Automotive Study Guide

Assessments:
2101 Automatic Transmission/Transaxle Technician
2102 Brakes Technician
2103 Electrical/Electronic Systems Technician
2104 Engine Performance Technician
2105 Heating and Air Conditioning Technician
2106 Suspension and Steering Technician
2107 Engine Repair Technician

Aligned with the ASE/NATEF standards

Endorsed by the Oklahoma Automobile Dealers Association
Overview

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

Each of the four sections in this guide provides useful information for students preparing for the Automatic Transmission/Transaxle Technician, Brakes Technician, Electrical/Electronics Systems Technician, Engine Performance Technician, Heating and Air Conditioning Technician, Suspension and Steering Technician, and Engine Repair Technician assessments.

- CareerTech and Competency-Based Education: A Winning Combination
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These assessments are aligned with the 2017 National Institute for Automotive Service Excellence (ASE)/National Automotive Technicians Education Foundation (NATEF) standards and endorsed by the Oklahoma Automobile Dealers Association (OADA). The assessments measure a student’s ability to apply knowledge of the skills necessary for success in the Automotive sector.

NATEF: www.natef.org

The NATEF task list was reviewed and updated in October 2016 by a national committee of individuals representing the major automobile manufacturers, auto mobile repair shop owners and technicians, automobile instructors and trainers, and automobile equipment and parts suppliers. The committee was also provided the most current National Institute for Automotive Service Excellence (ASE) Automobile Technician Tests Task Lists for reference purposes.

The OADA (405-521-1295) consists of new car and heavy-duty truck dealers and a primary purpose of their organization is to promote the common business interests of those engaged in the automotive industry.

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CareerTech and Competency-Based Education: A Winning Combination

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

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

Tools for Success

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

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

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

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

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

Measuring Success

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

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

What are the Automotive assessments?

The Automatic Transmission/Transaxle Technician, Brakes Technician, Electrical/Electronics Systems Technician, Engine Performance Technician, Heating and Air Conditioning Technician, Suspension and Steering Technician, and Engine Repair Technician assessments are end-of-program assessments for students in Automotive education programs. The assessments provide an indication of student mastery of knowledge and concepts necessary for success in careers in these areas.

How were the assessments developed?

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

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

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

What do the assessments cover?

Specifically, the tests include multiple-choice test items over the following areas:

**Automatic Transmission/Transaxle Technician (55 questions)**
- Perform General Transmission and Transaxle Diagnosis 49%
- Perform In-Vehicle Transmission/Transaxle Maintenance and Repair 38%
- Perform Off-Vehicle Transmission and Transaxle Repair 13%

**Brakes Technician (55 questions)**
- Perform General Brake Systems Diagnosis 13%
- Perform Hydraulic System Diagnosis and Repair 20%
- Perform Drum Brake Diagnosis and Repair 13%
- Perform Disc Brake Diagnosis and Repair 20%
- Perform Power-Assist Units Diagnosis and Repair 9%
- Perform Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, etc.) Diagnosis and Repair 18%
- Perform Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair 7%

**Electrical/Electronic Systems Technician (55 questions)**
- Perform General Electrical System Diagnosis 44%
- Perform Battery Diagnosis and Service 15%
- Perform Starting System Diagnosis and Repair 9%
- Perform Charging System Diagnosis and Repair 7%
Perform Lighting Systems Diagnosis and Repair 5%
Perform Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair 4%
Perform Horn and Wiper/Washer Diagnosis and Repair 7%
Perform Accessories Diagnosis and Repair 9%

**Engine Performance Technician (55 questions)**
Perform General Engine Diagnosis 33%
Perform Computerized Engine Controls Diagnosis and Repair 7%
Perform Ignition System Diagnosis and Repair 18%
Perform Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair 16%
Perform Emissions Control Systems Diagnosis and Repair 26%

**Heating and Air Conditioning Technician (55 questions)**
Perform A/C System Diagnosis and Repair 33%
Perform Refrigeration System Component Diagnosis and Repair 19%
Perform Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair 11%
Perform Operating Systems and Related Controls Diagnosis and Repair 15%
Perform Refrigerant Recovery, Recycling, and Handling 22%

**Suspension and Steering Technician (55 questions)**
Perform General Suspension and Steering Systems Diagnosis 6%
Perform Steering Systems Diagnosis and Repair 20%
Perform Suspension Systems Diagnosis and Repair 25%
Perform Related Suspension and Steering Service 4%
Perform Wheel Alignment Diagnosis, Adjustment, and Repair 25%
Perform Wheels and Tires Diagnosis and Repair 20%

