.
15. Inspect and record front and rear brake lining/pad condition and thickness.
16. Inspect condition of front and rear brake drums/rotors.
17. Check operation and adjustment of front and rear brake automatic slack adjusters.
18. Check S-camshaft and bushing condition.
19. Lubricate all air brake component grease fittings.
20. Check master cylinder for leaks and damage; check fluid level and condition.
21. Inspect hydraulic brake lines, fittings, flexible hoses, and valves for leaks and damage.
22. Check hydraulic parking brake operation; inspect parking brake application and holding devices.
23. Check operation of hydraulic system; pedal travel, pedal effort, and pedal feel (drift).
24. Inspect calipers and/or wheel cylinders for leaks and damage.
25. Inspect power brake booster(s), hoses, and control valves.
26. Check and/or adjust hydraulic drum brakes.
27. Check operation of hydraulic assist back-up system and warning devices.

2. Drivetrain (4 questions)

1. Check operation of release/throw out bearing and clutch brake.
2. Check clutch linkage/cable and levers for looseness or binding; lubricate release/throwout bearing as required.
3. Check clutch master cylinder fluid level; check clutch master cylinder, slave cylinder, lines, and hoses for leaks and damage.
4. Check and/or adjust clutch.
5. Check transmission and/or transfer case housing, fasteners, seals, filter, cooler, and cooler lines for cracks, leaks, and proper routing, if equipped.
6. Check transmission wiring, connectors, seals, and harnesses for damage and proper routing.
7. Inspect transmission breather, service as needed.
8. Inspect transmission mounts for looseness and deterioration.
9. Check transmission oil/fluid level and condition.
10. Inspect U-joints, yokes, driveshafts, and center bearings for looseness, damage, and proper phasing.
11. Inspect axle housing(s) for cracks and leaks.
12. Inspect axle breather(s); service as needed.
13. Lubricate all drivetrain grease fittings.
14. Check drive axle(s) oil level.
15. Change drive axle(s) oil and filter; check and clean magnetic plugs.

T8 LIST (CONTINUED)

16. Check power take off (PTO) unit operation and mounting; check PTO U-joints and driveshaft for looseness, damage, and proper phasing, if equipped.
17. Change transmission oil/fluid and filters; check and clean magnetic plugs.
18. Take transmission oil sample.
19. Take drive axle(s) oil sample.

3. Steering, Tires, and Wheels (4 questions)

1. Check steering wheel and column operation for free play and binding.
2. Check power steering pump and hoses for leaks and mounting; check fluid level and condition.
3. Change power steering fluid and filter.
4. Inspect steering gear(s) or rack-and-pinion for leaks and mounting.
5. Inspect steering shafts and U-joints condition and for proper phasing; inspect pinch bolts, splines, Pitman arm-to-steering sector shaft, drag link, tie rod ends, cross tube, and wheel stops.
6. Check kingpin and thrust bearing wear.
7. Check front and rear wheel bearings/hub assemblies for looseness and noise, including extended service (sealed, close tolerance, and unitized) assemblies.
8. Check oil level and condition in all non-drive axle hubs; check for leaks.
9. Adjust wheel bearings as needed (including one and two nut types) in accordance with manufacturer's specifications.
10. Inspect tires for irregular wear patterns and proper mounting of directional tires.
11. Inspect tires for cuts, cracks, bulges, and sidewall damage.
12. Inspect valve caps and stems.
13. Measure and record tire tread depth; probe for imbedded debris.
14. Check and record tire air pressure; adjust as needed.
15. Check for loose lugs and/or slipped wheels; check mounting hardware condition; service as needed.
16. Retorque lugs/nuts in accordance with manufacturers' specifications.
17. Inspect wheels and spacers for cracks or damage.
18. Check tire matching (diameter and tread) on dual tire installations.
19. Lubricate all steering grease fittings.

