South Carolina CTE

6033 Automotive Technology and Hybrid/BEV Technology 4 (AT4)

Student Organizations AT4.1	1 **Identify the purpose and goals of a Career and Technology Student Organization (CTSO).** AT4.1.1
	2 **Explain how CTSOs are integral parts of specific clusters, majors, and/or courses.** AT4.1.2
	3 **Explain the benefits and responsibilities of being a member of a CTSO.** AT4.1.3
	4 **List leadership opportunities that are available to students through participation in CTSO conferences, competitions, community service, philanthropy, and other activities.** AT4.1.4
	5 **Explain how participation in CTSOs can promote lifelong benefits in other professional and civic organizations.** AT4.1.5
Technology Knowledge AT4.2	1 **Demonstrate proficiency and skills associated with the use of technologies that are common to a specific occupation (e.g., keying speed).** AT4.2.1
	2 **Identify proper netiquette when using e-mail, social media, and other technologies for communication purposes.** AT4.2.2
	3 **Identify potential abuse and unethical uses of laptops, tablets, computers, and/or networks.** AT4.2.3
	4 **Explain the consequences of social, illegal, and unethical uses of technology (e.g., cyberbullying, piracy; illegal downloading; licensing infringement; inappropriate uses of software, hardware, and mobile devices in the work environment).** AT4.2.4
	5 **Discuss legal issues and the terms of use related to copyright laws, fair use laws, and ethics pertaining to downloading of images, photographs, documents, video, sounds, music, trademarks, Creative Commons, and other elements for personal use.** AT4.2.5
	6 **Describe ethical and legal practices of safeguarding the confidentiality of business- and personal-related information.** AT4.2.6

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	7 Describe possible threats to a laptop, tablet, computer, and/or network and methods of avoiding attacks. AT4.2.7
	8 Evaluate various solutions to common hardware and software problems. AT4.2.8
Personal Qualities and Employability Skills AT4.3	1 Demonstrate creativity and innovation. AT4.3.1
	2 Demonstrate critical thinking and problem-solving skills. AT4.3.2
	3 Demonstrate initiative and self-direction. AT4.3.3
	4 Demonstrate integrity. AT4.3.4
	5 Demonstrate work ethic. AT4.3.5
	6 Demonstrate conflict resolution skills. AT4.3.6
	7 Demonstrate listening and speaking skills. AT4.3.7
	8 Demonstrate respect for diversity. AT4.3.8
	9 Demonstrate customer service orientation. AT4.3.9
	10 Demonstrate teamwork. AT4.3.10
Professional Knowledge AT4.4	1 Demonstrate global or “big picture” thinking. AT4.4.1
	2 Demonstrate career and life management skills and goal-making. AT4.4.2
	3 Demonstrate continuous learning and adaptability skills to changing job requirements. AT4.4.3
	4 Demonstrate time and resource management skills. AT4.4.4
	5 Demonstrates information literacy skills. AT4.4.5
	6 Demonstrates information security skills. AT4.4.6
	7 Demonstrates information technology skills. AT4.4.7
	8 Demonstrates knowledge and use of job-specific tools and technologies. AT4.4.8
	9 Demonstrate job-specific mathematics skills. AT4.4.9
	10 Demonstrates professionalism in the workplace. AT4.4.10
	11 Demonstrate reading and writing skills. AT4.4.11
	12 Demonstrates workplace safety. AT4.4.12

