

*Massachusetts Department of Elementary & Secondary Education*

Office for College, Career and Technical Education



*Vocational Technical Education Framework*



Transportation Occupational Cluster

***Automotive Technology (VAUTO)***

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**Massachusetts Department of Elementary and Secondary Education**

**Office for College, Career, and Technical Education**

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## Acknowledgements

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The Department of Elementary and Secondary Education wishes to thank all the groups that contributed to the development of these standards and all the teachers, administrators, and private sector advisory committee members who provided valuable employer validation of standards.

This updated Framework reflects current business and industry standards and includes the addition of the *Hours of Instruction*, *updates to Industry Recognized Credentials*, *Equipment*, and the *addition of Embedded Academic Performance Examples*.

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## **Hours of Instruction**

Hours of Instruction have been provided for each framework standard to ensure that adequate instructional time is provided for students to attain complete and comprehensive knowledge of the subject matter.

<b>Schedule of Hours</b>		
<b>2.A.</b>	Automotive Technology Specific Safety Practices	50
<b>2.B.</b>	Hand Tools	25
<b>2.C.</b>	Power Tools	25
<b>2.D.</b>	Precision Measuring	25
<b>2.E.</b>	Fasteners	25
<b>2.F.</b>	Vehicle Service Information	25
<b>2.G.</b>	Wheels and Tires	50
<b>2.H.</b>	Suspension Systems	50
<b>2.I.</b>	Steering Systems	50
<b>2.J.</b>	Wheel Alignment	40
<b>2.K.</b>	Automotive Basic Maintenance	40
<b>2.L.</b>	Heating, Ventilation and Air Conditioning (HVAC)	40
<b>2.M.</b>	Brake System Research and Service	40
<b>2.N.</b>	Hydraulic Brake Systems	40
<b>2.O.</b>	Drum Brake Systems	50
<b>2.P.</b>	Disc Brake Systems	75
<b>2.Q.</b>	Power Brake Systems	40
<b>2.R.</b>	Parking Brake Components and Systems	40
<b>2.S.</b>	Antilock Brake System	40
<b>2.T.</b>	General Electrical Systems	60
<b>2.U.</b>	Automotive Batteries	40
<b>2.V.</b>	Automotive Starting System	40
<b>2.W.</b>	Automotive Charging System	40
<b>2.X.</b>	Electrical Accessories	40
<b>2.Y.</b>	Basic Hybrid/Electric Vehicle (EV) Theory	25
<b>2.Z.</b>	General Engine Problems	40
<b>2.AA.</b>	Ignition Systems	40
<b>2.BB.</b>	Emissions Control Systems	40
<b>2.CC.</b>	Demonstrate appropriate engine repair techniques (+)	25
<b>2.DD.</b>	Automatic Transmission/Transaxle (+)	25
<b>2.EE.</b>	Manual Transmission and Drivetrain (+)	25
<b>2.FF.</b>	Drive Axles (+)	25
<b>2.GG.</b>	Four Wheel Drive (+)	25
<b>2.HH.</b>	Manual Transmissions/Transaxle and Clutch Assembly (+)	25
<b>2.II.</b>	Heating and Air Conditioning (+)	25
<b>2.JJ.</b>	Engine Performance (+)	25
<b>2.KK.</b>	New/Emerging Technologies (+)	25
	<b>Total</b>	<b>1360</b>

## Introduction

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### **Overview & Organization of Strands**

The Massachusetts Department of Elementary and Secondary Education understands the necessity of maintaining current Vocational Technical Education Frameworks which ensure that vocational technical students across the Commonwealth are taught the most rigorous and relevant standards aligned to the needs of business and industry.

This Revised Framework models the same format of all Massachusetts' Vocational Technical Education Frameworks and is organized into six strands. Standardized VTE Frameworks Strands 1, 4, 5, and 6 have been revised to ensure currency with industry standards.

Strand Two has been revised to include technical standards aligned to current business and industry standards, including new processes utilizing state-of-the-art equipment. The equipment necessary to deliver standards is also identified in this framework. To meet Chapter 74 vocational technical education standards, the equipment must meet industry standards.

Strand Three, Embedded Academic Knowledge and Skills, has been revised to clarify the direct connection of Core Academic Frameworks as they apply to Vocational Technical Education Frameworks.

Framework revision teams created Embedded Academic Performance Examples to provide specific learning scenarios which are typically utilized in VTE classrooms and labs to create real life learning experiences which provide students with knowledge attainment in Vocational Technical Education Frameworks and Academic Learning Standards. It is understood that most VTE learning experiences include Academic Knowledge attainment. The Performance Examples provided in this Framework are intended to provide awareness of these learning experience.