**Engine Repair Technician (55 questions)**
Perform General Engine Diagnosis; Removal and Reinstallation (R & R) 27%
Perform Cylinder Head and Valve Train Diagnosis and Repair 29%
Perform Engine Block Assembly Diagnosis and Repair 4%
Perform Lubrication and Cooling Systems Diagnosis and Repair 40%

**What are the benefits of using these assessments?**

Students receive a certificate for each assessment that he/she passes. This certificate may be included in his/her portfolio and used to communicate the student's mastery of the subject matter to potential employers.

**When should assessments be taken?**

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

**Is the assessment timed?**

No. However, most students finish the assessment within one hour.
What resources can students use on these assessments?

Students are allowed to use calculators and scratch paper on CTTC assessments; however, these items must be provided by the testing proctor and returned to the proctor before the student’s exam is submitted for scoring. Calculator apps on cell phones and other devices may not be used on these assessments.

What accommodations can be made for students with Individualized Education Plans (IEPs)?

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

- Extended time — This assessment is not timed; therefore, students may take as much time as needed to finish. The assessment must be completed in one testing session.
- Readers — A reader may be used to read the assessment to a student who has been identified as needing this accommodation.
- Enlarged text — Students needing this accommodation can activate this feature by clicking the icon in the upper right corner of the screen.

What can students expect on Test Day?

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

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

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

Can students retake the test?

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

Perform General Transmission and Transaxle Diagnosis (27 questions)

1. Identify and interpret transmission/transaxle concern; differentiate between engine performance and transmission/transaxle concerns; determine necessary action (P-1)
2. Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins (P-1)
3. Diagnose fluid loss and condition concerns; determine necessary action (P-1)
4. Check fluid level and condition in a transmission or a transaxle equipped with a dip-stick (P-1)
5. Check fluid level and condition in a transmission or a transaxle not equipped with a dip-stick (P-1)
6. Perform stall test; determine needed action (P-3)
7. Perform lock-up converter system tests; determine necessary action (P-3)
8. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles (P-1)
9. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal’s Law) (P-2)

Perform In-Vehicle Transmission/Transaxle Maintenance and Repair (21 questions)

1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch. (P-2)
2. Inspect for leakage; replace external seals, gaskets, and bushings (P-2)
3. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits including computers, solenoids, sensors, relays, terminals, connectors, switches, and harnesses (P-1)
4. Drain and replace fluid and filter(s) (P-1)
5. Inspect, replace, and align power train mounts (P-2)

Perform Off-Vehicle Transmission and Transaxle Repair (7 questions)

1. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating mounting surfaces (P-1)
2. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings (P-1)
3. Inspect converter flex (drive) plate, convertor attaching bolts, convertor pilot, convertor pump drive surfaces, convertor end play, and crankshaft pilot bore (P-2)
4. Describe the operational characteristics of a continuously variable transmission (CVT) (P-3)
5. Describe the operational characteristics of a hybrid vehicle drive train (P-3)
Standards and Test Content
Brakes Technician

Perform General Brake Systems Diagnosis (7 questions)

1. Identify and interpret brake system concern; determine necessary action (P-1)
2. Research applicable vehicle and service information including fluid type, vehicle service history, service precautions, and technical service bulletins (P-1)
3. Describe procedure for performing a road test to check brake system operation; including an anti-lock brake system (ABS) (P-1)
4. Install wheel and torque lug nuts (P-1)

Perform Hydraulic System Diagnosis and Repair (11 questions)

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal’s Law) (P-1)
2. Measure brake pedal height, travel, and free play (as applicable); determine necessary action (P-1)
3. Check master cylinder for internal/external leaks and proper operation; determine necessary action (P-1)
4. Remove, bench bleed, and reinstall master cylinder (P-1)
5. Diagnose poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action (P-3)
6. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, check for and loose fittings/ supports; determine needed action (P-1)
7. Replace brake lines, hoses, fittings, and supports (P-2)
8. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types) (P-2)
9. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification (P-2)
10. Inspect, test, and/or replace components of brake warning light system (P-3)
11. Identify components of hydraulic brake warning light system (P-2)
12. Bleed and/or flush brake system (P-1)
13. Test brake fluid for contamination (P-1)
Perform Drum Brake Diagnosis and Repair (7 questions)

