FOUNDATIONAL TASKS

Each of these tasks are required to be included at all levels of accreditation.

Shop and Personal Safety

1. Identify general lab/shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation, ensuring the configuration and weight rating of the lift is appropriate for the vehicle being lifted, including xEVs.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
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.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
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.
14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: xEV drivetrains, lighting systems, ignition systems, A/C systems, injection systems, etc.
15. Locate and demonstrate knowledge of safety data sheets (SDS).
16. Demonstrate knowledge of personal protective equipment (PPE) required for use in high voltage/electric vehicle circuits.

xEV Vehicle Safety

1. Demonstrate knowledge of hazards related to high voltage systems/electric vehicles, including electrocution, fire, explosion, arc flash, gases and fumes, hazardous chemicals, and EMF, and how to properly respond to emergency situations.
2. Demonstrate knowledge of high voltage system and component coloring, warning labels, lights, signage, and lock-out/tag-out procedures.
3. Demonstrate ability to identify which components and circuits contain high voltage.
4. Demonstrate knowledge of steps needed to assess possible hazards prior to servicing a high voltage/electric vehicle, including awareness of automatic systems that may operate while the key switch/ignition is off.
5. Understand limitations on which systems, components, and circuits of a high voltage/electric vehicle a technician is capable of safely servicing based on their level of training and qualification.

6. Demonstrate knowledge of high voltage/electric vehicle intake process, inspection, handling, and in-process monitoring for all vehicles including damaged/compromised vehicles.

Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
5. Demonstrate proper use of precision measuring tools (e.g., micrometer, dial-indicator, dial-caliper).
6. Perform common fastener and thread repair, including removing broken bolts, restoring internal and external threads, and repairing internal threads with a thread insert.

Preparing for Vehicle Service

1. Identify information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of vehicle protection such as: fender covers, mats, seat, and steering wheel covers.
3. Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage, etc.
4. Perform a vehicle multi-point inspection and complete a vehicle inspection report (written and/or electronic).
5. Demonstrate use of the three C's (concern, cause, and correction).
6. Create a plan of action for each specific service or diagnostic situation, including placing vehicle in service mode as required.
7. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

Preparing Vehicle for Customer

1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).

WORKPLACE SKILLS

Each of these skills are required to be included at all levels of accreditation.

Personal Standards (see Standard 7.7)
All training activities and instructional material should emphasize the importance of maintaining high personal standards. While these skills should be integrated in instruction, they are not required to be individually measured by student for the purposes of program accreditation. The classroom/lab can be considered the equivalent of a workplace and classmates can be considered coworkers.

1. Reports to work daily on time; able to take directions and motivated to accomplish the task at hand.
2. Dresses appropriately and uses language and manners suitable for the workplace.
3. Maintains personal hygiene appropriate for the workplace.
4. Meets and maintains employment eligibility criteria, such as drug/alcohol-free status, clean driving record, etc.
5. Demonstrates honesty, integrity, and reliability.

Work Habits / Ethic (see Standard 7.8)
The training program should be organized in such a manner that work habits and ethical practices required on the job are an integral part of the instruction. While these skills should be integrated in instruction, they are not required to be individually measured by student for the purposes of program accreditation. The classroom/lab can be considered a workplace and classmates can be considered coworkers.
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1. Complies with workplace policies/laws, including proper and responsible use of personal electronic devices.
2. Contributes to the success of the team, assists others and requests help when needed.
3. Works well with all customers and coworkers.
4. Negotiates solutions to interpersonal and workplace conflicts.
5. Contributes ideas and initiative.
6. Follows directions.
7. Communicates effectively, both in writing and verbally, with customers and coworkers.
8. Reads and interprets workplace documents; writes clearly and concisely.
9. Analyzes and resolves problems that arise in completing assigned tasks.
10. Organizes and implements a productive plan of work.
11. Uses scientific, technical, engineering and mathematics (STEM) principles and reasoning to accomplish assigned tasks.
12. Identifies and addresses the needs of all customers, providing helpful, courteous, and knowledgeable service and advice as needed.
13. Respectful of tools and property used in school and workplace environment.
14. Contributes to an inclusive environment where every coworker and customer feels welcomed, heard, and valued.

MAINTENANCE AND LIGHT REPAIR (MLR)
TASK LIST

ENGINE REPAIR - MLR

For every task in Engine Repair, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

I. ENGINE REPAIR
A. General

1. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. 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. P-1

5. Install engine covers using gaskets, seals, and sealers as required. P-2

6. Demonstrate knowledge of the procedure for verifying engine mechanical timing. P-2

7. Inspect engine mounts. P-2

8. Identify service precautions related to service of the internal combustion engine of an xEV. P-2

I. ENGINE REPAIR
B. Cylinder Head and Valve Train

1. Identify cylinder head and valve train components and configurations. P-1

I. ENGINE REPAIR
C. Engine Block Assembly

1. Identify engine block assembly components and configurations. P-1

I. ENGINE REPAIR

D. Lubrication and Cooling Systems

1.	Identify lubrication and cooling system components and configurations	P-1
2.	Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required.	P-1
3.	Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant reservoir/recovery tank, heater core, and galley plugs.	P-1
4.	Identify causes of engine overheating	P-2
5.	Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment	P-1
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-1
7.	Identify different types of water/coolant pumps (belt driven, chain driven, and electric).	P-2
8.	Remove, inspect, and replace thermostat and gasket/seal.	P-1

ER Tasks - MLR

P-1	12
P-2	6
P-3	0

AUTOMATIC TRANSMISSION AND TRANSAXLE - MLR

For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify automatic transmission and transaxle components and configurations, including torque converter automatic, dual-clutch automatic (DCT), CVT, and xEV drive. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick. P-1

5. Demonstrate knowledge of procedures to check transmission fluid condition and level; inspect for leaks on transmission or transaxle not equipped with a dipstick. P-1

6. Demonstrate knowledge of transmission/transaxle gear reduction/multiplication operation using driving, driven, and held member (power flow) principles. P-3

7. Demonstrate knowledge of hydraulic principles (Pascal's Law) in a transmission/transaxle. P-3

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

B. In-Vehicle Transmission/Transaxle

1. Inspect external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch. P-2

2. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification. P-1

3. Demonstrate knowledge of relearn procedures. P-2

4. Inspect, replace and/or align power train mounts. P-3

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

C. Off-Vehicle Transmission and Transaxle

1. Describe the operational characteristics of a continuously variable transmission (CVT). P-3

2. Describe the operational characteristics of a hybrid vehicle drive train. P-3

3. Describe the operational characteristics of dual-clutch transmission (DCT). P-3

AT Tasks - MLR

P-1	6
P-2	2
P-3	6

MANUAL DRIVE TRAIN AND AXLES - MLR

For every task in Manual Drive Train and Axles, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

III. MANUAL DRIVE TRAIN AND AXLES

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify manual drive train and axle components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-2

4. Check fluid condition; check for leaks. P-3

5. Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification. P-2

III. MANUAL DRIVE TRAIN AND AXLES

B. Clutch

1. Demonstrate knowledge of procedures to check and adjust clutch primary cylinder fluid level. P-3

III. MANUAL DRIVE TRAIN AND AXLES

C. Drive Shaft, Half Shafts, Universal Joints and Constant-Velocity (CV) Joints (Front, Rear, All, and Four-wheel Drive)

1. Inspect and/or remove/replace bearings, hubs, and seals. P-2

2. Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints. P-2

III. MANUAL DRIVE TRAIN AND AXLES

D. Differential and Drive Axles

E.1 Ring and Pinion Gears and Differential Housing Assembly

1. Inspect differential housing; check for leaks; inspect housing vent. P-1

2. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification. P-1

3. Drain and refill differential housing; using proper fluid type per manufacturer specification. P-1

E.2 Drive Axles

1. Inspect and replace drive axle wheel studs. P-2

III. MANUAL DRIVE TRAIN AND AXLES

E. Four-wheel Drive/All-wheel Drive

1. Identify concerns related to variations in tire circumference and/or final drive ratios. P-3

2. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification. P-2

MD Tasks - MLR

P-1	5
P-2	6
P-3	3

SUSPENSION AND STEERING - MLR

For every task in Suspension and Steering, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

IV. SUSPENSION AND STEERING

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1
2. Identify suspension and steering system components and configurations. P-1
3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1
4. Disable, enable, and properly handle SRS/airbag system components during vehicle service following manufacturers' procedures. P-2

IV. SUSPENSION AND STEERING

B. Steering Systems

1. Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots. P-1
2. Inspect power steering fluid level and condition. P-2
3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification. P-2
4. Inspect for power steering fluid leakage. P-2
5. Remove, inspect, replace, and/or adjust power steering pump drive belt. P-2
6. Inspect, remove, and/or replace power steering hoses and fittings. P-2
7. Inspect pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper. P-3
8. Inspect tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion). P-3
9. Demonstrate knowledge of electric power steering system operation. P-2

IV. SUSPENSION AND STEERING

C. Suspension Systems

1. Inspect upper and/or lower control arms, bushings, and shafts. P-2
2. Inspect and replace rebound/jounce bumpers. P-3
3. Inspect track bar, strut rods/radius arms, and related mounts and bushings. P-2
4. Inspect upper and/or lower ball joints (with or without wear indicators). P-2
5. Inspect suspension system coil springs and spring insulators. P-2
6. Inspect torsion bars and mounts. P-3
7. Inspect, remove, and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links. P-2
8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount. P-2
9. Inspect components of rear suspension systems (Coil, Leaf, and Torsion Beams). P-1
10. Inspect components of electronically controlled suspension systems. P-2

IV. SUSPENSION AND STEERING

D. Related Suspension and Steering Service

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

IV. SUSPENSION AND STEERING

E. Wheel Alignment

1. Determine the need to recalibrate a vehicle’s advanced driver assistance system (ADAS) that may require calibration after repairs or adjustments. P-1
2. Perform pre-alignment inspection; place vehicle in service mode as required; measure vehicle ride height. P-1
3. Describe four-wheel alignment angles (camber, caster, toe, setback, and thrust angle) and effects on vehicle handling\tire wear. P-1

IV. SUSPENSION AND STEERING

F. Wheels and Tires

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. P-1

2. Rotate tires according to manufacturer's recommendations including vehicles equipped with tire pressure monitoring systems (TPMS). P-1

3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly. P-1

4. Inspect tire and wheel assembly for air loss; determine needed action. P-1

5. Repair tire following tire manufacturer approved procedure. P-1

6. Identify indirect and direct tire pressure monitoring systems (TPMS); calibrate/relearn system; verify operation of instrument panel lamps. P-1

7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS). P-1

8. Perform Road Force balance/match mounting. P-3

SS Tasks - MLR

P-1	17
P-2	15
P-3	5

BRAKES - MLR

For every task in Brakes, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

V. BRAKES
A. General

1. Research vehicle service information such as fluid type, system design (hydraulic, electronic, etc.), vehicle service history, service precautions, technical service bulletins, and recalls including xEV and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify brake system components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Research the need to place a vehicle in service mode before servicing the brake system. P-1

