Entry-Level Certification Program

TEST SPECIFICATIONS AND TASK LISTS

MASTER AUTOMOBILE SERVICE TECHNOLOGY (MAST) SERIES

(Effective July 1, 2023)

The task lists and test specifications for each of the eight individual tests below are derived directly from the 2022 Instructional Standard for ASE program accreditation.

The task lists are simply listings of the tasks involved in servicing and repair of various vehicle systems. Each question in a test is keyed to one or more of these tasks. The task lists are organized into content categories, and these content categories, along with the number of questions included in each category, comprise the test specifications. Every exam form meets these specifications.

Tests may include additional, unscored questions for statistical evaluation. Extra questions will not count for or against the final score. However, since they are not identified, candidates should answer every question to the best of their ability.

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I. ENGINE REPAIR

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D. Lubrication and Cooling Systems D&R	13
Required To Pass: 22 of 40 TOTAL	40

Notes:
This test may include additional questions for statistical evaluation. Extra questions will not count for or against the final score. Since the extra questions are not identified, test candidates should answer every question to the best of their ability.

ER-A. General: Engine Diagnosis; Removal and Reinstallation (R & R)

1. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
3. Verify operation of the instrument panel engine warning indicators.
4. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine needed action.
5. Install engine covers using gaskets, seals, and sealers as required.
6. Verify engine mechanical timing.
7. Inspect, remove, and/or replace engine mounts.
8. Identify service precautions related to service of the internal combustion engine of a hybrid electric vehicle.
9. Remove and reinstall engine on a newer vehicle equipped with OBD; reconnect all attaching components and restore the vehicle to running condition.

ER-B. Cylinder Head and Valve Train Diagnosis and Repair

1. Identify cylinder head and valve train components and configurations.
2. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specification and procedure.
3. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition.
4. Inspect valve actuating mechanisms for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine needed action.
5. Adjust valves (mechanical or hydraulic lifters).
6. 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.
7. Inspect valve springs for squareness and free height comparison; determine needed action.
8. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine needed action.
9. Inspect valve guides for wear; check valve stem-to-guide clearance; determine needed action.
10. Inspect valves and valve seats; determine needed action.
11. Check valve spring assembled height and valve stem height; determine needed action.
12. Inspect valve lifters and hydraulic lash adjusters; determine needed action.
13. Inspect and/or measure camshaft for runout, journal wear and lobe wear.
14. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine needed action.

ER-C. Engine Block Assembly Diagnosis and Repair

1. Identify engine block assembly components and configurations.
2. Remove, inspect, and/or replace crankshaft vibration damper (harmonic balancer).
3. Disassemble engine block; clean and prepare components for inspection and reassembly.
4. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine needed action.
5. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine needed action.
6. Perform deglazing and cleaning of cylinder walls.
7. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine needed action.
8. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine needed action.
9. Inspect main and connecting rod bearings for damage and wear; determine needed action.
10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine needed action.
11. Inspect and measure piston skirts and ring lands; determine needed action.
12. Determine piston-to-bore clearance.
13. Inspect, measure, and install piston rings.
14. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance and/or silencer); inspect shaft(s) and support bearings for damage and wear; determine needed action; reinstall and time.
15. Assemble engine block.

ER-D. Lubrication and Cooling Systems Diagnosis and Repair

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

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

Content Area	Questions In Test
A. General: Transmission and Transaxle Diagnosis	18
B. In-Vehicle Transmission/Transaxle Maintenance and Repair	10
C. Off-Vehicle Transmission and Transaxle Repair	12
Required To Pass: 22 of 40 TOTAL	40

Notes:
This test may include additional questions for statistical evaluation. These extra questions will not count for or against the final score. Since the extra questions are not identified, test candidates should answer every question to the best of their ability.

AT-A. General: Transmission and Transaxle Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify automatic transmission and transaxle components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick.
5. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick.
6. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.
7. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).
8. Identify and interpret transmission/transaxle concerns, differentiate between engine performance and transmission/transaxle concerns; determine needed action.
9. Diagnose fluid loss and condition concerns; determine needed action.
10. Perform stall test; determine needed action.
11. Perform lock-up converter system tests; determine needed action.
12. Perform pressure tests on transmissions/transaxles equipped with electronic pressure control; determine needed action.
13. Diagnose electronic transmission/transaxle control systems using appropriate test equipment and service information.
14. Diagnose noise and vibration concerns; determine needed action.