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Shop and Personal Safety AT4.A	1	**Identify general shop safety rules and procedures.** AT4.A.1
	2	**Utilize safe procedures for handling of tools and equipment.** AT4.A.2
	3	**Identify and use proper placement of floor jacks and jack stands.** AT4.A.3
	4	**Identify and use proper procedures for safe lift operation.** AT4.A.4
	5	**Utilize proper ventilation procedures for working within the lab/shop area.** AT4.A.5
	6	**Identify marked safety areas.** AT4.A.6
	7	**Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.** AT4.A.7
	8	**Identify the location and use of eye wash stations.** AT4.A.8
	9	**Identify the location of the posted evacuation routes.** AT4.A.9
	10	**Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities (PPE).** AT4.A.10
	11	**Identify and wear appropriate clothing for lab/shop activities.** AT4.A.11
	12	**Secure hair and jewelry for lab/shop activities.** AT4.A.12
	13	**Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems, stop/start systems, and remote start systems.** AT4.A.13
	14	**Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.** AT4.A.14
	15	**Locate and demonstrate knowledge of safety data sheets (SDS).** AT4.A.15
	16	**Successfully complete a written/online safety exam with a score of 100%.** AT4.A.16
Tools and Equipment AT4.B	1	**Identify tools and their usage in Automotive and Hybrid/BEV applications.** AT4.B.1
	2	**Identify standard and metric designation.** AT4.B.2
	3	**Demonstrate safe handling and use of appropriate tools.** AT4.B.3
	4	**Demonstrate proper cleaning, storage, and maintenance of tools and quipment.** AT4.B.4

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	5 Demonstrate proper use of precision measuring tools (i.e. micrometer, dial-indicator, dial-caliper). AT4.B.5
	6 Perform common fastener and thread repair, including removing broken bolts, restoring internal and external threads, and repairing internal threads with a thread insert. AT4.B.6
	7 Demonstrate proper use of insulated tools used for servicing hybrid/EV vehicles. AT4.B.7
	8 Demonstrate procedures for inspecting high-voltage safety gloves, insulated tools, and equipment prior to hybrid/EV service. P-1 AT4.B.8
Preparing Vehicle for Service and Return to Customer AT4.C	1 Identify information needed and the service requested on a repair order. AT4.C.1
	2 Identify purpose and demonstrate proper use of fender covers, mats, seat, and steering wheel covers. AT4.C.2
	3 Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage. AT4.C.3
	4 Perform a vehicle multi-point inspection and complete a vehicle inspection report. AT4.C.4
	5 Demonstrate use of the three C's (concern, cause, and correction). AT4.C.5
	6 Review vehicle service history. AT4.C.6
	7 Create a plan of action for each specific service or diagnostic situation. AT4.C.7
	8 Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. AT4.C.8
	9 Ensure the vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.). AT4.C.9
General Engine Repair AT4.D	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). (P-1) AT4.D.1
	2 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed. (P-1) AT4.D.2
	3 Verify operation of the instrument panel engine warning indicators. (P-1) AT4.D.3
	nspect engine assembly for fuel, oil, coolant, and other leaks. (P-1) AT4.D.4

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	5 Install engine covers using gaskets, seals, and sealers as required. (P-2) AT4.D.5
	6 Demonstrate understanding of the procedure for verifying engine mechanical timing. (P-2) AT4.D.6
	7 Inspect engine mounts. (P-2) AT4.D.7
	8 Identify service precautions related to service of the internal combustion engine of a hybrid BEV. (P-2) AT4.D.8
Engine Repair: Cylinder Head and Valve Train AT4.E	1 Identify cylinder head and valve train components and configurations. (P-1) AT4.E.1
Engine Repair: Engine Block Assembly AT4.F	1 Identify engine block assembly components and configurations. (P-1) AT4.F.1
Engine Repair: Lubrication and Cooling Systems AT4.G	1 Identify lubrication and cooling system components and configurations. (P-1) AT4.G.1
	2 Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required. (P-1) AT4.G.2
	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. (P-1) AT4.G.3
	4 Identify causes of engine overheating. (P-2) AT4.G.4
	5 Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment. (P-1) AT4.G.5
	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. (P-3) AT4.G.6
	7 Inspect, remove, and replace the water pump. (P-1) AT4.G.7
	8 Remove, inspect, and replace the thermostat and gasket/seal. (P-1) AT4.G.8
General Automatic Transmission and Transaxle Diagnosis AT4.H	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). P-1 AT4.H.1
	2 Identify automatic transmission and transaxle components and configurations. P-1 AT4.H.2