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation concerns; determine necessary action *(P-1)*
2. Remove, clean, and inspect brake drum; measure brake drum diameter; determine service ability *(P-1)*
3. Refinish brake drum and measure final drum diameter; compare with specification *(P-1)*
4. Remove, clean, inspect, and/or replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble *(P-1)*
5. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed *(P-2)*
6. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments *(P-2)*

Perform Disc Brake Diagnosis and Repair (11 questions)

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pulsation concerns; determine necessary action *(P-1)*
2. Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action *(P-1)*
3. Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine needed action *(P-1)*
4. Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action *(P-1)*
5. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads; inspect for leaks *(P-1)*
6. Clean and inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action *(P-1)*
7. Remove and reinstall/replace rotor *(P-1)*
8. Refinish rotor on vehicle; measure final rotor thickness and compare with specification *(P-1)*
9. Refinish rotor off vehicle; measure final rotor thickness and compare with specification *(P-1)*
10. Retract and re-adjust caliper piston on an integrated parking brake system *(P-3)*
11. Check brake pad wear indicator; determine necessary action *(P-2)*
12. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer’s recommendations *(P-1)*

Perform Power-Assist Units Diagnosis and Repair (5 questions)

1. Check brake pedal travel with, and without, engine running to verify proper power booster operation *(P-2)*
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster *(P-1)*
3. Inspect vacuum-type power booster unit for leaks; inspect the check valve for proper operation; determine necessary action *(P-1)*
4. Inspect and test hydraulically-assisted power brake system for leaks and proper operation; determine necessary action (P-3)

5. Measure and adjust master cylinder pushrod length (P-3)

**Perform Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, etc.) Diagnosis and Repair (10 questions)**

1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action (P-3)
2. Remove, clean, inspect, repack, and install wheel bearings; replace seals; install hub and adjust bearings (P-1)
3. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed (P-2)
4. Check parking brake operation and parking brake indicator light system operation; determine necessary action (P-1)
5. Check operation of brake stop light system (P-1)
6. Replace wheel bearing and race (P-2)
7. Inspect and replace wheel studs (P-1)
8. Remove, reinstall, and/or replace sealed wheel bearing assembly (P-2)

**Perform Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair (4 questions)**

1. Identify and inspect electronic brake control system components; determine necessary action (P-1)
2. Identify traction control/vehicle stability control system components
3. Describe the operation of a regenerative braking system
Standards and Test Content
Electrical/Electronic Systems Technician

Perform General Electrical System Diagnosis (24 questions)

1. Research vehicle service information including vehicle service history, service precautions, and technical service bulletins (P-1)
2. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm’s Law) (P-1)
3. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance (P-1)
4. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits (P-1)
5. Check operation of electrical circuits with a test light (P-1)
6. Check operation of electrical circuits using fused jumper wires (P-1)
7. Use wiring diagrams during the diagnosis (troubleshooting) of electrical/electronic circuit problems (P-1)
8. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine necessary action (P-1)
9. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action (P-1)
10. Inspect and test switches, connectors, relays, solenoid solid state devices, and wires of electrical/electronic circuits; determine necessary action (P-1)
11. Replace electrical connectors and terminal ends (P-1)
12. Repair wiring harness (P-3)
13. Perform solder repair of electrical wiring (P-1)

Perform Battery Diagnosis and Service (8 questions)

1. Perform battery state-of-charge test; determine necessary action (P-1)
2. Confirm proper battery capacity for vehicle application; perform battery capacity; determine necessary action (P-1)
3. Maintain or restore electronic memory functions (P-1)
4. Inspect and clean battery; fill battery cells; check battery cables, connectors, clamps, and hold-downs (P-1)
5. Perform slow/fast battery charge according to manufacturer’s recommendations (P-1)
6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply (P-1)
7. Identify high-voltage circuits of electric or hybrid electric vehicle and related safety precautions (P-3)
8. Identify electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery (P-1)
9. Identify hybrid vehicle auxiliary (12v) battery service, repair and test procedures (P-3)
Perform Starting System Diagnosis and Repair (5 questions)

1. Perform starter current draw tests; determine necessary action (P-1)
2. Perform starter circuit voltage drop tests; determine necessary action (P-1)
3. Inspect and test starter relays and solenoids; determine necessary action (P-2)
4. Remove and install starter in a vehicle (P-1)
5. Inspect and test switches, connectors, and wires of starter control circuits; determine necessary action (P-2)
6. Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition (P-2)