5. Research the need to perform calibration/recalibration, initialization, or relearn procedures as required. P-1

6. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS). P-1

7. Install wheel and torque lug nuts/wheel fasteners. P-1

V. BRAKES
B. Hydraulic System

1. Demonstrate knowledge of hydraulic principles (Pascal's law). P-1

2. Describe proper brake pedal height, travel, and feel. P-1

3. Check primary cylinder for proper operation. P-1

4. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports. P-1

5. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification. P-1

6. Bleed and/or replace fluid in the brake system. P-1

7. Test brake fluid for contamination. P-2

8. Identify components of brake warning light system. P-2

V. BRAKES

C. Drum Brakes

1. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability. P-2

2. Refinish brake drum and measure final drum diameter; compare with specification. P-3

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. P-3

4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed. P-3

5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments. P-3

V. BRAKES

D. Disc Brakes

1. Remove and clean caliper assembly; inspect for leaks, damage, and wear. P-1

2. Inspect caliper mounting and slides/pins for proper operation, wear, and damage. P-1

3. Remove, inspect, and/or replace brake pads and retaining hardware. P-1

4. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks. P-1

5. Clean and inspect rotor and mounting surface, measure rotor thickness, thickness variation, and lateral runout. P-1

6. Remove and reinstall/replace rotor. P-1

7. Refinish rotor on vehicle; measure final rotor thickness and compare with specification. P-3

8. Refinish rotor off vehicle; measure final rotor thickness and compare with specification. P-3

9. Retract and re-adjust caliper piston on an integrated parking brake system. P-2

10. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendation. P-1

V. BRAKES

E. Power-Assist Units

1. Check brake pedal travel with and without engine running to verify proper power booster operation. P-2

2. Identify components of the brake power assist system (vacuum/ hydraulic/electric). P-2

V. BRAKES

F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical)

1. Remove, clean, inspect, repack/replace, and install wheel bearings; remove and install bearing races; replace seals; install hub and adjust bearings. P-3

2. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed. P-2

3. Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation. P-2

4. Check operation of brake stop light system. P-1

5. Inspect and replace wheel studs/fasteners. P-2

V. BRAKES

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

1. Identify electronic brake control system components and describe function (ABS, TCS, ESC). P-2

2. Describe the operation of a regenerative braking system. P-3

BR Tasks - MLR

P-1	21
P-2	10
P-3	8

ELECTRICAL/ELECTRONIC SYSTEMS - MLR

For every task in Electrical/Electronic Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1
2. Identify electrical/electronic system components and configurations. P-1
3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1
4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law). P-1
5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance. P-1
6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits. P-1
7. Describe precautions related to the use of test lights. P-3
8. Use fused jumper wires to check operation of electrical circuits per service information. P-2
9. Use wiring diagrams to trace electrical/electronic circuits. P-1
10. Measure key-off battery drain (parasitic draw). P-2
11. Inspect and test fusible links, circuit breakers, and fuses. P-1
12. Repair and/or replace connectors, terminal ends, and wiring of electrical/electronic systems (including solder repair). P-2

13. Research the need to perform calibration/recalibration, initialization, or relearn procedures as required. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS

B. Batteries (Low Voltage)

1. Perform battery state-of-charge test; determine needed action. P-1
2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test, as recommended by manufacturer. P-1
3. Maintain or restore electronic memory functions as recommended by manufacturer. P-2
4. Inspect and clean battery; check battery cables, connectors, clamps, and hold-downs. P-1
5. Perform battery charging according to manufacturer's recommendations. P-1
6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply according to manufacturer's recommendations. P-1
7. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

C. Starting System (Low Voltage)

1. Perform starter current draw test. P-1
2. Perform starter circuit voltage drop tests. P-1
3. Inspect and test starter relays and solenoids. P-2
4. Remove and install starter in a vehicle. P-3
5. Inspect and test switches, connectors, and wires of starter control circuits. P-2
6. Demonstrate knowledge of an automatic idle-stop/start-stop system that uses a low-voltage starter to restart the engine. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

D. Charging System (Low Voltage)

1. Perform charging system output test. P-1
2. Inspect, adjust, and replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment. P-1

3. Remove, inspect, and replace generator (alternator). P-3

4. Perform charging circuit voltage drop tests. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS
E. Lighting Systems

1. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed. P-1

2. Aim headlights. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS
F. Instrument Cluster and Driver Information Systems

1. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS
G. Body Electrical Systems

1. Demonstrate knowledge of vehicle comfort, convenience, access, safety, and related systems operation. P-3

2. Remove and reinstall door panel. P-2

3. Describe the operation of keyless entry/remote-start systems. P-3

4. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation. P-2

5. Verify windshield wiper and washer operation; replace wiper blades. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS
H. xEV Systems

1. Locate procedures to safe de-energize/de-stable and energize/enable high-voltage systems. P-3

EE Tasks - MLR

P-1	21
P-2	12
P-3	6

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) - MLR

For every task in Heating, Ventilation and Air Conditioning (HVAC), the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

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

A. General

1. Research vehicle service information, including refrigerant/oil/fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1
2. Identify heating, ventilation, and air conditioning (HVAC) components and configurations. P-1
3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1
4. Demonstrate knowledge of the steps of an A/C performance test, as recommended by manufacturer. P-2
5. Identify abnormal operating noises in the A/C system. P-3
6. Visually inspect A/C system for signs of leaks. P-1
7. Verify heating and air conditioning concerns. P-1
8. Research the need to place a vehicle in service mode before servicing the HVAC system. P-1

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

B. Refrigeration System Components

1. Inspect and/or replace A/C compressor drive belts, pulleys, and tensioners. P-1
2. Inspect for proper A/C condenser airflow. P-2
3. Inspect evaporator housing condensation drain. P-1

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
C. Heating, Ventilation, and Engine Cooling Systems

1. Inspect engine cooling and heater systems hoses and pipes. P-1

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
D. Operating Systems and Related Controls

1. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets. P-1

2. Identify the source of HVAC system odors. P-2

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
E. Refrigerant Recovery, Recycling, and Handling

1. Demonstrate knowledge of the requirement to recover, recycle, and handle refrigerants using proper equipment and procedures. P-1

HA Tasks - MLR

P-1	11
P-2	3
P-3	1

ENGINE PERFORMANCE - MLR

For every task in Engine Performance the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

VIII. ENGINE PERFORMANCE
A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

3. Demonstrate knowledge of proper engine cooling system operation. P-1

4. Demonstrate knowledge of camshaft timing including engines equipped with variable valve timing (VVT) systems. P-1

VIII. ENGINE PERFORMANCE
B. Computerized Controls

1. Identify computerized control system components and configurations. P-1

VII. ENGINE PERFORMANCE
C. Ignition System

1. Identify ignition system components and configurations. P-1

2. Remove and replace spark plugs; inspect secondary ignition components for wear and damage. P-2

VIII. ENGINE PERFORMANCE
D. Fuel, Air Induction, and Exhaust Systems

1. Identify fuel, air induction, and exhaust system components and configurations. P-1

2. Replace fuel filter(s) where applicable. P-3

3. Inspect, service, or replace air filters, filter housings, and intake duct work. P-1

4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields. P-1

5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields. P-1

6. Check and refill diesel exhaust fluid (DEF). P-3

VIII. ENGINE PERFORMANCE

E. Emissions Control Systems

1. Identify emission control system components and configurations. P-1

2. Inspect, test, and service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses. P-2

EP Tasks - MLR

P-1	11
P-2	2
P-3	2

AUTOMOBILE SERVICE TECHNOLOGY (AST)
TASK LIST

ENGINE REPAIR - AST

For every task in Engine Repair, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

I. ENGINE REPAIR
A. General

1. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. 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 needed action. P-1

5. Install engine covers using gaskets, seals, and sealers as required. P-1

6. Verify engine mechanical timing. P-1

7. Inspect, remove, and/or replace engine mounts. P-2

8. Identify service precautions related to service of the internal combustion engine of an xEV. P-1

I. ENGINE REPAIR
B. Cylinder Head and Valve Train

1. Identify cylinder head and valve train components and configurations. P-1

2. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer’s specification and procedure. P-1

3. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition. P-2

4. Inspect valve actuating mechanisms for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine needed action. P-2

5. Adjust valves (mechanical or hydraulic lifters). P-2

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/variable lift components; verify correct camshaft timing. P-1

I. ENGINE REPAIR

C. Engine Block Assembly

1. Identify engine block assembly components and configurations. P-1

2. Remove, inspect, and/or replace crankshaft vibration damper (harmonic balancer). P-2

I. ENGINE REPAIR

D. Lubrication and Cooling Systems

1. Identify lubrication and cooling system components and configurations. P-1

2. Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required. P-1

3. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant reservoir/recovery tank, heater core, and galley plugs; determine needed action. P-1

4. Identify causes of engine overheating. P-1

5. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment. P-1

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-1

7. Identify different types of water/coolant pumps (belt driven, chain driven, and electric). P-1

8. Inspect, remove, and replace water/coolant pumps. P-2

9. Remove, inspect, and replace thermostat and gasket/seal. P-1

10. Remove and replace radiator. P-2

11. Inspect and test fan(s), fan clutch (electrical and/or mechanical), fan shroud, and air dams/shutters; determine needed action. P-1

12. Perform oil pressure tests; determine needed action. P-1

13. Inspect auxiliary coolers; determine needed action. P-2

14. Inspect, test, and replace oil temperature and pressure switches and sensors. P-2

ER Tasks - AST

P-1	21
P-2	9
P-3	0

AUTOMATIC TRANSMISSION AND TRANSAXLE - AST

For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify automatic transmission and transaxle components and configurations, including torque converter automatic, dual-clutch automatic (DCT), CVT, and xEV drive. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick. P-1

5. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick. P-1

6. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles. P-1

7. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law). P-2

8. Identify and interpret transmission/transaxle concerns, differentiate between engine performance and transmission/transaxle concerns; determine needed action. P-1

9. Diagnose fluid loss and condition concerns; determine needed action. P-1

10. Perform stall test; determine needed action. P-3

11. Perform lock-up converter system tests; determine needed action. P-3

12. Perform pressure tests on transmissions/transaxles equipped with electronic pressure control; determine needed action. P-2

13. Diagnose electronic transmission/transaxle control systems using appropriate test equipment and service information. P-1

II. AUTOMATIC TRANSMISSION AND TRANSAXLE
B. In-Vehicle Transmission/Transaxle

1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch. P-2

2. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification. P-1

3. Perform relearn procedures. P-2

4. Inspect, replace and/or align power train mounts. P-1

5. Inspect for leakage; replace external seals, gaskets, and bushings. P-2

6. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits. P-1

II. AUTOMATIC TRANSMISSION AND TRANSAXLE
C. Off-Vehicle Transmission and Transaxle

1. Describe the operational characteristics of a continuously variable transmission (CVT). P-2

2. Describe the operational characteristics of a hybrid vehicle drive train. P-2

3. Describe the operational characteristics of dual-clutch transmission (DCT). P-2

4. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces. P-2

5. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings. P-1

6. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore. P-2

AT Tasks - AST

P-1	13
P-2	10
P-3	2

MANUAL DRIVE TRAIN AND AXLES - AST

For every task in Manual Drive Train and Axles, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

III. MANUAL DRIVE TRAIN AND AXLES

A. General

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

III. MANUAL DRIVE TRAIN AND AXLES

B. Clutch

1. Check and adjust clutch primary cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification. P-2
2. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine needed action. P-3
3. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; determine needed action. P-3
4. Inspect clutch pressure plate assembly, clutch disc, release (throw-out) bearing, linkage, and pilot bearing/bushing (as applicable). P-2
5. Bleed clutch hydraulic system. P-2

6. Inspect flywheel and ring gear for wear and cracks, and discoloration; determine needed action. P-2

7. Measure flywheel runout and crankshaft end play; determine needed action. P-2

8. Describe the operation and service of a system that uses a dual mass flywheel. P-3

III. MANUAL DRIVE TRAIN AND AXLES

C. Transmission/Transaxle

1. Inspect, adjust, lubricate, and/or replace shift linkages, brackets, bushings, cables, pivots, and levers. P-2

III. MANUAL DRIVE TRAIN AND AXLES

D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joints (Front, Rear, All, Four-wheel Drive)