AT-B. In-Vehicle Transmission/Transaxle Maintenance and Repair

1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch.
2. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification.
3. Perform relearn procedures.
4. Inspect, replace/or and align powertrain mounts.
5. Inspect for leakage; replace external seals, gaskets, and bushings.
6. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits.

AT-C. Off-Vehicle Transmission and Transaxle Repair

1. Describe the operational characteristics of a continuously variable transmission (CVT).
2. Describe the operational characteristics of a hybrid vehicle drive train.

3. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mounting surfaces.
4. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings.
5. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.
6. Disassemble, clean, and inspect transmission/transaxle.
7. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, switches, solenoids, sleeves, retainers, brackets, check valves/balls, screens, spacers, and gaskets).
8. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine needed action.
9. Assemble transmission/transaxle.
10. Inspect, measure, and reseal oil pump assembly and components.
11. Measure transmission/transaxle end play and/or preload; determine needed action.
12. Inspect, measure, and/or replace thrust washers and bearings.
13. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls.
14. Inspect bushings; determine needed action.
15. Inspect and measure planetary gear assembly components; determine needed action.
16. Inspect case bores, passages, bushings, vents, and mating surfaces; determine needed action.
17. Diagnose and inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; determine needed action.
18. Inspect measure, repair, adjust or replace transaxle final drive components.
19. Inspect clutch drum, piston, check-balls, springs, retainers, seals, friction plates, pressure plates, and bands; determine needed action.
20. Measure clutch pack clearance; determine needed action.
21. Air test operation of clutch and servo assemblies.
22. Inspect one-way clutches, races, rollers, sprags, springs, cages, retainers; determine needed action.

III. MANUAL DRIVE TRAIN AND AXLES

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Required To Pass: 21 of 40 TOTAL	40

Notes:
This test may include additional questions for statistical evaluation. These extra questions will not count for or against the final score. Since the extra questions are not identified, test candidates should answer every question to the best of their ability.

MD-A. General: Drive Train Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify manual drive train and axles components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Check fluid condition; check for leaks; determine needed action.
5. Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification.
6. Diagnose drive train concerns; determine needed action.

MD-B. Clutch Diagnosis and Repair

1. Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification.
2. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine needed action.
3. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; determine needed action.
4. Inspect and/or replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing, linkage, and pilot bearing/bushing (as applicable).
5. Bleed clutch hydraulic system.
6. Inspect flywheel and ring gear for wear, cracks, and discoloration; determine needed action.
7. Measure flywheel runout and crankshaft end play; determine needed action.
8. Describe the operation and service of a system that uses a dual mass flywheel.

MD-C. Transmission/Transaxle Diagnosis and Repair

1. Describe the operational characteristics of an electronically controlled manual transmission/transaxle.
2. Inspect, adjust, lubricate, and/or replace shift linkages, brackets, bushings, cables, pivots, and levers.
3. Diagnose noise concerns through the application of transmission/transaxle power flow principles; determine needed action.
4. Diagnose hard shifting and jumping out of gear concerns; determine needed action.
5. Diagnose transaxle final drive assembly noise and vibration concerns; determine needed action.
6. Disassemble, inspect clean, and reassemble internal transmission/transaxle components.

MD-D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair (Front, Rear, All-wheel, and Four-wheel Drive)

1. Inspect and/or remove/replace bearings, hubs, and seals.
2. Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints.
3. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.
4. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine needed action.
5. Diagnose universal joint noise and vibration concerns; determine needed action.
6. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles; determine needed action.

MD-E. Differential and Drive Axles: Diagnosis and Repair

E.1 Ring and Pinion Gears and Differential Case Assembly

1. Inspect differential housing; check for leaks; inspect housing vent.
2. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification.
3. Drain and refill differential housing; use proper fluid type per manufacturer specification.
4. Inspect and replace companion flange and/or pinion seal; measure companion flange runout.
5. Inspect ring gear and measure runout; determine needed action.
6. Diagnose noise and vibration concerns; determine needed action.
7. Remove, inspect, reinstall, or replace drive pinion and ring gear, spacers, sleeves, and bearings.
8. Measure and adjust drive pinion depth.
9. Measure and adjust drive pinion bearing preload.
10. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).
11. Check ring and pinion tooth contact patterns; determine needed action.
12. Disassemble, inspect, measure, adjust, and/or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case.
13. Reassemble and reinstall differential case assembly; measure runout; determine needed action.