Perform Charging System Diagnosis and Repair (4 questions)

1. Perform charging system output test; determine necessary action (P-1)
2. Diagnose (troubleshoot) charging system for causes of undercharge, no-charge, or overcharge conditions (P-1)
3. Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment (P-1)
4. Remove, inspect, and/or replace generator (alternator) (P-1)
5. Perform charging circuit voltage drop tests; determine necessary action (P-1)

Perform Lighting Systems Diagnosis and Repair (3 questions)

1. Diagnose (troubleshoot) the causes of brighter-than-normal, intermittent, dim, or no light operation; determine necessary action (P-1)
2. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed (P-1)
3. Aim headlights (P-2)
4. Identify system voltage and safety precautions associated with high-intensity discharge headlights (P-2)

Perform Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair (2 questions)

1. Inspect and test gauges and gauge sending units for causes of abnormal readings; determine necessary action (P-2)
2. Diagnose (troubleshoot) the causes of incorrect operation of warning devices and other driver information systems; determine necessary action (P-2)
Perform Horn and Wiper/Washer Diagnosis and Repair (4 questions)

1. Diagnose (troubleshoot) causes of incorrect horn operation; perform necessary action (P-1)
2. Diagnose (troubleshoot) causes of incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action (P-2)
3. Diagnose (troubleshoot) windshield washer problems; perform necessary action (P-2)

Perform Accessories Diagnosis and Repair (5 questions)

1. Diagnose (troubleshoot) incorrect operation of motor-driven accessory circuits; determine necessary action (P-2)
2. Diagnose (troubleshoot) incorrect electric lock operation (including remote keyless entry); determine necessary action (P-2)
3. Diagnose (troubleshoot) incorrect operation of cruise control systems; determine necessary action (P-3)
4. Diagnose (troubleshoot) supplemental restraint system (SRS) problems; determine necessary action (P-2)
5. Disable and enable an airbag system for vehicle service; verify indicator lamp operation (P-1)
6. Remove and reinstall door panel (P-1)
7. Check for module communication (including CAN/BUS systems) using a scan tool (P-2)
8. Describe the operation of keyless entry/remote-start systems (P-3)
9. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators (P-1)
10. Verify windshield wiper and washer operation, replace wiper blades (P-1)
Standards and Test Content
Engine Performance Technician

Perform General Engine Diagnosis (18 questions)

1. Identify and interpret engine performance concerns; determine necessary action (P-1)
2. Research vehicle service information including vehicle service history, service precautions, and technical service bulletins (P-1)
3. Diagnose abnormal engine noises or vibration concerns; determine necessary action (P-3)
4. Diagnose the cause of excessive oil consumption, coolant consumption, unusual exhaust color, odor, and sound; determine necessary action (P-2)
5. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action (P-1)
6. Perform cylinder power balance test; determine necessary action (P-2)
7. Perform cylinder cranking and running compression tests; determine necessary action (P-1)
8. Perform cylinder leakage test; determine necessary action (P-1)
9. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action (P-2)
10. Verify engine operating temperature; determine necessary action (P-1)
11. Verify correct camshaft timing (P-1)

Perform Computerized Engine Controls Diagnosis and Repair (4 questions)

1. Retrieve and record diagnostic trouble codes (DTC), OBD monitor status, and freeze frame data; clear codes when applicable (P-1)
2. Access and use service information to perform step-by-step (troubleshooting) diagnosis (P-1)
3. Perform active tests of actuators using a scan tool; determine necessary action (P-2)
4. Describe the use of OBDII monitors for repair verification (P-1)

Perform Ignition System Diagnosis and Repair (10 questions)

1. Diagnose (troubleshoot) ignition system related problems such as no-starting, hard starting, engine misfire, poor drivability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action (P-2)
2. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action (P-1)
3. Inspect, test, and/or replace ignition control module, power train/engine control module; reprogram as necessary (P-3)
4. Remove and replace spark plugs; inspect secondary ignition components for wear and damage (P-1)
Perform Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair (9 questions)

1. Check fuel for contaminants; determine necessary action (P-2)
2. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action (P-1)
3. Replace fuel filters (P-1)
4. Inspect, service, or replace air filters, filter housings, and intake duct work (P-1)
5. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air (P-2)
6. Inspect and test fuel injectors (P-2)
7. Verify idle control operation (P-1)
8. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action (P-1)
9. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; repair or replace as needed (P-1)
10. Perform exhaust system back-pressure test; determine necessary action (P-2)
11. Check and refill diesel exhaust fluid (DEF) (P-1)