1. Inspect and/or remove/replace bearings, hubs, and seals. P-1

2. Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints. P-1

3. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine needed action. P-1

4. Diagnose universal joint noise and vibration concerns; determine needed action. P-1

5. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles; determine needed action. P-2

III. MANUAL DRIVE TRAIN AND AXLES

E. Differential and Drive Axles

E.1 Ring and Pinion Gears and Differential Housing Assembly

1. Inspect differential housing; check for leaks; inspect housing vent. P-1

2. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification. P-1

3. Drain and refill differential housing; using proper fluid type per manufacturer specification. P-1

4. Inspect and replace companion flange and/or pinion seal; measure companion flange runout. P-2

5. Demonstrate knowledge of drive pinion and ring gear service and set up including depth, preload, backlash, and gear tooth contact. P-2

E.2 Drive Axles

1. Inspect and replace drive axle wheel studs. P-2

2. Remove and replace drive axle shafts. P-1

3. Inspect and replace drive axle shaft seals, bearings, and retainers. P-2

4. Measure drive axle flange runout and shaft end play; determine needed action. P-2

III. MANUAL DRIVE TRAIN AND AXLES

F. Four-wheel Drive/All-wheel Drive

1. Identify concerns related to variations in tire circumference and/or final drive ratios. P-2

2. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification. P-2

3. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets. P-2

4. Inspect axle locking mechanisms; determine needed action(s). P-3

MD Tasks - AST

P-1	11
P-2	18
P-3	4

SUSPENSION AND STEERING - AST

For every task in Suspension and Steering, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

IV. SUSPENSION AND STEERING

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify suspension and steering system components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Disable, enable, and properly handle SRS/airbag system components during vehicle service following manufacturers' procedures. P-1

5. Identify and interpret suspension and steering system concerns; determine needed action. P-1

IV. SUSPENSION AND STEERING

B. Steering Systems

1. Inspect rack and pinion steering gear tie rod ends (sockets), and bellows boots; repair or replace as needed. P-1

2. Inspect power steering fluid level and condition. P-2

3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification. P-2

4. Inspect for power steering fluid leakage; determine needed action. P-2

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

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

7. Inspect, remove, and/or replace pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper. P-3

8. Inspect, replace, and/or adjust tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion). P-3

9. Inspect and test electric power steering system; determine needed action. P-2

10. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring). P-1

11. Diagnose steering column noises, looseness, and binding concerns (including tilt/telescoping mechanisms); determine needed action. P-2

12. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action. P-3

13. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action. P-2

14. Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; determine needed action. P-2

15. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets. P-2

16. Remove and reinstall power steering pump. P-2

17. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment. P-2

IV. SUSPENSION AND STEERING

C. Suspension Systems

1. Inspect, remove, and/or replace upper and/or lower control arms, bushings, and shafts. P-2

2. Inspect and replace rebound/jounce bumpers. P-2

3. Inspect, remove, and/or replace track bar, strut rods/radius arms, and related mounts and bushings. P-2

4. Inspect, remove, and/or replace upper and/or lower ball joints (with or without wear indicators). P-3

5. Inspect, remove, and/or replace suspension system coil springs and spring insulators. P-2

6. Inspect, remove, and/or replace torsion bars and mounts. P-3

7. Inspect, remove, and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links. P-2

8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount. P-2

9. Inspect, remove, and/or replace components of rear suspension systems (Coil, Leaf, and Torsion Beam). P-1

10. Inspect, remove, and/or replace components of electronically controlled suspension systems. P-2

11. Inspect, remove, and/or replace steering knuckle assemblies. P-2

12. Diagnose suspension system noises, body sway, and uneven ride height concerns; determine needed action. P-1

IV. SUSPENSION AND STEERING

D. Related Suspension and Steering Service

1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings. P-1

2. Inspect, service, and/or replace front and rear wheel bearings. P-1

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

IV. SUSPENSION AND STEERING

E. Wheel Alignment

1. Determine the need to recalibrate a vehicle’s advanced driver assistance system (ADAS) after repairs or adjustments. P-1

2. Perform pre-alignment inspection, place vehicle in service mode as required; measure vehicle ride height; determine needed action. P-1

3. Describe four-wheel alignment angles (camber, caster, toe, setback, and thrust angle) and effects on vehicle handling\tire wear. P-1

4. 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. P-1

5. Check toe-out-on-turns (turning radius); determine needed action. P-1

6. Check steering axis inclination (SAI) and included angle; determine needed action. P-1

7. Check rear wheel thrust angle; determine needed action. P-1

8. Check for front wheel setback; determine needed action. P-1

9. Identify front and/or rear cradle (subframe) misalignment; determine needed action. P-1

10. Reset steering angle sensor. P-1

11. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action. P-1

IV. SUSPENSION AND STEERING

F. Wheels and Tires

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. P-1

2. Rotate tires according to manufacturer's recommendation including vehicles equipped with tire pressure monitoring system (TPMS). P-1

3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly. P-1

4. Inspect tire and wheel assembly for air loss; determine needed action. P-1

5. Repair tire following tire manufacturer approved procedure. P-1

6. Identify indirect and direct tire pressure monitoring systems (TPMS); calibrate/relearn system; verify operation of instrument panel lamps. P-1

7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS). P-1

8. Perform Road Force balance/match mounting. P-2

9. Diagnose wheel/tire vibration, shimmy, and noise; determine needed action. P-1

10. Measure wheel, tire, axle flange, and hub runout; determine needed action. P-2

11. Diagnose tire pull problems; determine needed action. P-1

SS Tasks - AST

P-1	31
P-2	23
P-3	5

BRAKES - AST

For every task in Brakes, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

V. BRAKES

A. General

1. Research vehicle service information such as fluid type, system design (hydraulic, electronic, etc.), vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify brake system components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Perform calibration/recalibration initialization, or relearn procedure as required. P-1

5. Place a vehicle in service mode as needed before servicing the brake system. P-1

6. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS). P-1

7. Install wheel and torque lug nuts/wheel fasteners. P-1

8. Identify and interpret brake system concerns; determine needed action. P-1

V. BRAKES

B. Hydraulic System

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 needed action. P-1

3. Check primary cylinder for internal/external leaks and proper operation; determine needed action. P-1

4. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports; determine needed action. P-1

5. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification. P-1

6. Bleed and/or replace fluid in the brake system. P-1

7. Test brake fluid for contamination. P-2

8. Remove, bench bleed, and reinstall primary cylinder. P-1

9. Diagnose poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine needed action. P-2

10. Replace brake lines, hoses, fittings, and supports. P-2

11. Fabricate brake lines using proper material and flaring procedures. P-2

12. Identify, inspect, test, and replace components of brake warning light system. P-2

V. BRAKES

C. Drum Brakes

1. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability. P-2

2. Refinish brake drum and measure final drum diameter; compare with specification. P-2

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. P-2

4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed. P-2

5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments. P-2

6. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation concerns; determine needed action. P-2

V. BRAKES

D. Disc Brakes

1. Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action. P-1

2. Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine needed action P-1

3. Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action. P-1

4. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks. P-1

5. Clean and inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action. P-1

6. Remove and reinstall/replace rotor. P-1

7. Refinish rotor on vehicle; measure final rotor thickness and compare with specification. P-2

8. Refinish rotor off vehicle; measure final rotor thickness and compare with specification. P-2

9. Retract and re-adjust caliper piston on an integrated parking brake system. P-1

10. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendation. P-1

11. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine needed action. P-1

V. BRAKES

E. Power-Assist Units

1. Check brake pedal travel with and without engine running to verify proper power booster operation. P-2

2. Identify components of the brake power assist system (vacuum/ hydraulic/electric). P-2

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. P-2

4. Inspect and test hydraulically assisted power brake system for leaks and proper operation; determine needed action. P-2

V. BRAKES

F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical)

1. Remove, clean, inspect, repack/replace, and install wheel bearings; remove and install bearing races; replace seals; install hub and adjust bearings. P-3

2. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed. P-2

3. Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation; determine needed action. P-2

4. Check operation of brake stop light system. P-1

5. Inspect and replace wheel studs/fasteners. P-2

6. Remove, reinstall, and/or replace sealed wheel bearing assembly. P-1

7. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine needed action. P-2

V. BRAKES

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

1. Identify and inspect electronic brake control system components and describe function (ABS, TCS, ESC); determine needed action. P-1

2. Describe the operation of a regenerative braking system. P-2

3. Bleed the electronic brake control system hydraulic circuits. P-2

BR Tasks - AST

P-1	27
P-2	23
P-3	1

ELECTRICAL/ELECTRONIC SYSTEMS - AST

For every task in Electrical/Electronic Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify electrical/electronic system components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law). P-1

5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance. P-1

6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits. P-1

7. Describe precautions related to the use of test lights. P-3

8. Use fused jumper wires to check operation of electrical circuits per service information. P-1

9. Use wiring diagrams during the diagnosis of electrical/electronic circuit problems. P-1

10. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine needed action. P-1

11. Inspect and test fusible links, circuit breakers, and fuses; determine needed action P-1

12. Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, and wiring in electrical/electronic systems (including solder repairs); determine needed action. P-1

13. Test and measure circuit using an oscilloscope and/or graphing multimeter (GMM); interpret results; determine needed action. P-2

14. Perform calibration/recalibration, initialization, or relearn procedures as required. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS

B. Batteries (Low Voltage)

1. Perform battery state-of-charge test; determine needed action. P-1

2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test as recommended by manufacturer; determine needed action. P-1

3. Maintain or restore electronic memory functions as recommended by manufacturer. P-2

4. Inspect and clean battery; check battery cables, connectors, clamps, and hold-downs. P-1

5. Perform battery charging according to manufacturer's recommendations. P-1

6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply according to manufacturer's recommendations. P-1

7. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

C. Starting System (Low Voltage)

1. Perform starter current draw test; determine needed action. P-1

2. Perform starter circuit voltage drop tests; determine needed action. P-1

3. Inspect and test starter relays and solenoids; determine needed action. P-2

4. Remove and install starter in a vehicle. P-2

5. Inspect and test switches, connectors, and wires of starter control circuits; determine needed action. P-1

6. Demonstrate knowledge of automatic idle-stop/start-stop system that uses a low-voltage starter to restart the engine. P-1

7. Differentiate between electrical and engine mechanical problems that cause a slow-crank or a no-crank condition. P-2

8. Diagnose a no-crank condition using a wiring diagram and test equipment; determine needed action. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

D. Charging System (Low Voltage)

1. Perform charging system output test; determine needed action. P-1

2. Inspect, adjust, and replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment; determine needed action. P-1

3. Remove, inspect, and replace generator (alternator); determine needed action. P-2

4. Perform charging circuit voltage drop tests; determine needed action. P-1

5. Diagnose charging system for causes of undercharge, no-charge, or overcharge conditions; determine needed action. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS

E. Lighting Systems

1. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); determine needed action. P-1

2. Aim headlights. P-2

3. Diagnose the causes of brighter-than-normal, intermittent, dim, or no light operation; determine needed action. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS

F. Instrument Cluster and Driver Information Systems

1. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required. P-1

2. Inspect and test gauges and gauge sensors/sending units for causes of abnormal readings; determine needed action. P-2

3. Diagnose the causes of incorrect operation of warning devices and other driver information systems; determine needed action. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