During Phase 3 of the 2021 Framework Revision Process, Strands One, Four, Five, and Six teams completed the revision of these strands. All Strand One, Four, Five and Six teams worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Massachusetts Career and Technical Student Organizations to crosswalk standards to national Career & Technical Student Organizations Curricula, as applicable. The Office for College, Career, and Technical Education contracted the MAVA Consultant Team to work closely with the office to complete all the work accomplished during the 2021 Framework Revision Project. A remarkable amount of work was accomplished through the efforts of numerous professionals who collaborated and diligently supported this work. The Office for College, Career, and Technical Education is grateful for all the support received from the field, particularly all the teachers (technical and academic), administrators, advisory committee members, business and industry representatives, the Division of Professional Licensure boards, the Massachusetts Association of Vocational Administrators, the MAVA Consultants, and the Massachusetts Vocational Association, whose contributions were tremendous.

The **Strand Two Team** maintained the structure the 2013 framework that includes topic headings, standards and objectives, and performance examples. The Strand Two Framework now includes Hours of Instruction, as well as identifying Basic, Essential, Advanced and Advanced (A+) skill standards that are coded B, E, A and A+.

The **Strand Three Team** provided embedded academics performance examples that were developed to reflect the Standards for Literacy in Content Areas, the Standards for Mathematical Practice, the High School Science & Engineering Practices, and the Digital Literacy & Computer Science Practices.

## **Skill Standard Levels**

The 2021 Framework identifies vocational competencies in three skill levels: basic, essential and advanced. See below for more information.

**B = Basic Standards:** Fundamental Skills all Chapter 74 state-approved vocational programs are required to deliver basic standards.

**E = Essential Standards:** Knowledge and Skills required for industry licensure and credentials. All Chapter 74 state-approved vocational programs are required to deliver essential standards.

**A = Advanced Standards:** Higher-level knowledge and skills beyond essential entry level employment standards. All Chapter 74 state-approved vocational programs are required to deliver advanced standards.

**A+ = Advanced Plus (A+):** Denotes Advanced Standards - highest level of supplemental training

- **Advanced (A+) Skills Standards** are identified in Strand Two by a plus sign (A+). Although these standards are not required, they are provided as suggestions that districts may choose to use to increase the depth of a particular topic, or add additional topics, particularly for advanced students or for those seniors who do not participate in cooperative education. Advanced (A+) standards are identified with the use of a plus sign (A+).

It is not required that all students achieve “advanced (A+) level standards”, however, all Chapter 74 state-approved programs must have the capacity to deliver all three skill levels: Basic, Essential, and Advanced.

## **Definitions - Equipment**

**Simulator** – a computer or application designed to provide a realistic operation of an industry standard or control, not to include educational trainers.

**Educational Trainer** - equipment which is designed strictly for educational purposes. Trainers cannot be a substitute or replacement for industry standard equipment.

**Industry Standard Equipment** – current and relevant equipment used in the industry relating to the standard functioning and implementation of operations in the respective fields of production, not to be confused with educational trainers.

**Industry Standard** - a set of criteria within an industry relating to the standard functioning and carrying out of operations in their respective fields of production. It is the generally accepted requirements followed by the members of an industry.

**Software** - current and relevant software used in the industry relating to the standard functioning and implementation of operations in the respective fields of production.

## **Organization of Framework – Strand 2**

The Vocational Technical Education Frameworks contain knowledge and skills covering all aspects of industry, reflected in six strands: Safety and Health, Technical, Embedded Academics, Employability, Management and Entrepreneurship, and Technological.

Standards and objectives are grouped under topic headings, which are displayed in bold. Each standard is followed by performance example(s).

In the excerpt below, 2.Z is the topic; 2.Z.01 is the first standard and 2.Z.01.01 through 2.Z.01.04 are the objectives under that standard. Topic 2.Z.01.04 includes Advanced (A+) Skill Levels as defined on a previous page of this framework.

Strand 2 includes Hours of Instruction, Equipment Needed, and Skill Levels.

<b>2.Z</b>	<b>General Engine Problems</b>	40
	<b>Hours of Instruction</b>	
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.Z.01</b>	<b>Identify, test and repair leaks, abnormal sounds and odors commonly associated with engine malfunctions.</b>	<b>SKILL LEVEL</b>
2.Z.01.01	Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	B, E
2.Z.01.02	Identify abnormal engine noise or vibration concerns; determine necessary action.	B, E
2.Z.01.03	Identify abnormal exhaust color, odor, and sound; determine necessary action.	B, E
2.Z.01.04	Perform oil pressure tests; determine necessary action.	B, E, A, A+
	<b>Performance Example:</b> Student will remove and replace a valve cover gasket to repair an engine oil leak.	