Perform Emissions Control Systems Diagnosis and Repair (14 questions)

1. Diagnose oil leaks, emissions, and drivability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action (P-3)
2. Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; determine necessary action (P-2)
3. Diagnose emissions and drivability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action (P-3)
4. Inspect, test, service and replace components of the EGR system, including tubing, exhaust passages, vacuum/pressure controls, filters, and hoses; perform necessary action (P-2)
5. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action (P-3)
6. Inspect and test catalytic converter efficiency (P-2)
7. Inspect and test components and hoses of the evaporative emissions control system; perform necessary action (P-1)
8. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action (P-3)
Standards and Test Content
Heating & Air Conditioning Technician

Perform A/C System Diagnosis and Repair (18 questions)

1. Identify and interpret heating and air conditioning problems; determine necessary action (P-1)
2. Research vehicle service information including refrigerant/oil type, vehicle service history, service precautions, and technical service bulletins (P-1)
3. Performance test A/C system; identify problems (P-1)
4. Identify abnormal operating noises in the A/C system; determine necessary action (P-2)
5. Identify refrigerant type; select and connect proper gauge set/test equipment; record temperature and pressure readings (P-1)
6. Leak test A/C system; determine necessary action (P-1)
7. Inspect condition of refrigerant oil removed from A/C system; determine necessary action (P-2)
8. Determine recommended oil and oil capacity for system application (P-1)
9. Using a scan tool, observe and record related HVAC data and trouble codes (P-3)

Perform Refrigeration System Component Diagnosis and Repair (11 questions)

1. Inspect and replace A/C compressor drive belts, pulleys, and tensioners; determine necessary action (P-1)
2. Inspect, test, service or replace A/C compressor clutch components and/or assembly; check compressor clutch air gap; adjust as needed (P-2)
3. Remove, inspect, and reinstall A/C compressor and mountings; determine recommended oil quantity (P-2)
4. Identify hybrid vehicle A/C system electrical circuits and service/safety precautions (P-2)
5. Determine need for an additional A/C system filter; perform necessary action (P-3)
6. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; perform necessary action (P-2)
7. Inspect A/C condenser for airflow restrictions; perform necessary action (P-1)
8. Remove, inspect, and reinstall receiver/drier or accumulator/drier; determine required oil quantity (P-2)
9. Remove, inspect, and install expansion valve or orifice (expansion) tube (P-1)
10. Inspect evaporator housing water drain; perform necessary action (P-1)
11. Determine procedure to remove and reinstall evaporator; determine required oil quantity (P-2)
Perform Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair (6 questions)

1. Inspect engine cooling and heater systems hoses and pipes; perform necessary action (P-1)
2. Inspect and test heater control valve(s); perform necessary action (P-2)
3. Determine procedure to remove, inspect, reinstall, and/or replace heater core (P-2)

Perform Operating Systems and Related Controls Diagnosis and Repair (8 questions)

1. Inspect and test A/C-heater blower motors, resistors, switches, relays, wiring, and protection devices; perform necessary action (P-1)
2. Diagnose A/C compressor clutch control systems; determine necessary action (P-2)
3. Diagnose malfunctions in the vacuum, mechanical, and electrical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action (P-2)
4. Inspect and test A/C-heater control panel assembly; determine necessary action (P-3)
5. Inspect and test A/C-heater control cables, motors, and linkages; perform necessary action (P-3)
6. Inspect A/C-heater ducts, doors, hoses, cabin filters, and outlets; perform necessary action (P-1)
7. Identify the source of A/C system odors (P-2)
8. Check operation of automatic or semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action (P-2)

Perform Refrigerant Recovery, Recycling, and Handling (12 questions)

1. Perform correct use and maintenance of refrigerant handling equipment according to equipment manufacturer’s standards (P-1)
2. Identify and recover A/C system refrigerant (P-1)
3. Recycle, label, and store refrigerant (P-1)
4. Evacuate and charge A/C system; add refrigerant oil as required (P-1)
Standards and Test Content
Suspension and Steering Technician

Perform General Suspension and Steering System Diagnosis (3 questions)
1. Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins (P-1)