G. Body Electrical Systems

1. Diagnose vehicle comfort, convenience, access, safety, and related systems operation; determine needed action. P-2

2. Remove and reinstall door panel. P-1

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. P-2

4. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation. P-1

5. Verify windshield wiper and washer operation; replace wiper blades. P-1

6. Diagnose operation of entertainment/infotainment systems and related circuits (such as: radio, DVD, navigation, amplifiers, speakers, antennas, and voice-activated accessories); determine needed action. P-2

7. Diagnose operation of safety systems and related circuits (such as: horn, airbags, seat belt pretensioners, occupancy classification, wipers, and washers; determine needed action. P-2

8. Diagnose body electronic system circuits using a scan tool; check for module communication errors (data communication bus systems); determine needed action. P-2

9. Describe the process for software transfer, software updates, or reprogramming of electronic modules. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

H. xEV Systems

1. Locate procedures to safe de-energize/destable and energize/enable high-voltage systems. P-3

EE Tasks - AST

P-1	31
P-2	17
P-3	2

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) - AST

For every task in Heating, Ventilation, and Air Conditioning (HVAC), the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

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

A. General

1. Research vehicle service information, including refrigerant/oil/fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify heating, ventilation, and air conditioning (HVAC) components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed P-1

4. Perform A/C system performance test as recommended by manufacturer; interpret results; determine needed action P-1

5. Identify abnormal operating noises in the A/C system; determine needed action. P-2

6. Leak test A/C system; determine needed action. P-1

7. Verify and interpret heating and air conditioning concerns; determine needed action. P-1

8. Place a vehicle in service mode as needed before servicing and diagnosing the HVAC system. P-1

9. Identify refrigerant type; test for sealant/contaminant; select and connect proper gauge set/test equipment; record temperature and pressure readings. P-1

10. Inspect condition/quantity of refrigerant oil removed from A/C system; determine needed action. P-1

10. Determine recommended oil and oil capacity for system application and component(s) replacement. P-1

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
B. Refrigeration System Components

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

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
C. Heating, Ventilation, and Engine Cooling Systems

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

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
D. Operating Systems and Related Controls

1. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets; determine needed action. P-1

2. Identify the source of HVAC system odors. P-2

3. Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action. P-1

4. Diagnose A/C compressor control systems; determine needed action. P-2

5. Diagnose malfunctions in the vacuum, mechanical, and/or electrical components and controls of the HVAC system; determine needed action. P-2

6. Inspect, test, remove and/or replace HVAC system control panel; determine needed action P-2

7. Check operation of automatic HVAC control systems; determine needed action. P-2

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
E. Refrigerant Recovery, Recycling, and Handling

1. Demonstrate knowledge of the requirement to recover, recycle, and handle refrigerants using proper equipment and procedures. P-1

2. Use and maintain refrigerant handling equipment according to equipment manufacturer's standards. P-1

3. Identify A/C system refrigerant; test for sealants/contaminants; recover, evacuate, and charge A/C system; add refrigerant oil as required. P-1

4. Recycle, label, and store refrigerant. P-1

HA Tasks - AST

P-1	20
P-2	15
P-3	2

ENGINE PERFORMANCE - AST

For every task in Engine Performance the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

VIII. ENGINE PERFORMANCE
A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

3. Verify proper engine cooling system operation; determine needed action. P-1

4. Verify correct camshaft timing including engines equipped with variable valve timing (VVT) systems; determine needed action. P-1

5. Verify engine performance concerns; determine needed action. P-1

6. Diagnose abnormal engine noises or vibration concerns; determine needed action. P-3

7. Diagnose the cause of excessive oil consumption, coolant consumption, unusual exhaust color, odor, and sound; determine needed action. P-2

8. Perform engine manifold pressure tests (vacuum/boost); determine needed action. P-1

9. Perform cylinder power balance test; determine needed action. P-2

10. Perform cylinder cranking and running compression tests; determine needed action. P-1

11. Perform cylinder leakage test; determine needed action. P-1

VIII. ENGINE PERFORMANCE
B. Computerized Controls

1. Identify computerized control system components and configurations. 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 needed action. P-1

4. Demonstrate knowledge of OBD readiness flags, monitors, and drive cycle for repair verification. P-1

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. P-2

6. Describe the process for reprogramming or recalibrating the powertrain/engine control module (PCM/ECM). P-1

VIII. ENGINE PERFORMANCE

C. Ignition System

1. Identify ignition system components and configurations. P-1

2. Remove and replace spark plugs; inspect secondary ignition components for wear and damage; determine needed action. P-1

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. P-2

4. Inspect and test crankshaft and camshaft position sensor(s); determine needed action. P-2

5. Inspect, test, and/or replace ignition control module and/or powertrain/engine control module; reprogram/initialize as needed. P-2

VIII. ENGINE PERFORMANCE

D. Fuel, Air Induction, and Exhaust Systems

1. Identify fuel, air induction, and exhaust system components and configurations. P-1

2. Replace fuel filter(s) where applicable. P-3

3. Inspect, service, or replace air filters, filter housings, and intake duct work. P-1

4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields for leaks and unmetered air; determine needed action. P-1

5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine needed action. P-1

6. Check and refill diesel exhaust fluid (DEF). P-3

7. Check fuel for quality, composition, and contamination; determine needed action. P-2

8. Inspect and test fuel pump(s) and pump control system for pressure, regulation, and volume; determine needed action. P-1

9. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air P-1

10. Inspect, test, and/or replace fuel injectors on low- and high-pressure systems. P-2

11. Verify proper idle speed; determine needed action. P-1

12. Perform exhaust system back-pressure test; determine needed action. P-2

13. Demonstrate knowledge of the operation of turbocharger/supercharger systems. P-2

VIII. ENGINE PERFORMANCE

E. Emissions Control Systems

1. Identify emission control system components and configurations. P-1

2. Inspect, test, service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; determine needed action. P-2

3. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine needed action. P-2

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, coolers, vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) system; determine needed action. P-2

5. Inspect and test electrical/electronically operated components and circuits of secondary air injection systems; determine needed action. P-3

6. Diagnose emissions and driveability concerns caused by catalytic converter system; determine needed action. P-1

7. Diagnose emissions and driveability concerns caused by the evaporative emissions control (EVAP) system; determine needed action. P-1

EP Tasks - AST

P-1	25
P-2	13
P-3	4

MASTER AUTOMOBILE SERVICE TECHNOLOGY (MAST)
Task List

ENGINE REPAIR - MAST

For every task in Engine Repair, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

I. ENGINE REPAIR
A. General

1. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. 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 needed action. P-1

5. Install engine covers using gaskets, seals, and sealers as required. P-1

6. Verify engine mechanical timing. P-1

7. Inspect, remove, and/or replace engine mounts. P-2

8. Identify service precautions related to service of the internal combustion engine of an xEV. P-1

9. Remove and reinstall engine on a newer vehicle equipped with OBDII; reconnect all attaching components and restore the vehicle to running condition. P-3

I. ENGINE REPAIR
B. Cylinder Head and Valve Train

1. Identify cylinder head and valve train components and configurations. P-1

2. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer’s specification and procedure. P-1

3. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition. P-2

4. Inspect valve actuating mechanisms for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine needed action. P-1

5. Adjust valves (mechanical or hydraulic lifters). P-2

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/variable lift components; verify correct camshaft timing. P-1

7. Inspect valve springs for squareness and free height comparison; determine needed action. P-3

8. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine needed action. P-3

9. Inspect valve guides for wear; check valve stem-to-guide clearance; determine needed action. P-3

10. Inspect valves and valve seats; determine needed action. P-3

11. Check valve spring assembled height and valve stem height; determine needed action. P-3

12. Inspect valve lifters and hydraulic lash adjusters; determine needed action. P-2

13. Inspect and/or measure camshaft for runout, journal wear and lobe wear. P-3

14. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine needed action. P-3

I. ENGINE REPAIR

C. Engine Block Assembly

1. Identify engine block assembly components and configurations. P-1

2. Remove, inspect, and/or replace crankshaft vibration damper (harmonic balancer). P-1

3. Disassemble engine block; clean and prepare components for inspection and reassembly. P-2

4. Inspect engine block for visible cracks, passage condition, core and galley plug condition, and surface warpage; determine needed action. P-2

5. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine needed action. P-2

6. Perform deglazing and cleaning of cylinder walls. P-2

7. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine needed action. P-2

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. P-2

9. Inspect main and connecting rod bearings for damage and wear; determine needed action. P-2

10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine needed action. P-2

11. Inspect and measure piston skirts and ring lands; determine needed action. P-2

12. Determine piston-to-bore clearance. P-2

13. Inspect, measure, and install piston rings. P-2

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. P-2

15. Assemble engine block. P-1

I. ENGINE REPAIR

D. Lubrication and Cooling Systems

1. Identify lubrication and cooling system components and configurations P-1

2. Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required. P-1

3. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant reservoir/recovery tank, heater core, and galley plugs; determine needed action. P-1

4. Identify causes of engine overheating. P-1

5. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment. P-1

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-1

7. Identify different types of water/coolant pumps (belt driven, chain driven, and electric). P-1

8. Inspect, remove, and replace water/coolant pumps. P-2

9. Remove, inspect, and replace thermostat and gasket/seal. P-1

10. Remove and replace radiator. P-2

11. Inspect and test fan(s), fan clutch (electrical and/or mechanical), fan shroud, and air dams/shutters; determine needed action. P-1

12. Perform oil pressure tests; determine needed action. P-1

13. Inspect auxiliary coolers; determine needed action. P-2

14. Inspect, test, and replace oil temperature and pressure switches and sensors. P-1

15. Inspect oil pump gears or rotors, housing, pressure relief devices, pressure control devices, and pump drive; determine needed action P-2

ER Tasks - MAST

P-1	25
P-2	20
P-3	8

AUTOMATIC TRANSMISSION AND TRANSAXLE - MAST

For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

II. AUTOMATIC TRANSMISSION AND TRANSAXLE

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify automatic transmission and transaxle components and configurations, including torque converter automatic, dual-clutch automatic (DCT), CVT, and xEV drive. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick. P-1

5. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick. P-1

6. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles. P-1

7. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law). P-1

8. Identify and interpret transmission/transaxle concerns, differentiate between engine performance and transmission/transaxle concerns; determine needed action. P-1

9. Diagnose fluid loss and condition concerns; determine needed action. P-1

10. Perform stall test; determine needed action. P-3

11. Perform lock-up converter system tests; determine needed action. P-2

12. Perform pressure tests on transmissions/transaxles equipped with electronic pressure control; determine needed action. P-1

13. Diagnose electronic transmission/transaxle control systems using appropriate test equipment and service information. P-1

14. Diagnose noise and vibration concerns; determine needed action. P-2

II. AUTOMATIC TRANSMISSION AND TRANSAXLE
B. In-Vehicle Transmission/Transaxle

1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch. P-1

2. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification. P-1

3. Perform relearn procedures. P-2

4. Inspect, replace/or and align powertrain mounts. P-1

5. Inspect for leakage; replace external seals, gaskets, and bushings. P-2

6. Inspect, test, adjust, repair, and/or replace electrical/electronic components and circuits. P-1

II. AUTOMATIC TRANSMISSION AND TRANSAXLE
C. Off-Vehicle Transmission and Transaxle

1. Describe the operational characteristics of a continuously variable transmission (CVT). P-2

2. Describe the operational characteristics of a hybrid vehicle drive train. P-2

3. Describe the operational characteristics of dual-clutch transmission (DCT). P-2

4. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces. P-2

5. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings. P-1

6. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore. P-2

7. Disassemble, clean, and inspect transmission/transaxle. P-2

8. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, switches, solenoids, sleeves, retainers, brackets, check valves/balls, screens, spacers, and gaskets). P-2

9. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine needed action. P-2

10. Assemble transmission/transaxle. P-2

11. Inspect, measure, and reseal oil pump assembly and components. P-2

12. Measure transmission/transaxle end play and/or preload; determine needed action. P-2

13. Inspect, measure, and/or replace thrust washers and bearings. P-2

14. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls. P-2

15. Inspect bushings; determine needed action. P-2

16. Inspect and measure planetary gear assembly components; determine needed action. P-2

17. Inspect case bores, passages, bushings, vents, and mating surfaces; determine needed action. P-2

18. Diagnose and inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; determine needed action. P-2

19. Inspect measure, repair, adjust or replace transaxle final drive components. P-2

20. Inspect clutch drum, piston, check-balls, springs, retainers, seals, friction plates, pressure plates, and bands; determine needed action. P-2

21. Measure clutch pack clearance; determine needed action. P-2

22. Air test operation of clutch and servo assemblies. P-2

23. Inspect one-way clutches, races, rollers, sprags, springs, cages, retainers; determine needed action. P-2

AT Tasks - MAST

P-1	16
P-2	26
P-3	1

MANUAL DRIVE TRAIN AND AXLES - MAST

For every task in Manual Drive Train and Axles, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

III. MANUAL DRIVE TRAIN AND AXLES

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify manual drive train and axles components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Check fluid condition; check for leaks; determine needed action. P-2

5. Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification. P-2

6. Diagnose drive train concerns; determine needed action. P-1

III. MANUAL DRIVE TRAIN AND AXLES

B. Clutch

1. Check and adjust clutch primary cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification. P-2

2. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine needed action. P-3

3. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; determine needed action. P-3

4. Inspect clutch pressure plate assembly, clutch disc, release (throw-out) bearing, linkage, and pilot bearing/bushing (as applicable). P-2

5. Bleed clutch hydraulic system. P-2

6. Inspect flywheel and ring gear for wear, cracks, and discoloration; determine needed action. P-2

7. Measure flywheel runout and crankshaft end play; determine needed action. P-2

8. Describe the operation and service of a system that uses a dual mass flywheel. P-3

III. MANUAL DRIVE TRAIN AND AXLES

C. Transmission/Transaxle

1. Inspect, adjust, lubricate, and/or replace shift linkages, brackets, bushings, cables, pivots, and levers. P-2

2. Diagnose noise concerns through the application of transmission/transaxle powerflow principles; determine needed action. P-2

3. Diagnose hard shifting and jumping out of gear concerns; determine needed action. P-2

4. Diagnose transaxle final drive assembly noise and vibration concerns; determine needed action. P-2

5. Disassemble, inspect clean, and reassemble internal transmission/transaxle components. P-3

III. MANUAL DRIVE TRAIN AND AXLES

D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joints (Front, Rear, All, and Four-wheel Drive)

1. Inspect and/or remove/replace bearings, hubs, and seals. P-1

2. Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints. P-1

3. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine needed action. P-1

4. Diagnose universal joint noise and vibration concerns; determine needed action. P-1

5. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles; determine needed action. P-2

III. MANUAL DRIVE TRAIN AND AXLES

E. Differential and Drive Axles

E.1 Ring and Pinion Gears and Differential Case Assembly

1. Inspect differential housing; check for leaks; inspect housing vent. P-1

2. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification. P-1

3. Drain and refill differential housing; use proper fluid type per manufacturer specification. P-1

4. Inspect and replace companion flange and/or pinion seal; measure companion flange runout. P-2

5. Inspect ring gear and measure runout; determine needed action. P-2

6. Diagnose noise and vibration concerns; determine needed action. P-2

7. Remove, inspect, reinstall or replace drive pinion and ring gear, spacers, sleeves, and bearings. P-2

8. Measure and adjust drive pinion depth. P-2

9. Measure and adjust drive pinion bearing preload. P-2

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). P-2

11. Check ring and pinion tooth contact patterns; determine needed action. P-2

12. Disassemble, inspect, measure, adjust, and/or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case. P-2

13. Reassemble and reinstall differential case assembly; measure runout; determine needed action. P-2

E.2 Drive Axles

1. Inspect and replace drive axle wheel studs. P-2

2. Remove and replace drive axle shafts. P-1

3. Inspect and replace drive axle shaft seals, bearings, and retainers. P-2

4. Measure drive axle flange runout and shaft end play; determine needed action. P-2

5. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine needed action. P-2

E.3 Limited Slip Differential

1. Diagnose noise, slippage, and chatter concerns including electronically controlled systems; determine needed action. P-3

2. Measure rotating torque; determine needed action. P-3

III. MANUAL DRIVE TRAIN AND AXLES

F. Four-wheel Drive/All-wheel Drive

1. Identify concerns related to variations in tire circumference and/or final drive ratios. P-1

2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets. P-2

3. Inspect axle locking mechanisms; determine needed action(s). P-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-2

5. Diagnose noise, vibration, and unusual steering concerns; determine needed action. P-2

6. Diagnose, test, adjust, and/or replace electrical/electronic components of four-wheel drive/all-wheel drive systems. P-2

7. Disassemble, service, and reassemble transfer case and components. P-3

MD Tasks - MAST

P-1	12
P-2	31
P-3	8

SUSPENSION AND STEERING - MAST

For every task in Suspension and Steering, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

IV. SUSPENSION AND STEERING

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify suspension and steering system components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Disable, enable, and properly handle SRS/airbag system components during vehicle service following manufacturers' procedures. P-1

5. Identify and interpret suspension and steering system concerns; determine needed action. P-1

IV. SUSPENSION AND STEERING

B. Steering Systems

1. Inspect rack and pinion steering gear, tie rod ends (sockets) and bellows boots; repair or replace as needed. P-1

2. Inspect power steering fluid level and condition. P-2

3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification. P-2

4. Inspect for power steering fluid leakage; determine needed action. P-2

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

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

7. Inspect, remove, and/or replace pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper. P-3

8. Inspect, replace, and/or adjust tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinion). P-3

9. Inspect and test electric power steering system; determine needed action. P-1

10. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring). P-1

11. Diagnose steering column noises, looseness, and binding concerns (including tilt/telescoping mechanisms); determine needed action. P-2

12. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action. P-3

13. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine needed action. P-1

14. Inspect steering shaft universal joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; determine needed action. P-2

15. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets. P-2

16. Remove and reinstall power steering pump. P-2

17. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment. P-2

18. Test power steering system pressure; determine needed action. P-3

IV. SUSPENSION AND STEERING

C. Suspension Systems

1. Inspect, remove, and/or replace upper and/or lower control arms, bushings, and shafts. P-2

2. Inspect and replace rebound/jounce bumpers. P-2

3. Inspect, remove, and/or replace track bar, strut rods/radius arms, and related mounts and bushings. P-2

4. Inspect, remove, and/or replace upper and/or lower ball joints (with or without wear indicators). P-2

5. Inspect, remove, and/or replace suspension system coil springs and spring insulators. P-2

6. Inspect, remove, and/or replace torsion bars and mounts P-3

7. Inspect, remove, and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links. P-2

8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount. P-2

9. Inspect, remove, and/or replace components of rear suspension systems (Coil, Leaf, and Torsion Beam). P-1

10. Inspect, remove, and/or replace components of electronically controlled suspension systems. P-1

11. Inspect, remove, and/or replace steering knuckle assemblies. P-2

12. Diagnose suspension system noises, body sway, and uneven ride height concerns; determine needed action P-1

IV. SUSPENSION AND STEERING

D. Related Suspension and Steering Service

1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings P-1

2. Inspect, service, and/or replace front and rear wheel bearings. P-1

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

IV. SUSPENSION AND STEERING

E. Wheel Alignment

1. Determine the need to recalibrate a vehicle's advanced driver assistance system (ADAS) after repairs or adjustments. P-1

2. Perform pre-alignment inspection, place vehicle in service mode as required; measure vehicle ride height; determine needed action. P-1

3. Describe four-wheel alignment angles (camber, caster, toe, setback, and thrust angle) and effects on vehicle handling\tire wear. P-1

4. 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. P-1

5. Check toe-out-on-turns (turning radius); determine needed action. P-1

6. Check steering axis inclination (SAI) and included angle; determine needed action. P-1

7. Check rear wheel thrust angle; determine needed action. P-1

8. Check for front wheel setback; determine needed action. P-1

9. Identify front and/or rear cradle (subframe) misalignment; determine needed action. P-1

10. Reset steering angle sensor. P-1

11. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action. P-1

IV. SUSPENSION AND STEERING

F. Wheels and Tires

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. P-1

2. Rotate tires according to manufacturer's recommendation including vehicles equipped with tire pressure monitoring systems (TPMS) P-1

3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly. P-1

4. Inspect tire and wheel assembly for air loss; determine needed action. P-1

5. Repair tire following tire manufacturer approved procedure. P-1

6. Identify indirect and direct tire pressure monitoring system (TPMS); calibrate/relearn system; verify operation of instrument panel lamps. P-1

7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS). P-1

8. Perform Road Force balance/match mounting. P-1

9. Diagnose wheel/tire vibration, shimmy, and noise; determine needed action. P-1

10. Measure wheel, tire, axle flange, and hub runout; determine needed action. P-2

11. Diagnose tire pull problems; determine needed action. P-1

SS Tasks - MAST

P-1	35
P-2	20
P-3	5

BRAKES - MAST

For every task in Brakes, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

V. BRAKES
A. General

1. Research vehicle service information such as fluid type, system design (hydraulic, electronic, etc.), vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1

2. Identify brake system components and configurations. P-1

3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1

4. Perform calibration/recalibration, initialization, or relearn procedure as required. P-1

5. Place vehicle in service mode as needed before servicing the brake system. P-1

6. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS). P-1

7. Install wheel and torque lug nuts/wheel fasteners. P-1

8. Identify and interpret brake system concerns; determine needed action. P-1

V. BRAKES
B. Hydraulic System

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 needed action. P-1

3. Check primary cylinder for internal/external leaks and proper operation; determine needed action. P-1

4. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fittings/supports; determine needed action. P-1

5. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification. P-1

6. Bleed and/or replace fluid in the brake system. P-1

7. Test brake fluid for contamination. P-2

8. Identify, inspect, test, and replace components of brake warning light system. P-2

9. Remove, bench bleed, and reinstall primary cylinder. P-1

10. Diagnose poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine needed action. P-1

11. Replace brake lines, hoses, fittings, and supports. P-2

12. Fabricate brake lines using proper material and flaring procedures. P-2

V. BRAKES
C. Drum Brakes

1. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability. P-2

2. Refinish brake drum and measure final drum diameter; compare with specification. P-2

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. P-2

4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed. P-2

5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments. P-2

6. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pedal pulsation concerns; determine needed action. P-2

V. BRAKES
D. Disc Brakes

1. Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action. P-1

2. Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine needed action P-1

3. Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action. P-1

4. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks. P-1

5. Clean and inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action. P-1

6. Remove and reinstall/replace rotor. P-1

7. Refinish rotor on vehicle; measure final rotor thickness and compare with specification. P-1

8. Refinish rotor off vehicle; measure final rotor thickness and compare with specification. P-2

9. Retract and re-adjust caliper piston on an integrated parking brake system. P-1

10. Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendation. P-1

11. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine needed action. P-1

V. BRAKES

E. Power-Assist Units

1. Check brake pedal travel with and without engine running to verify proper power booster operation. P-2

2. Identify components of the brake power assist system (vacuum/ hydraulic/electric). P-2

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. P-2

4. Inspect and test hydraulically assisted power brake system for leaks and proper operation; determine needed action. P-2