E.2 Drive Axles

1. Inspect and replace drive axle wheel studs.
2. Remove and replace drive axle shafts.
3. Inspect and replace drive axle shaft seals, bearings, and retainers.
4. Measure drive axle flange runout and shaft end play; determine needed action.
5. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine needed action.

E.3 Limited Slip Differential

1. Diagnose noise, slippage, and chatter concerns including electronically controlled systems; determine needed action.
2. Measure rotating torque; determine needed action.

MD-F. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair

1. Identify concerns related to variations in tire circumference and/or final drive ratios.
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.
3. Inspect axle locking mechanisms; determine needed action(s).
4. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.

5. Diagnose noise, vibration, and unusual steering concerns; determine needed action.
6. Diagnose, test, adjust, and/or replace electrical/electronic components of four-wheel drive/all-wheel drive systems.
7. Disassemble, service, and reassemble transfer case and components.

IV. SUSPENSION AND STEERING

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Required To Pass: 20 of 40 TOTAL	40

Notes:
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SS-A. General Suspension and Steering Systems

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify suspension and steering system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation.
5. Identify and interpret suspension and steering system concerns; determine needed action.

SS-B. Steering Systems Diagnosis and Repair

1. Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots; repair or replace as needed.
2. Inspect power steering fluid level and condition.
3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification.
4. Inspect for power steering fluid leakage; determine needed action.
5. Remove, inspect, replace, and/or adjust power steering pump drive belt.
6. Inspect, remove, and/or replace power steering hoses and fittings.
7. Inspect, remove, and/or replace pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper.
8. Inspect, replace, and/or adjust tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion).
9. Inspect and test electric power steering system; determine needed action.
10. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).
11. Diagnose steering column noises, looseness, and binding concerns (including tilt/telescoping mechanisms); determine needed action.
12. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.
13. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action.
14. Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; determine needed action.
15. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets.
16. Remove and reinstall power steering pump.
17. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment.
18. Test power steering system pressure; determine needed action.

SS-C. Suspension Systems Diagnosis and Repair

1. Inspect, remove, and/or replace upper and/or lower control arms, bushings, and shafts.
2. Inspect and replace rebound/jounce bumpers.
3. Inspect, remove, and/or replace track bar, strut rods/radius arms, and related mounts and bushings.
4. Inspect, remove, and/or replace upper and/or lower ball joints (with or without wear indicators).
5. Inspect, remove, and/or replace suspension system coil springs and spring insulators.
6. Inspect, remove, and/or replace torsion bars and mounts.
7. Inspect, remove, and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links.
8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount.
9. Inspect, remove, and/or replace components of suspension systems (Coil, Leaf, and Torsion).
10. Inspect, remove, and/or replace components of electronically controlled suspension systems.
11. Inspect, remove, and/or replace steering knuckle assemblies.
12. Diagnose suspension system noises, body sway, and uneven ride height concerns; determine needed action.

SS-D. Related Suspension and Steering Service

1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings.
2. Inspect, service, and/or replace front and rear wheel bearings.
3. Describe the function of electronically controlled suspension and steering systems and components, (i.e., active suspension and stability control).

SS-E. Wheel Alignment Diagnosis, Adjustment, and Repair

1. Perform pre-alignment inspection; measure vehicle ride height; determine needed action.
2. Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling\tire wear.
3. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front caster, front and rear camber, and toe as required; center steering wheel.
4. Check toe-out-on-turns (turning radius); determine needed action.
5. Check steering axis inclination (SAI) and included angle; determine needed action.
6. Check rear wheel thrust angle; determine needed action.
7. Check for front wheel setback; determine needed action.
8. Identify front and/or rear cradle (subframe) misalignment; determine needed action.
9. Reset steering angle sensor.
10. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action.

SS-F. Wheels and Tires Diagnosis and Repair

1. Inspect tire condition/age; identify tire wear patterns; check for correct tire size, application (service-class, load, and speed ratings), and air pressure as listed on the tire information placard/label.
2. Rotate tires according to manufacturer’s recommendation including vehicles equipped with tire pressure monitoring systems (TPMS)
3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly.
4. Inspect tire and wheel assembly for air loss; determine needed action.
5. Repair tire following tire manufacturer approved procedure.
6. Identify indirect and direct tire pressure monitoring system (TPMS); calibrate/relearn system; verify operation of instrument panel lamps.
7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS).
8. Perform Road Force balance/match mounting.