Perform Steering Systems Diagnosis and Repair (11 questions)
1. Disable and enable supplemental restraint system (SRS) (P-1)
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring) (P-1)
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action (P-2)
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action (P-2)
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action (P-2)
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action (P-2)
7. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets (P-2)
8. Inspect and replace rack and pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed (P-2)
9. Determine proper power steering fluid type; inspect fluid level and condition (P-1)
10. Flush, fill, and bleed power steering system (P-2)
11. Inspect for power steering fluid leakage; determine necessary action (P-1)
12. Remove, inspect, replace, and adjust power steering pump drive belt (P-1)
13. Remove and reinstall power steering pump (P-2)
14. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment (P-2)
15. Inspect and replace power steering hoses and fittings (P-2)
16. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper (P-2)
17. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps (P-1)
18. Identify hybrid vehicle power steering system electrical circuits and safety precautions (P-2)
19. Inspect electric power-assisted steering (P-3)
Perform Suspension Systems Diagnosis and Repair (14 questions)

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action (P-1)
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action (P-1)
3. Inspect, remove, and install upper and lower control arms, bushings, shafts, and rebound bumpers (P-3)
4. Inspect, remove, and install strut rods and bushings (P-3)
5. Inspect, remove, and install upper and/or lower ball joints (with or without wear indicators) (P-2)
6. Inspect, remove, and install steering knuckle assemblies (P-3)
7. Inspect, remove, and install short and long arm suspension system coil springs and spring insulators (P-3)
8. Inspect, remove, and install torsion bars and mounts (P-3)
9. Inspect, remove, and install front stabilizer bar (sway bar) bushings, brackets, and links (P-3)
10. Inspect, remove, and install strut (P-3)
11. Inspect, remove, and install track bar, strut rods/radius arms, and related mounts and bushings (P-3)
12. Inspect rear suspension system leaf spring(s), bushings, center pins/bolts, and mounts (P-1)

Perform Related Suspension and Steering Service (2 questions)

1. Inspect, remove, and/or replace shock absorbers, inspect mounts and bushings (P-1)
2. Remove, inspect, and/or service or replace front and rear wheel bearings (P-1)
3. Describe the function of the power steering pressure switch (P-3)

Perform Wheel Alignment Diagnosis, Adjustment, and Repair (14 questions)

1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action (P-1)
2. Perform pre-alignment inspection and measure vehicle ride height; perform necessary action (P-1)
3. Prepare vehicle for wheel alignment on the alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber; and toe as required; center steering wheel (P-1)
4. Check toe-out-on turns (turning radius); determine necessary action (P-2)
5. Check SAI (steering axis inclination) and included angle; determine necessary action (P-2)
6. Check rear wheel thrust angle; determine necessary action (P-1)
7. Check for front wheel setback; determine necessary action (P-2)
8. Check front and/or rear cradle (sub frame) alignment; determine necessary action (P-3)
9. Reset steering angle sensor (P-2)
Perform Wheels and Tires Diagnosis and Repair (11 questions)

1. Inspect tire condition; identify tire wear patterns; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action (P-1)
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action (P-2)
3. Rotate tires according to manufacturer’s recommendations (P-1)
4. Measure wheel, tire, axle flange, and hub run out; determine necessary action (P-2)
5. Diagnose tire pull problems; determine necessary action (P-2)
6. Dismount, inspect, and remount tire on wheel; balance wheel and tire assembly (static and dynamic) (P-1)
7. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor (P-2)
8. Inspect tire and wheel assembly for air loss; perform necessary action (P-1)
9. Repair tire using internal patch (P-1)
10. Identify and test tire pressure monitoring system (indirect and direct) for operation; verify operation of instrument panel lamps (P-2)
11. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system (P-1)
Standards and Test Content
Engine Repair Technician

Perform General Engine Diagnosis; Removal and Reinstallation (R & R) (15 questions)

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction (P-1)
2. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins (P-1)
3. Verify operation of the instrument panel engine warning indicators (P-1)
4. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action (P-1)
5. Install engine covers using gaskets, seals, and sealers as required (P-1)
6. Remove and replace timing belt; verify correct camshaft timing (P-1)
7. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert (P-1)
8. Inspect, remove and replace engine mounts (P-2)
9. Identify hybrid vehicle internal combustion engine service precautions (P-3)
10. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition (P-3)

Perform Cylinder Head and Valve Train Diagnosis and Repair (16 questions)

1. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer’s specifications and procedures (P-1)
2. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition (P-1)
3. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action (P-2)
4. Adjust valves (mechanical or hydraulic lifters) (P-1)
5. Inspect and replace camshaft and drive belt/chain; includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and valve timing components; verify correct camshaft timing (P-1)
6. Establish camshaft position sensor indexing (P-1)