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	3	Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed. P-1 AT4.H.3
	4	Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick. P-1 AT4.H.4
	5	Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick. P-3 AT4.H.5
	6	Demonstrate knowledge of transmission/transaxle gear reduction/multiplication operation using driving, driven, and held-member (power flow) principles. P-3 AT4.H.6
	7	Demonstrate knowledge of hydraulic principles (Pascal's Law) in a transmission/transaxle. P-3 AT4.H.7
In-Vehicle Transmission/Transaxle AT4.I	1	Inspect external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch. P-2 AT4.I.1
	2	Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification. P-1 AT4.I.2
	3	Demonstrate understanding of relearn procedures. P-2 AT4.I.3
	4	Inspect, replace and/or align powertrain mounts. P-3 AT4.I.4
Off-Vehicle Transmission and Transaxle AT4.J	1	Describe the operational characteristics of a continuously variable transmission (CVT). P-3 AT4.J.1
	2	Describe the operational characteristics of a hybrid vehicle drive train. P-2 AT4.J.2
General Drivetrain Diagnosis AT4.K	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). (P-1) AT4.K.1
	2	Identify manual drivetrain and axles components and configurations. (P-1) AT4.K.2
	3	Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed. (P-1) AT4.K.3
	4	Check fluid condition; check for leaks. (P-2) AT4.K.4
	5	Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification. (P-1) AT4.K.5

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Manual Drive Chain: Clutches AT4.L	1	**Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification. (P-3)** AT4.L.1
Manual Drive Train: Transmission/Transaxle AT4.M	1	**Describe the operational characteristics of an electronically controlled manual transmission/transaxle. (P-2)** AT4.M.1
Manual Drive Train: Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair (Front, Rear, All-Wheel, Four-Wheel Drive) AT4.N	2	**Inspect and/or remove/replace bearings, hubs, and seals. (P-2)** AT4.N.2
	3	**Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints. (P-1)** AT4.N.3
	4	**Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification. (P-1)** AT4.N.4
Manual Drive Train: Drive Axles and Repair (Ring and Pinion Gears and Differential Housing Assembly, Drive Axles, and Four-Wheel Drive/All-Wheel Drive) AT4.O	1	**Inspect differential housing; check for leaks; inspect housing vent. P-1** AT4.O.1
	2	**Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification. P-1** AT4.O.2
	3	**Drain and refill differential housing; using proper fluid type per manufacturer specification. P-1** AT4.O.3
	4	**Inspect and replace drive axle wheel studs. (P-2)** AT4.O.4
	5	**Identify concerns related to variations in tire circumference and/or final drive ratios. (P-3)** AT4.O.5
General Suspension and Steering Systems AT4.P	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). (P-1)** AT4.P.1
	2	**Identify suspension and steering system components and configurations. (P-1)** AT4.P.2
	3	**Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed. (P-1)** AT4.P.3
	4	**Disable and enable supplemental restraint system (SRS); verify indicator lamp operation. (P-2)** AT4.P.4
Related Suspension and Steering Service AT4.Q	1	**Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots. P-1** AT4.Q.1
	2	**Inspect power steering fluid level and condition. P-2** AT4.Q.2
	3	**Drain and replace power steering system fluid; use proper fluid type per manufacturer specification. P-2** AT4.Q.3

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4 **Inspect for power steering fluid leakage. P-2** AT4.Q.4

5 **Remove, inspect, replace, and/or adjust power steering pump drive belt. P-2** AT4.Q.5

6 **Inspect, remove, and/or replace power steering hoses and fittings. P-2** AT4.Q.6

7 **Inspect pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper. P-2** AT4.Q.7

8 **Inspect tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion). P-2** AT4.Q.8

9 **Inspect electric power steering system. P-2** AT4.Q.9

10 **Inspect upper and/or lower control arms, bushings, and shafts. P-2** AT4.Q.10

11 **Inspect and replace rebound/jounce bumpers. P-3** AT4.Q.11

12 **Inspect track bar, strut rods/radius arms, and related mounts and bushings. P-2** AT4.Q.12