9. Diagnose wheel/tire vibration, shimmy, and noise; determine needed action.
10. Measure wheel, tire, axle flange, and hub runout; determine needed action.
11. Diagnose tire pull problems; determine needed action.

V. BRAKES

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Required To Pass: 21 of 40 TOTAL	40

Notes:
This test may include additional questions for statistical evaluation. These extra questions will not count for or against the final score. Since the extra questions are not identified, test candidates should answer every question to the best of their ability.

BR-A. General: Brake Systems Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify brake system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS).
5. Install wheel and torque lug nuts.
6. Identify and interpret brake system concerns; determine needed action.

BR-B. Hydraulic System Diagnosis and Repair

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

BR-C. Drum Brakes Diagnosis and Repair

1. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability.
2. Refinish brake drum and measure final drum diameter; compare with specification.
3. 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.
4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed.
5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.
6. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation concerns; determine needed action.

BR-D. Disc Brakes Diagnosis and Repair

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

BR-E. Power-Assist Units Diagnosis and Repair

1. Check brake pedal travel with and without engine running to verify proper power booster operation.
2. Identify components of the brake power assist system (vacuum/ hydraulic/electric).
3. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster determine needed action.
4. Inspect and test hydraulically assisted power brake system for leaks and proper operation; determine needed action.
5. Inspect electric power booster unit; determine needed action.

BR-F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical) Diagnosis and Repair

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

BR-G. Electronic Brake Control Systems: Antilock Brake (ABS), Traction Control (TCS), and Electronic Stability Control (ESC) Systems Diagnosis and Repair

1. Identify and inspect electronic brake control system components and describe function (ABS, TCS, ESC); determine needed action.
2. Describe the operation of a regenerative braking system.
3. Bleed the electronic brake control system hydraulic circuits.
4. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system; determine needed action.
5. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine needed action.
6. Depressurize high-pressure components of an electronic brake control system.
7. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).
8. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).

VI. ELECTRICAL/ELECTRONIC SYSTEMS

Content Areas	Questions In Test
A. General: Electrical System Diagnosis	11
B. Battery Diagnosis and Service	5
C. Starting System Diagnosis and Service	5
D. Charging System Diagnosis and Service	5
E. Lighting Systems Diagnosis and Service	4
F. Instrument Cluster and Driver Information Systems D&R	3
G. Body Electrical Systems Diagnosis and Service	7
Required To Pass: 20 of 40 TOTAL	40

Notes:
This test may include additional questions for statistical evaluation. These extra questions will not count for or against the final score. Since the extra questions are not identified, test candidates should answer every question to the best of their ability.

EE-A. General: Electrical System Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify electrical/electronic system components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law).
5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance.
6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits.
7. Describe types of test lights; use appropriate test light to check operation of electrical circuits per service information.
8. Use fused jumper wires to check operation of electrical circuits per service information.
9. Use wiring diagrams during the diagnosis of electrical/electronic circuit problems.
10. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine needed action.
11. Inspect and test fusible links, circuit breakers, and fuses; determine needed action.
12. Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, and wiring in electrical/electronic systems (including solder repairs); determine needed action.
13. Test and measure circuit using an oscilloscope and/or graphing multimeter (GMM); interpret results; determine needed action.

EE-B. Battery Diagnosis and Service (Conventional 12-volt)

1. Perform battery state-of-charge test; determine needed action.
2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test; determine needed action.
3. Maintain or restore electronic memory functions as recommended by manufacturer.
4. Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold-downs.
5. Perform battery charging according to manufacturer's recommendations.
6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply.

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

EE-C. Starting System Diagnosis and Repair

1. Perform starter current draw test; determine needed action.
2. Perform starter circuit voltage drop tests; determine needed action.
3. Inspect and test starter relays and solenoids; determine needed action.
4. Remove and install starter in a vehicle.
5. Inspect and test switches, connectors, and wires of starter control circuits; determine needed action.
6. Demonstrate knowledge of an automatic idle-stop/start-stop system.
7. Differentiate between electrical and engine mechanical problems that cause a slow-crank or a no-crank condition.

EE-D. Charging System Diagnosis and Repair

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

EE-E. Lighting Systems Diagnosis and Repair

1. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); determine needed action.
2. Aim headlights.
3. Diagnose the causes of brighter-than-normal, intermittent, dim, or no light operation; determine needed action.