5. Inspect electric power booster unit; determine needed action. P-3

V. BRAKES

F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical)

1. Remove, clean, inspect, repack/replace, and install wheel bearings; remove and install bearing races; replace seals; install hub and adjust bearings. P-3

2. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed. P-2

3. Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation; determine needed action. P-2

4. Check operation of brake stop light system. P-1

5. Inspect and replace wheel studs/fasteners. P-2

6. Remove, reinstall, and/or replace sealed wheel bearing assembly. P-1

7. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine needed action. P-1

V. BRAKES

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

1. Identify and inspect electronic brake control system components and describe function (ABS, TCS, ESC); determine needed action. P-1

2. Describe the operation of a regenerative braking system. P-2

3. Bleed the electronic brake control system hydraulic circuits. P-1

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. P-2

5. Diagnose electronic brake control system electronic control(s) and components using recommended test equipment; determine needed action. P-2

6. Depressurize high-pressure components of an electronic brake control system. P-2

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). P-2

8. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.). P-2

BR Tasks - MAST
P-1 31
P-2 24
P-3 2

ELECTRICAL/ELECTRONIC SYSTEMS - MAST

For every task in Electrical/Electronic Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

VI. ELECTRICAL/ELECTRONIC SYSTEMS

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including xEVs and vehicles equipped with advanced driver assistance systems (ADAS). P-1
2. Identify electrical/electronic system components and configurations. P-1
3. Retrieve and record on-board diagnostic DTCs, monitor status, and freeze frame data; clear codes and data when directed. P-1
4. Perform calibration/recalibration, initialization, or relearn procedure as required. P-1
5. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm’s Law). P-1
6. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance. P-1
7. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits. P-1
8. Describe precautions related to the use of test lights. P-3
9. Use fused jumper wires to check operation of electrical circuits per service information. P-1
10. Use wiring diagrams during the diagnosis of electrical/electronic circuit problems. P-1

11. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine needed action. P-1

12. Inspect and test fusible links, circuit breakers, and fuses; determine needed action. P-1

13. Inspect, test, repair, and/or replace components, connectors, terminals, harnesses, and wiring in electrical/electronic systems (including solder repairs); determine needed action. P-1

14. Test and measure circuit using an oscilloscope and/or graphing multimeter (GMM); interpret results; determine needed action. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS

B. Batteries (Low Voltage)

1. Perform battery state-of-charge test; determine needed action. P-1

2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test as recommended by manufacturer; determine needed action. P-1

3. Maintain or restore electronic memory functions as recommended by manufacturer. P-2

4. Inspect and clean battery; check battery cables, connectors, clamps, and hold-downs. P-1

5. Perform battery charging according to manufacturer's recommendations. P-1

6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply according to manufacturer's recommendations. P-1

7. Identify electrical/electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery. P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

C. Starting System (Low Voltage)

1. Perform starter current draw test; determine needed action. P-1

2. Perform starter circuit voltage drop tests; determine needed action. P-1

3. Inspect and test starter relays and solenoids; determine needed 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 needed action. P-1

6. Demonstrate knowledge of an automatic idle-stop/start-stop system that uses a low-voltage starter to restart the engine. P-1

7. Differentiate between electrical and engine mechanical problems that cause a slow-crank or a no-crank condition. P-1

8. Diagnose a no-crank condition using a wiring diagram and test equipment; determine needed action. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS
D. Charging System (Low Voltage)

1. Perform charging system output test; determine needed action. P-1

2. Inspect, adjust, and replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment; determine needed action. P-1

3. Remove, inspect, and replace generator (alternator); determine needed action. P-1

4. Perform charging circuit voltage drop tests; determine needed action. P-1

5. Diagnose charging system for causes of undercharge, no-charge, or overcharge conditions; determine needed action. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS
E. Lighting Systems

1. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); determine needed action. P-1

2. Aim headlights. P-2

3. Diagnose the causes of brighter-than-normal, intermittent, dim, or no light operation; determine needed action. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS
F. Instrument Cluster and Driver Information Systems

1. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required. P-1

2. Inspect and test gauges and gauge sensors/sending units for causes of abnormal readings; determine needed action. P-1

3. Diagnose the causes of incorrect operation of warning devices and other driver information systems; determine needed action. P-1

VI. ELECTRICAL/ELECTRONIC SYSTEMS

G. Body Electrical Systems

1. Diagnose vehicle comfort, convenience, access, safety, and related systems operation; determine needed action P-2

2. Remove and reinstall door panel. P-1

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. P-1

4. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation. P-1

5. Verify windshield wiper and washer operation; replace wiper blades. P-1

6. Diagnose operation of entertainment/infotainment systems and related circuits (such as: radio, DVD, navigation, amplifiers, speakers, antennas, and voice-activated accessories); determine needed action. P-2

7. Diagnose operation of safety systems and related circuits (such as: horn, airbags, seat belt pretensioners, occupancy classification, wipers, washers) determine needed action. P-1

8. Diagnose body electronic systems circuits using a scan tool; check for module communication errors (data communication bus systems); determine needed action. P-1

9. Describe the process for software transfer, software updates, or reprogramming of electronic modules. P-1

10. Demonstrate knowledge of advanced driver assistance systems (ADAS) and related circuits (such as: adaptive cruise control, lane keeping, collision avoidance, parking assist, and back-up camera). P-2

11. Recalibrate a vehicle's advanced driver assistance system (ADAS). P-2

VI. ELECTRICAL/ELECTRONIC SYSTEMS

H. xEV Systems

1. Locate procedures to safely de-energize/disable and energize/enable high-voltage systems. P-3

2. Identify potential safety and material handling concerns associated with high-voltage battery/energy storage systems. P-3

3. Demonstrate knowledge of special multimeters, insulated tools, and other test equipment required for use in high-voltage circuits. P-3

4. Demonstrate knowledge of personal protective equipment (PPE) required for use while servicing high-voltage circuits. P-3

5. Demonstrate knowledge of the use of a live-dead-live/zero potential test to verify isolation of the high-voltage battery/energy storage system. P-3

6. Demonstrate knowledge of the testing and verification of ground circuit isolation between vehicle chassis ground and the high-voltage circuits and components. P-3

7. Demonstrate knowledge of safe handling procedures associated with high-voltage A/C/ compressors and wiring. P-3

8. Demonstrate knowledge of high-voltage thermal management systems. P-3

9. Demonstrate knowledge of safe handling procedures associated with high-voltage powertrain components, such as electric motors. P-3

EE Tasks - MAST

P-1	42
P-2	8
P-3	10

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) - MAST

For every task in Heating, Ventilation, and Air Conditioning (HVAC), the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

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

A. General

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

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
B. Refrigeration System Components

1. Inspect, remove, and/or replace A/C compressor drive belts, pulleys, tensioners; determine needed action. P-1

2. Inspect for proper A/C condenser airflow; determine needed action. P-1

3. Inspect evaporator housing condensation drain; determine needed action. P-1

4. Inspect, test, and/or service A/C compressor clutch components and/or assembly; determine needed action. P-2

5. Remove, inspect, reinstall, and/or replace A/C compressor and mountings; determine recommended oil type and quantity. P-1

6. Remove and inspect A/C system hoses, lines, fittings, O-rings, seals, and service valves; determine needed action. P-2

7. Remove, inspect, and replace receiver/drier, accumulator/drier, or desiccant; determine recommended oil type and quantity. P-2

8. Remove, inspect, and install expansion valve or orifice (expansion) tube. P-1

9. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and/or control module) to interrupt system operation; determine needed action. P-1

10. Determine procedure to remove and reinstall evaporator; determine required oil type and quantity. P-2

11. Remove, inspect, reinstall, and/or replace condenser; determine required oil type and quantity. P-2

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
C. Heating, Ventilation, and Engine Cooling Systems

1. Inspect engine cooling and heater systems hoses and pipes; determine needed action. P-1

2. Inspect and test heater control valve(s); determine needed action. P-2

3. Diagnose temperature control problems in the HVAC system related to the engine cooling system, including electric heating; determine needed action. P-2

4. Determine procedure to remove, inspect, reinstall, and/or replace heater core; properly refill system. P-2

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
D. Operating Systems and Related Controls

1. Inspect HVAC system ducts, doors, hoses, cabin filters, and outlets; determine needed action. P-1

2. Identify the source of HVAC system odors. P-2

3. Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices; determine needed action. P-1

4. Diagnose A/C compressor control systems; determine needed action. P-1

5. Diagnose malfunctions in the vacuum, mechanical, and/or electrical components and controls of the HVAC system; determine needed action. P-2

6. Inspect, test, remove and/or replace HVAC system control panel; determine needed action. P-2

7. Check operation of automatic HVAC control systems; determine needed action. P-2

VII. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)
E. Refrigerant Recovery, Recycling, and Handling

1. Demonstrate knowledge of the requirement to recover, recycle, and handle refrigerants using proper equipment and procedures P-1

2. Use and maintain refrigerant handling equipment according to equipment manufacturer's standards. P-1

3. Identify A/C system refrigerant; test for sealants/contaminants; recover, evacuate, and charge A/C system; add refrigerant oil as required. P-1

4. Recycle, label, and store refrigerant. P-1

HA Tasks - MAST

P-1	24
P-2	13
P-3	0

ENGINE PERFORMANCE - MAST

For every task in Engine Performance the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

VIII. ENGINE PERFORMANCE
A. General

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

VIII. ENGINE PERFORMANCE
B. Computerized Controls

1. Identify computerized control system components and configurations. 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 needed action. P-1

4. Demonstrate knowledge of OBD readiness flags, monitors, and drive cycle for repair verification. P-1

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. P-1

6. Describe the process for reprogramming or recalibrating the powertrain/engine control module (PCM/ECM). P-1

7. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes (DTC); obtain, graph, and interpret scan tool data. P-1

8. Diagnose emissions or driveability concerns without stored or active diagnostic trouble codes; determine needed action. P-1

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. P-2

VIII. ENGINE PERFORMANCE
C. Ignition System

1. Identify ignition system components and configurations. P-1

2. Remove and replace spark plugs; inspect secondary ignition components for wear and damage; determine needed action. P-1

3. Diagnose no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns related to ignition system problems; determine needed action. P-1

4. Inspect and test crankshaft and camshaft position sensor(s); determine needed action. P-1

5. Inspect, test, and/or replace ignition control module and/or powertrain/engine control module; reprogram/initialize as needed. P-2

VIII. ENGINE PERFORMANCE
D. Fuel, Air Induction, and Exhaust Systems

1. Identify fuel, air induction, and exhaust system components and configurations. P-1

2. Replace fuel filter(s) where applicable. P-3

3. Inspect, service, or replace air filters, filter housings, and intake duct work. P-1

4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields for leaks and unmetered air; determine needed action. P-1

5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; determine needed action. P-1

6. Check and refill diesel exhaust fluid (DEF). P-3

7. Check fuel for quality, composition, and contamination; determine needed action. P-1

8. Inspect and test fuel pump(s) and pump control system for pressure, regulation, and volume; determine needed action. P-1

9. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air. P-1

10. Inspect, test, and/or replace fuel injectors on low- and high-pressure systems. P-1

11. Verify proper idle speed; determine needed action. P-1

12. Perform exhaust system back-pressure test; determine needed action. P-2

13. Demonstrate knowledge of the operation of turbocharger/supercharger systems. P-2

14. 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, and engine run-on, and emissions problems related to fuel air induction, ; determine needed action. P-2

14. 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, engine run-on, and emissions problems related to fuel, air induction, and exhaust system problems; determine needed action. P-2

VIII. ENGINE PERFORMANCE

E. Emissions Control Systems

1. Identify emission control system components and configurations. P-1

2. Inspect, test, service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; determine needed action. P-2

3. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine needed action. P-2

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, coolers, vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; determine needed action. P-1

5. Inspect and test electrical/electronically operated components and circuits of secondary air injection systems; determine needed action. P-3

6. Diagnose emission and driveability concerns caused by catalytic converter system; determine needed action. P-1

7. Diagnose emissions and driveability concerns caused by the evaporative emissions control (EVAP) system; determine needed action. P-1

EP Tasks - MAST

P-1	34
P-2	9
P-3	3

TASK LIST PRIORITY ITEM TOTALS

The Program Standards recognize that program content requirements vary by program type and by regional employment needs. Therefore, flexibility has been built into the task list by assigning each task a priority number. **A program must include in their curriculum the designated percentage of tasks (or more) in each priority numbered category (P-1, P-2, and P-3) to be accredited.** For MLR, AST, and MAST Automobile programs, the following minimum percentages are required:

At least 90% of all Priority 1 (P-1) tasks must be taught
At least 75% of all Priority 2 (P-2) tasks must be taught
At least 50% of all Priority 3 (P-3) tasks must be taught

Note that all Foundational Tasks and Workplace Skills are also required to be included at all levels of accreditation.