13 **Inspect upper and/or lower ball joints (with or without wear indicators). P-2** AT4.Q.13

14 **Inspect suspension system coil springs and spring insulators. P-2** AT4.Q.14

15 **Inspect torsion bars and mounts. P-3** AT4.Q.15

16 **Inspect and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links. P-2** AT4.Q.16

17 **Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount. P-2** AT4.Q.17

18 **Inspect components of suspension systems (Coil, Leaf, and Torsion). P-1** AT4.Q.18

19 **Inspect components of electronically controlled suspension systems. P-2** AT4.Q.19

20 **Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings. P-2** AT4.Q.20

21 **Inspect front and rear wheel bearings. P-1** AT4.Q.21

22 **Describe the function of electronically controlled suspension and steering systems and components, (i.e., active suspension and stability control). P-2** AT4.Q.22

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Suspension and Steering: Wheel Alignment AT4.R	1	**Perform pre-alignment inspection; measure vehicle ride height. (P-2)** AT4.R.1
	2	**Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling\tire wear. (P-1)** AT4.R.2
	3	**Describe ADAS systems. (P-1)** AT4.R.3
Suspension and Steering: Wheels and Tires AT4.S	1	**Inspect tire condition; identify tire wear patterns; check for correct tire 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. (P-1)** AT4.S.1
	2	**Rotate tires according to manufacturer's recommendations including vehicles equipped with tire pressure monitoring systems (TPMS). (P-1)** AT4.S.2
	3	**Dismount, inspect, and remount tire on wheel (with/without TPMS), balance wheel and tire assembly. (P-1)** AT4.S.3
	4	**Inspect tire and wheel assembly for air loss; determine needed action.** AT4.S.4
	5	**Repair tire following tire manufacturer approved procedure. (P-1)** AT4.S.5
	6	**Identify indirect and direct tire pressure monitoring systems (TPMS); calibrate/relearn system; verify operation of instrument panel lamps. (P-1)** AT4.S.6
	7	**Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS). (P-1)** AT4.S.7
	8	**Perform Road Force balance/match mounting. (P-3)** AT4.S.8
General Brake Systems AT4.T	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) (P-1** AT4.T.1
	2	**Identify brake system components and configurations. (P-1)** AT4.T.2
	3	**Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed. (P-1)** AT4.T.3
	4	**Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS). (P-1)** AT4.T.4
	5	**Install wheel and torque lug nuts. (P-1)** AT4.T.5
Br[illegible] Sy[illegible]	1	**Demonstrate understanding of hydraulic principles (Pascal's law). (P-1)** AT4.U.1
		escribe proper brake pedal height, travel, and feel. (P-1) AT4.U.2

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	3 Check master cylinder for proper operation. (P-1) AT4.U.3
	4 Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports. (P-1) AT4.U.4
	5 Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification. (P-1) AT4.U.5
	6 Identify components of hydraulic brake warning light system. (P-3) AT4.U.6
	7 Bleed and/or replace fluid in the brake system. (P-1) AT4.U.7
	8 Test brake fluid for contamination. (P-2) AT4.U.8
Drum Brakes AT4.V	1 Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability. (P-2) AT4.V.1
	2 Refinish brake drum and measure final drum diameter; compare with specification.(P-3) AT4.V.2
	3 Remove, clean, inspect, and/or replace brake shoes, springs, pins, 4. clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble. (P-3) AT4.V.3
	5 Inspect wheel cylinders for leaks and proper operation; remove and replace as needed. (P-3) AT4.V.5
	6 Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; make final checks and adjustments. (P-3) AT4.V.6
Disc Brakes AT4.W	1 Remove and clean caliper assembly; inspect for leaks and damage, and wear. (P-1) AT4.W.1
	2 Inspect caliper mounting and slides/pins for proper operation, wear, and damage. (P-1) AT4.W.2
	3 Remove, inspect, and/or replace brake pads and retaining hardware. (P-1) AT4.W.3
	4 Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks. (P-1) AT4.W.4
	5 Clean and inspect rotor and mounting surface, measure rotor thickness, thickness variation, and lateral runout. (P-1) AT4.W.5
	6 Remove and reinstall/replace rotor. (P-1) AT4.W.6
	7 Refinish rotor on vehicle; measure final rotor thickness and compare with pecification. (P-3) AT4.W.7