EE-F. Instrument Cluster and Driver Information Systems Diagnosis and Repair

1. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required.
2. Inspect and test gauges and gauge sending units for causes of abnormal readings; determine needed action.
3. Diagnose the causes of incorrect operation of warning devices and other driver information systems; determine needed action.

EE-G. Body Electrical Systems Diagnosis and Repair

1. Diagnose vehicle comfort, convenience, access, safety, and related systems operation; determine needed action.
2. Remove and reinstall door panel.
3. Diagnose operation of security/anti-theft systems and related circuits (such as: theft deterrent, door locks, remote keyless entry, remote start, and starter/fuel disable); determine needed action.
4. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation.
5. Verify windshield wiper and washer operation; replace wiper blades.
6. Diagnose operation of entertainment and related circuits (such as: radio, DVD, remote CD changer, navigation, amplifiers, speakers, antennas, and voice-activated accessories); determine needed action.

7. Diagnose operation of safety systems and related circuits (such as: horn, airbags, seat belt pretensioners, occupancy classification, wipers, washers, speed control/collision avoidance, heads-up display, parking assist, and back-up camera); determine needed action.
8. Diagnose body electronic systems circuits using a scan tool; check for module communication errors (data communication bus systems); determine needed action.
9. Describe the process for software transfer, software updates, or reprogramming of electronic modules.

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

Content Areas	Questions In Test
A. General: A/C System Diagnosis and Repair	11
B. Refrigeration System Component Diagnosis and Repair	9
C. Heating, Ventilation, and Engine Cooling Systems D&R	4
D. Operating Systems and Related Controls Diagnosis and Repair	11
E. Refrigerant Recovery, Recycling, and Handling	5
Required To Pass: 20 of 40 TOTAL	40

Notes:
This test may include additional questions for statistical evaluation. These extra questions will not count for or against the final score. Since the extra questions are not identified, test candidates should answer every question to the best of their ability.

AC-A. General: A/C System Diagnosis and Repair

1. Research vehicle service information, including refrigerant/oil/fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Identify heating, ventilation, and air conditioning (HVAC) components and configurations.
3. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
4. Perform A/C system performance test; interpret results; determine needed action.
5. Identify abnormal operating noises in the A/C system; determine needed action.
6. Leak test A/C system; determine needed action.
7. Identify and interpret heating and air conditioning problems; determine needed action.
8. Identify refrigerant type; test for sealant; select and connect proper gauge set/test equipment; record temperature and pressure readings.
9. Inspect condition/quantity of refrigerant oil removed from A/C system; determine needed action.
10. Determine recommended oil and oil capacity for system application and component(s) replacement.

AC-B. Refrigeration System Component Diagnosis and Repair

1. Inspect, remove, and/or replace A/C compressor drive belts, pulleys, tensioners; determine needed action.
2. Inspect for proper A/C condenser airflow; determine needed action.
3. Inspect evaporator housing condensation drain; determine needed action.
4. Inspect, test, and/or service A/C compressor clutch components and/or assembly; determine needed action.
5. Remove, inspect, reinstall, and/or replace A/C compressor and mountings; determine recommended oil type and quantity.
6. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; determine needed action.
7. Remove, inspect, and replace receiver/drier or accumulator/drier; determine recommended oil type and quantity.
8. Remove, inspect, and install expansion valve or orifice (expansion) tube.
9. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and/or control module) to interrupt system operation; determine needed action.
10. Determine procedure to remove and reinstall evaporator; determine required oil type and quantity.
11. Remove, inspect, reinstall, and/or replace condenser; determine required oil type and quantity.

AC-C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair

1. Inspect engine cooling and heater systems hoses and pipes; determine needed action.
2. Inspect and test heater control valve(s); determine needed action.
3. Diagnose temperature control problems in the HVAC system related to the engine cooling system, including electric heating; determine needed action.
4. Determine procedure to remove, inspect, reinstall, and/or replace heater core; properly refill system.

AC-D. Operating Systems and Related Controls Diagnosis and Repair

1. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets; determine needed action.
2. Identify the source of HVAC system odors.
3. Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action.
4. Diagnose A/C compressor control systems; determine needed action.
5. Diagnose malfunctions in the vacuum, mechanical, and/or electrical components and controls of the HVAC system; determine needed action.
6. Inspect, test, remove and/or replace HVAC system control panel; determine needed action.
7. Check operation of automatic HVAC control systems; determine needed action.