4. Suspension, Frame, and 5th Wheel (4 questions)

1. Inspect front and rear suspension components (springs, hangers, shackles, spring U-bolts, insulators, radius rods, torque rods, load pads, walking beams, and equalizers); check U-bolt torque in accordance with manufacturers' specifications.
2. Inspect shock absorbers for leaks and mounting.
3. Inspect air suspension components (air springs/bags, mounts, arms, hoses, valves, linkage, and fittings) for leaks and damage; check suspension ride height.
4. Inspect operation of tag/pusher axle and components for mounting and damage.
5. Lubricate all suspension grease fittings.
6. Check tandem axle spacing.
7. Inspect fifth wheel mount, bolts, slider, air lines, locks, pivot pins, bushings, and stops.
8. Test operation of fifth wheel locking device; adjust as needed.
9. Check mud flaps, brackets, and reflective devices.
10. Check pintle hook assembly, mounting bolts, and locks.

T8 LIST (CONTINUED)

11. Clean and inspect fifth wheel plate for cracks and damage; lubricate fifth wheel plate and all grease fittings.
12. Inspect frame and frame members for cracks and damage.
13. Inspect body attaching hardware.
14. Inspect cargo ramps. Inspect lift gates, cylinders, controls, hoses, wiring, and warning decals; check fluid level, service as needed.
15. Inspect rear (ICC/DOT) impact guard.

E. Road/Operational Test (3 questions)

1. Check operation of clutch and gear shift.
2. Check operation of all instruments, gauges, and lights.
3. Check steering wheel for play, binding, and centering.
4. Check operation of automatic or automated mechanical transmission.
5. Check road speed limiter.
6. Check cruise control.
7. Observe exhaust for excessive smoke.
8. Test service brakes.
9. Verify engine/exhaust brake or retarder operation.
10. Check operation of backup warning devices. ■

SAMPLE QUESTIONS

PREVENTIVE MAINTENANCE INSPECTION (PMI) (TEST T8)

1. Which of these is the minimum tire tread depth permitted by federal DOT standards on all steer axle tires on trucks, tractors, or buses?
 - (A) 1/32 in.
 - (B) 2/32 in.
 - * (C) 4/32 in.
 - (D) 5/32 in.

2. Technician A says that the low air brake pressure warning lamp should be lit when the supply system pressure is below 60 psi. Technician B says that the parking brakes should automatically apply when the supply system air pressure falls below 45 psi. Who is right?
 - (A) A only
 - (B) B only
 - * (C) Both A and B
 - (D) Neither A nor B

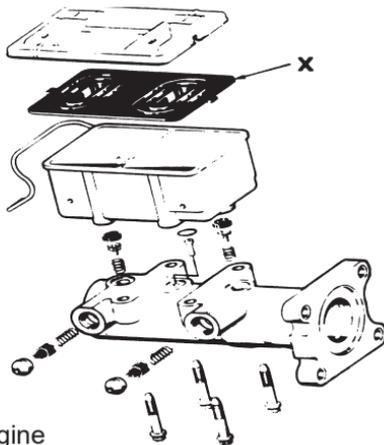
3. The driver of a tractor/trailer reports that the engine's fan hits the shroud when accelerating under a load. The cause could be:
 - (A) overspeeding the engine.
 - (B) improper vehicle shifting.
 - (C) excessive fan blade flexing.
 - * (D) a broken engine mount.

4. A drive axle lubricant is a milky color. The cause could be:
 - (A) metal contamination.
 - (B) mixing lubricant types.
 - (C) gasket sealer contamination.
 - * (D) water contamination.

T8 SAMPLE QUESTIONS (CONTINUED)

5. The PM inspector notices that part "X" in the illustration is missing. This could cause:

- * (A) fluid contamination.
- (B) loss of static pressure.
- (C) excessive pedal effort.
- (D) brake warning lamp illumination.



6. When pressure testing a cooling system, the technician should apply:

- (A) 5 pounds of pressure with the engine running.
- * (B) the amount of pressure listed on the radiator cap.
- (C) pressure not to exceed the danger zone on the pressure gauge.
- (D) 5 pounds more pressure than listed on the radiator cap.

7. When performing a battery load test on a multiple battery vehicle:

- (A) connect the load test clamps to any positive battery post and ground.
- (B) disconnect the ground cable(s) from the frame.
- (C) connect the load test amps clamp around a negative vehicle battery cable.
- * (D) isolate the batteries from each other.

This question contains the word EXCEPT. Read the question carefully before choosing your answer.

8. A zero reading on an air restriction dash gauge could be caused by any of these **EXCEPT**:

- (A) a bad restriction gauge.
- * (B) a plugged air filter.
- (C) an opening in the intake system.
- (D) a torn air filter.

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