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	8 Refinish rotor off vehicle; measure final rotor thickness and compare with specification. (P-3) AT4.W.8
	9 Retract and re-adjust caliper piston on an integrated parking brake system. (P-2) AT4.W.9
	10 Describe the importance of operating a vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations. (P-2) AT4.W.10
Brakes: Power-Assist Units AT4.X	1 Check brake pedal travel with, and without, engine running to verify proper power booster operation. (P-2) AT4.X.1
	2 Identify components of the brake power assist system (vacuum/ hydraulic/electric). (P-2) AT4.X.2
Brakes: Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical) AT4.Y	1 Remove, clean, inspect, repack, and install wheel bearings; replace seals; install hub and adjust bearings. (P-3) AT4.Y.1
	2 Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed. (P-2) AT4.Y.2
	3 Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation. (P-2) AT4.Y.3
	4 Check operation of brake stop light system. (P-1) AT4.Y.4
	5 Inspect and replace wheel studs. (P-2) AT4.Y.5
Brakes: Electronic Brake Control Systems, Anti Lock Brake (ABS), Traction Control (TCS), Electronic Stability Control (ESC) Systems AT4.Z	1 Identify electronic brake control system components and describe function (ABS, TCS, ESC). (P-2) AT4.Z.1
	2 Describe the operation of a regenerative braking system. (P-3) AT4.Z.2
General Electrical/Electronic Systems AT4.AA	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). P-1 AT4.AA.1
	2 Identify electrical/electronic system components and configurations. P-1 AT4.AA.2
	3 Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed. P-1 AT4.AA.3
	4 Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law). P-1 AT4.AA.4

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	5 Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance. P-1 AT4.AA.5
	6 Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits. P-1 AT4.AA.6
	7 Describe types of test lights; use appropriate test light to check operation of electrical circuits per service information. P-2 AT4.AA.7
	8 Use fused jumper wires to check operation of electrical circuits per service information. P-2 AT4.AA.8
	9 Use wiring diagrams to trace electrical/electronic circuits .P-1 AT4.AA.9
	10 Measure key-off battery drain (parasitic draw). P-2 AT4.AA.10
	11 Inspect and test fusible links, circuit breakers, and fuses. P-1 AT4.AA.11
	12 Repair and/or replace connectors, terminal ends, and wiring of electrical/electronic systems (including solder repair). P-2 AT4.AA.12
Automotive Electrical Fundamentals AT4.AB	1 Demonstrate proper use and understanding of the Multi 13S Digital Multimeter. P-1 AT4.AB.1
	2 Demonstrate proper use of a test lamp. P-1 AT4.AB.2
	3 Use wiring diagrams to identify and troubleshoot electrical/electrical circuit problems. P-2 AT4.AB.3
	4 Display knowledge of electrical diagnostic process using electrical theory, tolls, and schematics. P-2 AT4.AB.4
	5 Apply electrical principles to assemble and diagnose series, parallel, and series parallel circuits to measure resistance, voltage drops, and current flow. MC-7 AT4.AB.5
Electric Drive in Cars, Commercial Vehicles, and Two-Wheelers AT4.AC	1 Display knowledge of electric drive-in cars, commercial vehicles, and two wheelers. P-1 AT4.AC.1
	2 Understand the differences in design in drive in cars, commercial vehicles, and two wheelers as it relates to structure and function of the battery and motor. P-1 AT4.AC.2
	3 Diagnose and troubleshoot problems in relation to specific scenarios for these vehicles. P-2 AT4.AC.3
Ele Skip to main content **Systems: Diagnostics**	**'erform LV battery state-of-charge test; determine needed action. P-1** AT4.AD.1