Maintenance & Light Repair

P-1 =	104	90% =	94 tasks
P-2 =	55	75% =	41 tasks
P-3 =	31	50% =	16 tasks

Foundational Tasks & Workplace Skills = 55

Automobile Service Technology

P-1 =	179	90% =	161 tasks
P-2 =	128	75% =	96 tasks
P-3 =	20	50% =	10 tasks

Foundational Tasks & Workplace Skills = 55

Master Automobile Service Technology

P-1 =	219	90% =	197 tasks
P-2 =	151	75% =	113 tasks
P-3 =	37	50% =	19 tasks

Foundational Tasks & Workplace Skills = 55

DEFINITIONS – TECHNICAL TERMS

1. ADJUST – To bring components to specified operational settings.
2. ALIGN – To restore the proper position of components.
3. ANALYZE – Assess the condition of a component or system.
4. ASSEMBLE (REASSEMBLE) – To fit together the components of a device or system.
5. BALANCE – To establish correct linear, rotational or weight relationship.
6. BLEED – To remove air from a closed system.
7. CHARGE – To bring to a specified state, e.g., battery or air conditioning system.
8. CHECK – To verify condition by performing an operational or comparative examination.
9. CLEAN – To rid component of foreign matter for the purpose of reconditioning, repairing, measuring or reassembling.
10. DEGLAZE – To remove a smooth glossy surface.
11. DEMONSTRATE – Give a practical exhibition and explanation. For example: how a system or component works, or how a procedure is performed.
12. DESCRIBE – To represent or give an account of the component or system.
13. DETERMINE – To establish the procedure to be used to perform the necessary repair.
14. DETERMINE NECESSARY/NEEDED ACTION – Indicates that the diagnostic routine(s) is the primary emphasis of a task. The student is required to perform the diagnostic steps and communicate the diagnostic outcomes and corrective actions required addressing the concern or problem. The training program determines the communication method (worksheet, test, verbal communication, or other means deemed appropriate) and whether the corrective procedures for these tasks are actually performed.
15. DIAGNOSE – To identify the cause of a problem.
16. DISASSEMBLE – To separate a component's parts as a preparation for cleaning, inspection, or service.
17. DISCHARGE – To empty a storage device or system.

18. EVACUATE – To remove air, fluid or vapor from a closed system by use of a vacuum pump.

19. FLUSH – To internally clean a component or system.

20. HIGH VOLTAGE – Automotive system voltages greater than 30 VAC or 60 VDC.

21. HONE – To restore cylinder wall finish by creating fine crosshatch imperfections on the surface of the cylinder's bore.

22. IDENTIFY – To describe the component or system.

23. INSPECT – To verify condition of component or system via visual examination.

24. INTERPRET – To explain the operation/condition of component or system.

25. JUMP START – To use an auxiliary power supply to assist a battery to crank an engine.

26. LOCATE – Determine or establish a specific spot or area.

27. MEASURE – To determine existing dimensions/values for comparison to specifications.

28. NETWORK – A system of interconnected electrical modules or devices.

29. ON-BOARD DIAGNOSTICS (OBD) – Diagnostic protocol which monitors computer inputs and outputs for failures.

30. PARASITIC DRAW – Electrical loads which are still present when the ignition is OFF.

31. PERFORM – To accomplish a procedure in accordance with established methods and standards.

32. PERFORM NECESSARY ACTION – Indicates that the student is to perform the diagnostic routine(s) and perform the corrective action item. Where various scenarios (conditions or situations) are presented in a single task, at least one of the scenarios must be accomplished.

33. PRIMARY CYLINDER – Control device that converts mechanical force into hydraulic pressure, typically used in automotive brake and clutch systems. This device controls the secondary cylinder(s) located on the other end of the hydraulic system.

34. PURGE – To remove air or fluid from a closed system.

35. REMOVE – To disconnect and separate a component from a system.

36. REPAIR – To restore a malfunctioning component or system to operating condition.

37. REPLACE – To exchange a component; to reinstall a component.

38. RESURFACE – To restore correct finish.

39. SECONDARY CYLINDER – Actuator that converts hydraulic pressure into mechanical force, typically used in automotive brake and clutch systems.

40. SERVICE – To perform a procedure as specified in the owner's or service manual.

41. TEST – To verify condition through the use of meters, gauges or instruments.

42. TORQUE – To tighten a fastener to specified degree or tightness (in a given order or pattern if multiple fasteners are involved on a single component).

43. VERIFY – To confirm that a problem exists after hearing the customer's concern; or to confirm the effectiveness of a repair.

44. VOLTAGE DROP – A reduction in voltage (electrical pressure) caused by the resistance in a component or circuit.

45. xEV – Any electrified propulsion vehicle with a high-voltage system, including, but not limited to, HEV, PHEV, PEV, BEV, FCEV, and EV (SAE J715-1 SEP (2022)).

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TOOLS AND EQUIPMENT

Local employer needs and the availability of funds are key factors for determining each program's structure and operation. The ASE Education Foundation Program Standards recognize that not all programs have the same needs, nor do all programs teach 100 % of the automobile tasks. Therefore, the basic philosophy for the tools and equipment requirement is as follows: *for all tasks which are taught in the program, the training should be as thorough as possible with the tools and equipment necessary for those tasks*. In other words, if a program does not teach a particular task, the tool from the tool list associated with that task is not required.

The tool lists are organized into three basic categories*: Hand Tools, General Lab/Shop Equipment,* and *Specialty Tools and Equipment.* The Specialty Tools and Equipment section is further separated into the three Automobile Accreditation levels. When referring to the tools and equipment list, please note the following:

A. The organization of the tool list is not intended to dictate how a program organizes its tool crib or student tool sets (i.e., which tools should be in a student set, if utilized, and which should be in the tool crib or shop area).

B. Quantities for each tool or piece of equipment are determined by the program needs; however, sufficient quantities to provide quality instruction should be on hand.

C. For *Specialty Tools and Equipment*, the program need only have those tools for the level of accreditation being sought. In addition, if a program does not teach a particular task, tools associated with that task are not required.

D. Programs may meet the equipment requirements by borrowing special equipment or providing for off-site instruction (e.g., in a dealership or independent repair shop). Use of borrowed or off-site equipment *must* be appropriately documented.

E. No specific brand names for tools and equipment are specified or required.

F. Although the Program Standards recommend that programs encourage students to begin to build their own tool sets, this is not a requirement. However, many employers require an entry-level automobile technician to provide his/her own basic hand tool set.

HAND TOOLS

(Contained in individual sets or the tool crib in sufficient quantities to permit efficient instruction)

Air Nozzle (meeting OSHA requirements)		Hammers:	
Allen (Wrench or Socket) Set - Standard (.050"-3/8")		16 oz. Ball Peen	
Allen (Wrench or Socket) Set - Metric (2mm - 8mm, 10mm, 12mm)		Brass	
Battery Post Cleaner		Dead Blow Plastic Mallet	
Battery Terminal Pliers		Plastic Tip	
Battery Terminal Puller		Rubber Mallet	
Chisels:		Inspection Mirror	
Cape 5/16"		Magnetic Pickup Tool	
Cold 3/8", 3/4"		Pliers:	
Chisel Holder		Combination 6"	
Claw Type Pickup Tool		Hose Clamp	
Combination Wrenches:		Locking Jaw	
Standard (1/4" – 1 1/4") (optional)		Needle Nose 6"	
Metric (7mm - 24mm)		Side Cutting	
Crowfoot Wrench Set - Metric		Slip Joint	
Crowfoot Wrench Set – Standard (optional)		Pry Bars:	
Ear Protection		Rolling Head	
Feeler Gauge (Blade Type):		Straight	
.002" - .040"		Punches:	
.006mm - .070mm		Center	
Files:		Brass Drift	
Coarse 6" and 12"		Pin 1/8", 3/16", 1/4", 5/16 "	
Fine 6" and 12"		Taper 3/8", 1/2", 5/8"	
Half Round 12"		Safety Glasses (meeting OSHA requirements)	
Round 6" and 12"		Scraper:	
Flare Nut (tubing) Wrenches:		Plastic	
3/8" - 3/4"		Gasket 1"	
10mm - 17mm		Screwdriver - Blade Type:	
Flashlight		Stubby	
Fuse Puller/Remover		6", 9", 12"	
Fused Jumper Wire Set (with various adapters)		Offset	
Hack Saw			

(list continued on next page)

Screwdriver - Phillips:		Socket Set - 1/2" Drive:	
Stubby #1, #2		7/16" - 1 1/8" Standard Depth (optional)	
6" #1, #2		7/16" - 1 1/8" Deep (optional)	
12" #3		10mm - 24mm Standard Depth	
Offset #2		10mm - 24mm Deep	
Screwdriver - Impact Driver Set		3", 6", 12" Extensions	
Socket Set - 1/4" Drive:		Flex Handle (Breaker Bar)	
1/4" - 1/2" Standard Depth (optional)		Ratchet	
1/4" - 1/2" Deep (optional)		Spark Plug Feeler Gauge (Gap Tool)	
6mm - 12mm Standard Depth		Tape Measure – Standard and Metric	
6mm - 12mm Deep		Tire Pressure Gauge	
2”, 4” Extensions		Tire Tread Depth Gauge	
Ratchet		Torque Wrench:	
Socket Set - 3/8" Drive:		3/8" Drive (10 - 250 lb. in.)	
5/16" - 3/4" Standard Depth (6 point) (optional)		3/8" Drive (5 - 75 lb. ft.)	
3/8" - 3/4" Deep (6 point) (optional)		1/2" Drive (50 - 250 lb. ft.)	
10mm - 19mm Standard Depth (6 point)		Torx® Plus Set External and Internal (optional)	
10mm - 19mm Deep (6 point)		Torx® Set	
3", 5", 10" Extensions		T-8 to T-55	
Flexhead Ratchet		Torx® External Set	
Ratchet		E-4 to E-18	
Spark Plug Sockets 5/8", 13/16", 9/16"		Wire Brush	
Spark Plug Sockets 14mm			
Speed Handle			
Universal Joint			
Flexible Socket Set 10mm - 19mm			

GENERAL LAB/SHOP EQUIPMENT

The tools and equipment on this list are used in general lab/shop work but are not generally considered to be individually owned hand tools. A well-equipped, accredited program should have all these general tools and equipment readily available and in sufficient quantity to provide quality instruction.