AC-E. Refrigerant Recovery, Recycling, and Handling

1. Demonstrate awareness of the need to recover, recycle, and handle refrigerants using proper equipment and procedures.
2. Use and maintain refrigerant handling equipment according to equipment manufacturer's standards.
3. Identify A/C system refrigerant; test for sealants; recover, evacuate, and charge A/C system; add refrigerant oil as required.
4. Recycle, label, and store refrigerant.

VIII. ENGINE PERFORMANCE

Content Areas	Questions In Test
A. General: Engine Diagnosis	10
B. Computerized Controls Diagnosis and Repair	11
C. Ignition System Diagnosis and Repair	6
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair	7
E. Emissions Control Systems Diagnosis and Repair	6
Required To Pass: 21 of 40 TOTAL	40

Notes:
This test may include additional questions for statistical evaluation. These extra questions will not count for or against the final score. Since the extra questions are not identified, test candidates should answer every question to the best of their ability.

EP-A. General: Engine Diagnosis

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
3. Verify proper engine cooling system operation; determine needed action.
4. Verify correct camshaft timing including engines equipped with variable valve timing (VVT) systems; determine needed action.
5. Identify and interpret engine performance concerns; determine needed action.
6. Diagnose abnormal engine noises or vibration concerns; determine needed action.
7. Diagnose the cause of excessive oil consumption, coolant consumption, unusual exhaust color, odor, and sound; determine needed action.
8. Perform engine manifold pressure tests (vacuum/boost); determine needed action.
9. Perform cylinder power balance test; determine needed action.
10. Perform cylinder cranking and running compression tests; determine needed action.
11. Perform cylinder leakage test; determine needed action.
12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine needed action.

EP-B. Computerized Controls Diagnosis and Repair

1. Identify computerized control system components and configurations.
2. Access and use service information to perform step-by-step (troubleshooting) diagnosis.
3. Perform active tests of actuators using a scan tool; determine needed action.
4. Describe the use of OBD monitors for repair verification.
5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM), digital storage oscilloscope (DSO), and/or scan tool; determine needed action.
6. Describe the process for reprogramming or recalibrating the powertrain/engine control module (PCM/ECM).
7. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes (DTC); obtain, graph, and interpret scan tool data.
8. Diagnose emissions or driveability concerns without stored or active diagnostic trouble codes; determine needed action.

9. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, HVAC, automatic transmissions, non-OEM installed accessories, or similar systems); determine needed action.

EP-C. Ignition System Diagnosis and Repair

1. Identify ignition system components and configurations.
2. Remove and replace spark plugs; inspect secondary ignition components for wear and damage; determine needed action.
3. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine needed action.
4. Inspect and test crankshaft and camshaft position sensor(s); determine needed action.
5. Inspect, test, and/or replace ignition control module and/or powertrain/engine control module; reprogram/initialize as needed.

EP-D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair

1. Identify fuel, air induction, and exhaust system components and configurations.
2. Replace fuel filter(s) where applicable.
3. Inspect, service, or replace air filters, filter housings, and intake duct work.
4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields; determine needed action.
5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine needed action.
6. Check and refill diesel exhaust fluid (DEF).
7. Check fuel for quality, composition, and contamination; determine needed action.
8. Inspect and test fuel pump(s) and pump control system for pressure, regulation, and volume; determine needed action.
9. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.
10. Inspect, test, and/or replace fuel injectors on low- and high-pressure systems.
11. Verify proper idle speed; determine needed action.
12. Perform exhaust system back-pressure test; determine needed action.
13. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine needed action.
14. Test the operation of turbocharger/supercharger systems; determine needed action.

EP-E. Emissions Control Systems Diagnosis and Repair

1. Identify emission control system components and configurations.
2. Inspect, test, service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; determine needed action.
3. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine needed action.
4. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; inspect, test, service and/or replace electrical/electronic sensors, controls, wiring, tubing, exhaust passages, vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; determine needed action.
5. Inspect and test electrical/electronically operated components and circuits of secondary air injection systems; determine needed action.

6. Diagnose emission and driveability concerns caused by catalytic converter system; determine needed action.
7. Diagnose emissions and driveability concerns caused by the evaporative emissions control (EVAP) system; determine needed action.
8. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine needed action.