and Maintenance of a Low-Voltage Battery AT4.AD	**2** Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test. P-1 AT4.AD.2
	3 Maintain or restore electronic memory functions as recommended by manufacturer. P-2 AT4.AD.3
	4 Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold-downs. P-1 AT4.AD.4
	5 Perform battery charging according to manufacturer's recommendations. P-1 AT4.AD.5
	6 Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply. P-1 AT4.AD.6
	7 Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery. P-2 AT4.AD.7
DC-AC Conversion in Vehicles AT4.AE	**1** Display knowledge of DC-AC conversion in vehicles. P-1 AT4.AE.1
	2 Understand the components and function of inverter and converter and how they work in tandem. P-1 AT4.AE.2
	3 Understand and identify the in/outflow of electricity and how step up and step-down converters are used as a power source. P-2 AT4.AE.3
	4 Diagnose and troubleshoot problems in relation to specific scenarios for these vehicles. P-2 AT4.AE.4
DC-DC Step-Up Converters in Hybrid and Electric Vehicles AT4.AF	**1** Display knowledge of DC-DC conversion step up converters in vehicles. P-1 AT4.AF.1
	2 Understand the components and function of converters and how they work in hybrid and electric vehicles. P-1 AT4.AF.2
	3 Understand and identify the in/outflow of electricity and how step up and step down converters are used as a power source. P-2 AT4.AF.3
	4 Diagnose and troubleshoot problems in relation to specific scenarios for these vehicles. P-2 AT4.AF.4
Interlock in Hybrid and Electric Vehicles AT4.AG	**1** Display knowledge of interlock safety features in hybrid and electric vehicles. P-1 AT4.AG.1
	2 Understand the components and function of interlock and how it protects ersonnel during vehicle assembly, repair, maintenance and operation. P- AT4.AG.2

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Electrical/Electronic Systems: Diagnostics and Maintenance of a High-Voltage Battery AT4.AH	1	**Confirm proper battery capacity for vehicle application; perform battery capacity and load test; determine necessary action. P-1** AT4.AH.1
	2	**Identify safety precautions for high voltage systems on electric, hybrid-electric, and diesel vehicles. P-2** AT4.AH.2
Vehicle HV Charging Systems AT4.AI	1	**Display knowledge of Level 1, Level 2, and Level 3- DC EV Chargers. P-1** AT4.AI.1
	2	**Understand the differences between Mobile EV Stations, Commercial EV charging, and Level 3 DC EV charging. P-1** AT4.AI.2
Electrical/Electronic Systems: Starting Systems AT4.AJ	1	**Perform starter current draw test. P-1** AT4.AJ.1
	2	**Perform starter circuit voltage drop tests. P-1** AT4.AJ.2
	3	**Inspect and test starter relays and solenoids. P-2** AT4.AJ.3
	4	**Remove and install starter in a vehicle. P-3** AT4.AJ.4
	5	**Inspect and test switches, connectors, and wires of starter control circuits. P-2** AT4.AJ.5
	6	**Demonstrate knowledge of an automatic idle stop/start-stop system. P-3** AT4.AJ.6
Electrical/Electronic Systems: Low-Voltage Charging Systems AT4.AK	1	**Perform charging system output test. P-1** AT4.AK.1
	2	**Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment. P-1** AT4.AK.2
	3	**Remove, inspect, and/or replace generator (alternator). P-3** AT4.AK.3
	4	**Perform charging circuit voltage drop tests. P-2** AT4.AK.4
Electrical/Electronic Systems: Lighting, Instrument Cluster, Driver Information, and Body Electrical Systems AT4.AL	1	**Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed. P-1** AT4.AL.1
	2	**Aim headlights. P-2** AT4.AL.2
	3	**Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required. P-1** AT4.AL.3
	4	**Demonstrate understanding of vehicle comfort, convenience, access, safety, and related systems operation. P-3** AT4.AL.4
	5	**Remove and reinstall door panel. P-2** AT4.AL.5
		)escribe the operation of keyless entry/remote-start systems. P-3 AT4.AL.6