Air or Electric Chisel Set (various bits)		Engine Coolant Recovery Equipment or Recycler or Coolant Disposal Contract Service (in accordance with state and local requirements)	
Air Compressor and Hoses		Engine Coolant Vacuum Refill Tool (optional)	
Air Pressure Regulator		Engine Hoist/Crane	
Air or Electric Ratchet (1/4” and 3/8” drive)		Extension Cords	
Automotive Stethoscope (electronic recommended)		Face Shields	
Axle Stands (Jack Stands)(2 Ton minimum)		Fender Covers	
Axle Support Stands (Screw Jacks)		Floor Jack (2 Ton minimum)	
Bearing Packer (hand operated)		Handheld Vacuum Pump	
Belt Tension/Wear Gauge		Hood Prop	
Bench or Pedestal Grinder (including guards)		Hydraulic Press with adapters	
Calipers – 0-6”, 0-125mm		Impact Socket Sets – 3/8" Drive (Standard - optional)	
Comprehensive Puller Set		Impact Socket Sets – 3/8 Drive (8mm-19mm)	
Coolant/Combustion Gas Detector (recommended)		Impact Sockets – 1/2" Drive (7/16" - 1 1/8") (optional)	
Coolant Tester – refractometer type		Impact Sockets – 1/2" Drive (12mm – 24mm)	
Cooling System Pressure Tester and Adapters		Impact Sockets – 1/2” Drive Deep (30 mm, 32 mm, 36mm)	
Creeper		Impact Wrench – 1/2" Drive	
Cylinder Leakage Tester		Impact Wrench – 3/8" Drive	
Dial Indicator with Flex Arm and Clamp Base		Induction Heater, MAP-gas, or Oxy-Acetylene Torch Set (in accordance with state and local requirements)	
Digital Multimeter (DMM) with various lead sets (enough to meet instruction goals)		Jumper Cables	
Drain Pans		Low Voltage Battery Charger (to meet current industry standard)	
Drill - 3/8" variable speed, reversible		Low Voltage Battery/Starter/Charging System Tester (to meet current industry standard)	
Drill - 1/2" variable speed, reversible		Micrometer (Depth) 0-6”, 0-125mm	
Drill Bit Set (Twist)		Micrometers - (Outside Type) 0-1", 1-2", 2-3", 3-4", 4-5"	
Electric Hot Air Tool		Oil Can - Pump Type	

Oil Filter Wrench and Sockets	
Parts Cleaning Tank and Gloves (in accordance with state and local requirements, aqueous based recommended)	
Scan Tool OBDII w/CAN capability or Personal Computer (PC) with equivalent interface (appropriate capability to support tasks taught)	
Screw Extractor Set	
Seat Covers	
Serpentine Belt Tensioner Tools	
Shop/Work Lights (Non-incandescent)	
Snap Ring Pliers Set - external	
Snap Ring Pliers Set - internal	
Soldering Tool	
Spark Plug Boot Puller	
Tap and Die Set – Standard (optional)	
Tap and Die Set – Metric	
Temperature Sensing Device	
Thread Repair Insert Kit	
Thread Repair (Thread Chaser) Set	
Tire Inflator Chuck	
Tube Quick Disconnect Tool Set	
Tubing Bender	
Tubing Cutter/Flaring Set (Double-lap and ISO)	
Ultraviolet Leak Detection Kit	
Used Oil Receptacle with extension neck and funnel	
Valve Core Removing Tool	
Vehicle Lift (ALI® certified for new purchases)	
Waste Fluid Storage Container(s) and Disposal Method (in accordance with state and local requirements)	
Wheel Chocks	
Workbenches with vises	

SPECIALTY TOOLS AND EQUIPMENT

This section covers the tools and equipment a lab/shop should have for training in any given specialty area. This equipment is specialized, and it must be available in the lab/shop or to the program. No specific type or brand names are identified because they will vary in each local situation. A check mark indicates that tool is appropriate for performing tasks at that accreditation level.

For all tasks which are taught in the program, the training should be as thorough as possible with the tools and equipment necessary for those tasks. **In other words, if a program does not teach a particular task, tools associated with that task are not required.**

ENGINE REPAIR	**MLR**	**AST**	**MAST**	
Antifreeze/Coolant Tester - Refractometer	✓	✓	✓	
Ball (Small Hole) Gauges			✓	
Cam Bearing Driver Set			✓	
Camshaft Holding Tool			✓	
Cylinder Deglazer			✓	
Dial Bore Indicator			✓	
Engine Stands and/or Cylinder Head Stands		✓	✓	
Inside Micrometer Set – 0-6”, 0-125mm			✓	
Oil Pressure Gauge		✓	✓	
Portable Crane - 1/2 Ton			✓	
Precision Straight Edge	✓	✓	✓	
Ring Compressor			✓	
Ring Expander			✓	
Ring Groove Cleaner			✓	
Telescopic Gauge Set			✓	
Torque Angle Gauge	✓	✓	✓	
V-Blocks			✓	
Valve Spring Compressor			✓	
Valve Spring Tester			✓	

AUTOMATIC TRANSMISSION/TRANSAXLE	**MLR**	**AST**	**MAST**	
Differential Set-up Tools			✓	
Hydraulic Pressure Gauge Set		✓	✓	
Transmission Jack(s)		✓	✓	
Transmission/Transaxle Flushing Equipment		✓	✓	
Transmission/Transaxle Removal and Installation Equipment		✓	✓	
Transmission/Transaxle Holding Fixtures		✓	✓	
Transmission/Transaxle Special Tool Sets (appropriate for units being utilized)		✓	✓	

MANUAL DRIVE TRAIN AND AXLES	**MLR**	**AST**	**MAST**	
Axle Nut Socket Set (or equivalent)	✓	✓	✓	
Clutch Alignment Set		✓	✓	
Clutch Pilot Bearing/Bushing Puller/Installer		✓	✓	
Constant Velocity Joint (CV) Boot Clamp Pliers or Crimping Ring		✓	✓	
Engine Support Fixture		✓	✓	
Rotating Torque Wrench		✓	✓	

Special Tools for Transmissions, Transaxles, Transfer Cases, and Differentials (appropriate for units being taught)			✓	
Universal Joint Tools	✓	✓	✓	
Wheel Stud Installation Tools	✓	✓	✓	

SUSPENSION & STEERING	**MLR**	**AST**	**MAST**	
Ball Joint Press and other Special Tools		✓	✓	
Brake Pedal Depressor	✓	✓	✓	
Bushing Driver Set		✓	✓	
Coil Spring Compressor Tool		✓	✓	
Chassis Ear or equivalent listening device		✓	✓	
Frame Angle Gauge or Portable Digital Protractor	✓	✓	✓	
Hand Grease Gun	✓	✓	✓	
Inner Tie Rod End Tool		✓	✓	
Pitman Arm Puller		✓	✓	
Power Steering Pump Pulley Special Tool Set		✓	✓	
Power Steering Pressure Gauges			✓	
Strut Spring Compressor Tool (OEM-Recommended)	✓	✓	✓	
Tie Rod Puller/Separator/Remover		✓	✓	
Tire Mounting Machine	✓	✓	✓	
Tire Patching Tools and Supplies	✓	✓	✓	
Tire Pressure Monitoring System (TPMS) Tool	✓	✓	✓	
Wheel Alignment Equipment-4 wheel (including alignment tools)		✓	✓	
Wheel Balancer - Electronic Type (force variation or equivalent recommended)	✓	✓	✓	
Wheel Weight Pliers	✓	✓	✓	

BRAKES	**MLR**	**AST**	**MAST**	
Bearing Seal and Race Driver Set	✓	✓	✓	
Brake Bleeder (Pressure or Vacuum)	✓	✓	✓	
Brake Disc Micrometer	✓	✓	✓	
Brake Drum Micrometer and Calibration Equipment	✓	✓	✓	
Brake Fluid Test Strips or Tester	✓	✓	✓	
Brake Lathe (bench with disc and drum service attachments)	✓	✓	✓	
Brake Lathe (on car)	✓	✓	✓	
Brake Lining Thickness Measurement Tool	✓	✓	✓	
Brake Shoe Adjusting Gauge	✓	✓	✓	
Brake Spring Remover/Installer	✓	✓	✓	
Brake Spring Pliers	✓	✓	✓	
Brake Spoon	✓	✓	✓	
Caliper Piston Retraction Set	✓	✓	✓	
Primary Cylinder Bleeder Kit		✓	✓	
Wheel Stud/Fastener Service Tools	✓	✓	✓	
Graphing Multimeter (GMM) and/or Digital Storage Oscilloscope (DSO)*			✓	

ELECTRICAL/ELECTRONIC SYSTEMS	MLR	AST	MAST	
Connector Pick Tool Set	✓	✓	✓	
Molding and Trim Removal Tool(s)	✓	✓	✓	
Headlight Aimer or Screen	✓	✓	✓	
Heat Gun (or equivalent for heat shrinking operations)	✓	✓	✓	
Terminal Tension (Pin Drag) Test Kit/Terminal Probe Kit (or equivalent)	✓	✓	✓	
Wire and Terminal Repair Kit	✓	✓	✓	
Graphing Multimeter (GMM) and/or Digital Storage Oscilloscope (DSO)*		✓	✓	

xEV SHOP/LAB EQUIPMENT	MLR	AST	MAST	
xEV Vehicle Safety Kit			✓	
Electrical Insulating Gloves – must meet CAT 0 1000 VAC and 1500 VDC electrical safety glove rating – may have expired certification if used for demonstration only			✓	
Leather Gloves to go over Electrical Insulating Gloves			✓	
xEV charging equipment (level 1 or higher)			✓	
Insulated Retrieval Hook			✓	
Insulation Tester/Multimeter and leads – must meet CAT III 600-volt, CAT III 1000-volt, or CAT IV 600-volt rating			✓	

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)	MLR	AST	MAST	
A/C Compressor Clutch Service Tools		✓	✓	
Dye Injection Kit		✓	✓	
A/C Leak Detector (to meet current industry standard)		✓	✓	
A/C Manifold Gauge Set or equivalent (to meet current industry standard)		✓	✓	
A/C Refrigerant Identification Equipment		✓	✓	
A/C Refrigerant Recovery/Recycling/Recharging Station (to meet current industry standard)		✓	✓	
Thermometer(s)		✓	✓	
A/C Sealant Detector Kit		✓	✓	

ENGINE PERFORMANCE	MLR	AST	MAST	
Compression Tester		✓	✓	
Cylinder Power Balance Tester (Scan Tool/Manual Method)		✓	✓	
Evaporative Emissions Control System (EVAP) Tester		✓	✓	
Exhaust Backpressure Tester (or equivalent)		✓	✓	
Fuel Injection Pressure Gauge Sets with Adapters		✓	✓	
Gasoline Quality Testing Kit (or equivalent)		✓	✓	
*Graphing Multimeter (GMM) and/or Digital Storage Oscilloscope (DSO)		✓	✓	
Infrared Thermometer (or appropriate substitute)	✓	✓	✓	
Injector Pulse Tester (or equivalent)		✓	✓	
Leak Detector (Smoke or Nitrogen)		✓	✓	
Oxygen Sensor Socket(s)		✓	✓	
Pinch-off Pliers		✓	✓	

Sensor/Sending Unit Socket(s)		✓	✓	
Spark Plug Thread Repair Tool(s)	✓	✓	✓	
Spark Tester		✓	✓	
Vacuum/Pressure Gauge (or equivalent)	✓	✓	✓	
*Also necessary to accomplish tasks in other MAST categories (Brakes and Electrical/Electronic Systems)				

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