Perform Engine Block Assembly Diagnosis and Repair (2 questions)

1. Remove, inspect and/or replace crankshaft vibration damper (harmonic balancer) (P-2)
Perform Lubrication and Cooling Systems Diagnosis and Repair (22 questions)

1. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, and heater core and galley plugs; determine necessary action (P-1)
2. Identify causes of engine overheating (P-1)
3. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment (P-1)
4. Inspect and test coolant; drain and recover coolant; flush and refill cooling system; use proper fluid type per manufacturer specification; bleed air as required (P-1)
5. Inspect, remove and replace water pump (P-2)
6. Remove and replace radiator (P-2)
7. Remove, inspect, and replace thermostat and gasket/seal (P-1)
8. Inspect and test fan(s), fan clutch (electrical or mechanical), fan shroud, and air dams; determine needed action (P-1)
9. Perform oil pressure tests; determine necessary action (P-1)
10. Perform engine oil and filter change; use proper fluid type per manufacturer specification (P-1)
11. Inspect auxiliary coolers; determine necessary action (P-3)
12. Inspect, test, and replace oil temperature and pressure switches and sensors (P-1)
Sample Questions

1. Prior to performing a road test for an automatic transmission, Technician A says you should gather detailed information from the driver of the vehicle. Technician B says you need to check and record the shift points and shift quality. Who is correct?
   a. Technician A
   b. Technician B
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

2. Technician A says transmission upshifts depend on car speed and throttle position. Technician B says transmission upshifts depend on car speed and engine speed. Who is correct?
   a. Technician A
   b. Technician B
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

3. Transmission fluid leaking from the rear of the transmission is caused by:
   a. a bad extension housing bushing.
   b. a bad oil pump.
   c. a broken speedometer cable.
   d. too much modular vacuum.

4. If the fill port on the master cylinder becomes plugged:
   a. air can bypass the rear piston cup and get into the brake system.
   b. heat expansion cannot take place in the cylinder.
   c. pressure can build in the cylinder forcing too much fluid to the brakes.
   d. pressure in the cylinder could blow the cover off.

5. A partially restricted brake line or hose causes:
   a. brake drag/pull.
   b. pedal drop.
   c. pulsation.
   d. spongy pedal.
6. Before removing the alternator from the system, a technician should first disconnect the:
   a. alternator wiring.
   b. ammeter from the ground.
   c. battery ground cable.
   d. field circuit.

7. A dim courtesy light operation is present, but all other lights function normally. What is the most likely cause?
   a. defective dimmer switch
   b. defective light switch
   c. loose ground
   d. weak battery

8. When a vehicle accelerates, the manifold absolute pressure (MAP):
   a. decreases rapidly.
   b. fluctuates up and down.
   c. increases rapidly.
   d. stays the same.

9. A technician has performed a resistance test on the compressor clutch magnet and has found the coil to have low resistance. This is an indication of:
   a. normal operation.
   b. open.
   c. a short to ground.
   d. a short to power.

10. A vehicle's idler arm has too much vertical (up and down) movement. Technician A says this causes excessive change in toe. Technician B says this causes excessive change in caster angles when cornering. Who is correct?
    a. Technician A
    b. Technician B
    c. Both Technician A and Technician B
    d. Neither Technician A nor Technician B

11. Technician A says a bad upper bearing on a strut assembly causes a riding height problem. Technician B says a bad upper bearing causes a grinding noise when turning. Who is correct?
    a. Technician A
    b. Technician B
    c. Both Technician A and Technician B
    d. Neither Technician A nor Technician B
12. During inspection of the engine block, a crack is found on the outside of the block between the core plugs. What most likely caused this condition?

a. excessive engine blow-by 
   b. improper coolant/water mixture
   c. incorrect oil viscosity 
   d. leaking oil pressure relief valve 

13. During the inspection of an engine block and crankshaft assembly, crankshaft end-play is found to be out of the manufacturer’s specifications. Which of the following concerns causes this condition?

a. damaged main bearing cap 
   b. excessive thrust bearing wear
   c. excessive wear of the timing chain/belt components 
   d. worn connecting rod bearings 

14. When inspecting a transmission extension housing, a technician finds pieces of plastic. These pieces are part of the:

a. 3-4 drive gear. 
   b. blocker ring. 
   c. shift fork. 
   d. speedometer drive gear. 