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	7 Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation. P-2 AT4.AL.7
	8 Verify windshield wiper and washer operation; replace wiper blades. P-1 AT4.AL.8
	9 Identify system voltage and safety precautions associated with high-intensity discharge headlights. P-2 AT4.AL.9
	10 Adjust and calibrate panel for light detection and ranging. MC-2 AT4.AL.10
Measurements and Diagnosis of an Electric Drive Motor in Electric Vehicles AT4.AM	1 Display knowledge of On-Board Diagnostics (OBD) in hybrid and electric vehicles. P-1 AT4.AM.1
	2 Perform and analyze a systematic model-based diagnostic approach based on structural analysis for electric drive systems. P-2 AT4.AM.2
Diagnostics on Hybrid and Electric Vehicles AT4.AN	1 Display knowledge of On-Board Diagnostics (OBD) in hybrid and electric vehicles. P-1 AT4.AN.1
	2 Perform and analyze a systematic model-based diagnostic approach based on structural analysis for electric drive systems. P-2 AT4.AN.2
Automotive Electronic Controls Unit Architecture and Logic AT4.AO	1 Describe ECU operation and structure. P-1 AT4.AO.1
	2 Identify logic functions and how they interact with controls. P-2 AT4.AO.2
	3 Demonstrate pulse width modulation to represent analog input signal. P-2 AT4.AO.3
	4 Identify and describe inputs and switches. P-1 AT4.AO.4
	5 Differentiate light, temperature, Hall effect sensors and the interaction with ECU. P-2 AT4.AO.5
	6 Identify transistor and relay outputs and how they affect the ECU. P-1 AT4.AO.6
	7 Differentiate simple actuators (motors and solenoids) and how they interact with the ECU. P-2 AT4.AO.7
	8 Identify and describe fiber optics in the controls unit. P-1 AT4.AO.8
	9 Demonstrate fault finding in ECU circuits. P-1 AT4.AO.9
Automotive Motors, Generators, and Charging AT4.AP	1 Display knowledge of automotive motors, generators and charging features in vehicles. P-1 AT4.AP.1
	Inderstand the components and function of automotive motors, generators and harging features and compatibility to Level 1, Level 2, and Level 3 EV Chargers. P-

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	1 AT4.AP.2
General Heating, Ventilation, and Air Conditioning (HVAC) AT4.AQ	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). P-1** AT4.AQ.1
	2 **Identify heating, ventilation, and air conditioning (HVAC) components and configurations. P-1** AT4.AQ.2
	3 **Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed. P-1** AT4.AQ.3
	4 **Identify steps of an A/C performance test. P-2** AT4.AQ.4
	5 **Identify abnormal operating noises in the A/C system. P-3** AT4.AQ.5
	6 **Visually inspect A/C system for signs of leaks. P-1** AT4.AQ.6
	7 **Identify and interpret heating and air conditioning problems. P-1** AT4.AQ.7
HVAC: Refrigeration System Components AT4.AR	1 **Inspect and/or replace A/C compressor drive belts, pulleys, and tensioners. P-1** AT4.AR.1
	2 **Inspect for proper A/C condenser airflow. P-2** AT4.AR.2
	3 **Inspect evaporator housing condensation drain. P-1** AT4.AR.3
HVAC: Heating, Ventilation, and Engine Cooling Systems AT4.AS	1 **Inspect engine cooling and heater systems hoses and pipes. P-1** AT4.AS.1
HVAC: Operating Systems and Related Controls AT4.AT	1 **Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets. P-1** AT4.AT.1
	2 **Identify the source of HVAC system odors. P-2** AT4.AT.2
HVAC: Refrigerant Recovery, Recycling, and Handling AT4.AU	1 **Demonstrate awareness of the need to recover, recycle, and handle refrigerants using proper equipment and procedures. P-1** AT4.AU.1
General Engine Performance AT4.AV	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). P-1** AT4.AV.1
	2 **Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes nd data when directed. P-1** AT4.AV.2

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	3 Demonstrate understanding of proper engine cooling system operation. P-1 AT4.AV.3
	4 Demonstrate understanding of camshaft timing including engines equipped with variable valve timing (VVT) systems. P-1 AT4.AV.4
Engine Performance: Computerized Controls AT4.AW	1 Identify computerized control system components and configurations. P-1 AT4.AW.1
Engine Performance: Ignition Systems AT4.AX	1 Identify ignition system components and configurations. P-1 AT4.AX.1
	2 Remove and replace spark plugs; inspect secondary ignition components for wear and damage. P-2 AT4.AX.2
Engine Performance: Fuel, Air Induction, and Exhaust Systems AT4.AY	1 Identify fuel, air induction, and exhaust system components and configurations. P-1 AT4.AY.1
	2 Replace fuel filter(s) where applicable. P-2 AT4.AY.2
	3 Inspect, service, or replace air filters, filter housings, and intake duct work. P-1 AT4.AY.3
	4 Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields. P-1 AT4.AY.4
	5 Inspect condition of exhaust system hangers, brackets, clamps, and heat shields. P-1 AT4.AY.5
	6 Check and refill diesel exhaust fluid (DEF). P-3 AT4.AY.6
Engine Performance: Emissions Control Systems AT4.BA	1 Identify emission control system components and configurations. P-1 AT4.BA.1
	2 Inspect, test, and service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses. P-2 AT4.BA.2
Hybrid/EV Safety Awareness AT4.BB	1 Identify risks associated with hybrid/electric vehicle (EV) repair. P-1 AT4.BB.1
	2 List the steps needed to aid people subjected to high voltage. P-1 AT4.BB.2
	3 Review basic first aid/CPR procedures. P-1 AT4.BB.3
	4 Identify appropriate personal protective equipment (PPE) and inspection procedures (e.g., goggles, hard hat, gloves, shoes, face shield). P-1 AT4.BB.4
	5 Demonstrate procedures for inspecting high-voltage safety gloves, insulated tools, and equipment prior to hybrid/EV service. P-1 AT4.BB.5

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	6 Identify different types of high-voltage components (e.g., converters, capacitors, cables, air conditioner compressor, modules/electronic control units). P-1 AT4.BB.6
	7 Identify high-voltage components, circuits, and warning labeling (orange cables). P-1 AT4.BB.7
	8 List the steps used in the high-voltage disconnect process. P-1 AT4.BB.8
	9 Compare and contrast different types of batteries (e.g., lithium, solid-state) used in hybrid/EV vehicles. P-1 AT4.BB.9
	10 Identify the associated risks created by damaged batteries (e.g., thermal runaway, stranded energy). P-1 AT4.BB.10
	11 List the steps to de-energize/disable hybrid/EV vehicles. P-1 AT4.BB.11
	12 Identify barriers, barricades, signs, and practices needed to prevent intrusion into the work zone. P-1 AT4.BB.12
	13 Describe lockout/tagout procedures used during hybrid/EV repair. P-1 AT4.BB.13
	14 Successfully complete the ASE Hybrid/xEV Safety certification exam. P-1 AT4.BB.14
Safe Handling of HV Systems AT4.BC	1 Demonstrate proper safety procedures for lockout/tagout. P-1 AT4.BC.1
	2 Demonstrate proper use of electric service gloves when working with high voltage systems. P-1 AT4.BC.2
Rear-View Camera and Park Assist AT4.BD	1 Display knowledge of rear-view camera and park assist features in hybrid and electric vehicles. P-1 AT4.BD.1
	2 Understand the components of rear view and park assist and how sensors interact with vehicle systems. P-1 AT4.BD.2
Adaptive Cruise Control with Emergency Brake Assist AT4.BE	1 Display knowledge of adaptive cruise control with emergency brake assist components and features in hybrid and electric vehicles. P-1 AT4.BE.1
	2 Explain the calibration target for radar and the function of the camera screwdriver. P-2 AT4.BE.2
	3 Describe the operation and structure of automatic emergency braking (AEB) and forward collision warning (FCW) systems. P-1 AT4.BE.3
	4 Identify the uses of AI in vehicle operations. P-1 AT4.BE.4