15. If the transmission shaft bearing preload torque measurement is excessive, a technician should replace the:

a. counter shaft. 
   b. main shaft.
   c. shim with a thicker shim. 
   d. shim with a thinner shim.
Sample Questions — Key

1. Prior to performing a road test for an automatic transmission, Technician A says you should gather detailed information from the driver of the vehicle. Technician B says you need to check and record the shift points and shift quality. Who is correct?
   a. Technician A  
      Wrong, but plausible
   b. Technician B  
      Wrong, but plausible
   c. Both Technician A and Technician B  
      Correct
   d. Neither Technician A nor Technician B  
      Wrong, but plausible

2. Technician A says transmission upshifts depend on car speed and throttle position. Technician B says transmission upshifts depend on car speed and engine speed. Who is correct?
   a. Technician A  
      Correct
   b. Technician B  
      Wrong, but plausible
   c. Both Technician A and Technician B  
      Wrong, but plausible
   d. Neither Technician A nor Technician B  
      Wrong, but plausible

3. Transmission fluid leaking from the rear of the transmission is caused by:
   a. a bad extension housing bushing.  
      Correct
   b. a bad oil pump.  
      Wrong, but plausible
   c. a broken speedometer cable.  
      Wrong, but plausible
   d. too much modular vacuum.  
      Wrong, but plausible

4. If the fill port on the master cylinder becomes plugged:
   a. air can bypass the rear piston cup and get into the brake system.  
      Correct
   b. heat expansion cannot take place in the cylinder.  
      Wrong, but plausible
   c. pressure can build in the cylinder forcing too much fluid to the brakes.  
      Wrong, but plausible
   d. pressure in the cylinder could blow the cover off.  
      Wrong, but plausible

5. A partially restricted brake line or hose causes:
   a. brake drag/pull.  
      Correct
   b. pedal drop.  
      Wrong, but plausible
   c. pulsation.  
      Wrong, but plausible
   d. spongy pedal.  
      Wrong, but plausible
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   a. alternator wiring.  
   b. ammeter from the ground.  
   c. battery ground cable.  
   d. field circuit.

   - Correct
   - Wrong, but plausible

7. A dim courtesy light operation is present, but all other lights function normally. What is the most likely cause?

   a. defective dimmer switch  
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   - Correct
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10. A vehicle's idler arm has too much vertical (up and down) movement. Technician A says this causes excessive change in toe. Technician B says this causes excessive change in caster angles when cornering. Who is correct?

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    b. Technician B  
    c. Both Technician A and Technician B  
    d. Neither Technician A nor Technician B

    - Correct
    - Wrong, but plausible

11. Technician A says a bad upper bearing on a strut assembly causes a riding height problem. Technician B says a bad upper bearing causes a grinding noise when turning. Who is correct?

    a. Technician A  
    b. Technician B  
    c. Both Technician A and Technician B  
    d. Neither Technician A nor Technician B

    - Correct
    - Wrong, but plausible
12. During inspection of the engine block, a crack is found on the outside of the block between the core plugs. What most likely caused this condition?

a. excessive engine blow-by  
Correct
b. improper coolant/water mixture  
Wrong, but plausible
c. incorrect oil viscosity  
Wrong, but plausible
d. leaking oil pressure relief valve  
Wrong, but plausible

13. During the inspection of an engine block and crankshaft assembly, crankshaft end-play is found to be out of the manufacturer’s specifications. Which of the following concerns causes this condition?

a. damaged main bearing cap  
Wrong, but plausible
b. excessive thrust bearing wear  
Correct
c. excessive wear of the timing chain/belt components  
Wrong, but plausible
d. worn connecting rod bearings  
Wrong, but plausible

14. When inspecting a transmission extension housing, a technician finds pieces of plastic. These pieces are part of the:

a. 3-4 drive gear.  
Wrong, but plausible
b. blocker ring.  
Wrong, but plausible
c. shift fork.  
Wrong, but plausible
d. speedometer drive gear.  
Correct

15. If the transmission shaft bearing preload torque measurement is excessive, a technician should replace the:

a. counter shaft.  
Wrong, but plausible
b. main shaft.  
Wrong, but plausible
c. shim with a thicker shim.  
Wrong, but plausible
d. shim with a thinner shim.  
Correct
Abbreviations, Symbols and Acronyms

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

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

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

General Testing Advice

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

Testing Tips

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