## **Strand 2: Technical Knowledge and Skills**

<b>2.A Automotive Technology Specific Safety Practices</b>		
	<b>Hours of Instruction</b>	50
	<b>Equipment Needed – (Must Meet Industry Standards)</b>	
	Industry standard automotive lifting equipment, i.e., lifts and floor jacks and jack stands.	
<b>2.A.01</b>	<b>Identify and describe safety procedures when dealing with different types of automotive lifts according to current industry standards.</b>	<b>SKILL LEVEL</b>
2.A.01.01	Demonstrate procedures for safe lift operations.	B, E
2.A.01.02	Demonstrate safe use, placement and storage of floor jacks and jack stands.	B, E
	<b>Performance Example:</b> Student will set up lift using manufacturer’s suggested lift points.	
<b>2.A.02</b>	<b>Demonstrate and describe safety procedures when dealing with high pressure systems including necessary ventilation according to current industry standards.</b>	<b>SKILL LEVEL</b>
2.A.02.01	Describe and demonstrate the importance of safety procedures to be used when servicing high pressurized systems (fuel systems, brakes, air conditioning, suspension, hydraulic systems, etc.).	B, E, A
2.A.02.02	Describe and demonstrate safe use of oxygen/acetylene torches and electric welding equipment.	B, E, A
2.A.02.03	Demonstrate ventilation procedures to be followed when working in the lab/shop area.	B, E
	<b>Performance Example:</b> Student will relieve fuel system pressure to perform necessary repairs.	
<b>2.A.03</b>	<b>Identify and describe safety procedures when dealing with electrical circuits according to current industry standards.</b>	<b>SKILL LEVEL</b>
2.A.03.01	Describe safety procedures to be followed when servicing supplemental restraint systems.	B, E, A
2.A.03.02	Demonstrate safety awareness of high voltage circuits of electric or hybrid electric vehicles and related safety precautions.	B, E
	<b>Performance Example:</b> Safely disable Supplemental Restraint System (SRS) air bag for repair using manufacturer’s recommendations.	
<b>2.B Hand Tools</b>		
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b>	
	Sufficient quantities of all industry standard hand tools should be available to provide quality instruction.	
<b>2.B.01</b>	<b>Demonstrate the appropriate use of hand tools according to current industry and OSHA standards</b>	<b>SKILL LEVEL</b>
2.B.01.01	Identify and describe various types of screwdrivers.	B
2.B.01.02	Identify and describe various types of pliers.	B
2.B.01.03	Identify and describe various types of combination wrenches.	B
2.B.01.04	Identify and describe various types of sockets and drive tools.	B
2.B.01.05	Identify and describe various types of hammering tools.	B

2.B.01.06	Identify and describe various types of metal working tools.	B
2.B.01.07	Identify and describe various types of surface prep tools.	B
2.B.01.08	Identify and describe various types of holding tools.	B
<b>Performance Example:</b> Student will select and use the appropriate hand tool for the task assigned.		
<b>2.C</b>	<b>Power Tools</b>	
	<b>Hours of Instruction</b>	25
<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard pneumatic and electric power tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)		
<b>2.C.01</b>	<b>Demonstrate and explain the use of electric power tools according to current industry standards.</b>	<b>SKILL LEVEL</b>
2.C.01.01	Describe safety procedures to be followed when using corded electric tools.	B, E
2.C.01.02	Describe safety procedures to be followed when using cordless electric tools.	B, E,
<b>Performance Example:</b> Student will drill a hole to given specification using appropriate speeds and bits for various metals.		
<b>2.C.02</b>	<b>Demonstrate and explain the use of pneumatic power tools according to current industry standards.</b>	<b>SKILL LEVEL</b>
2.C.02.01	Identify and explain the purpose of industry standard pneumatic tools.	B, E
2.C.02.02	Describe the maintenance needs of industry standard pneumatic tools	B, E
2.C.02.03	Demonstrate and describe safety procedures to follow when using industry standard pneumatic tools.	B, E
2.C.02.04	Identify and explain the purpose of impact sockets.	B, E
<b>Performance Example:</b> Student will remove wheel fasteners using an impact wrench, selecting appropriate size and type of socket.		
<b>2.C.03</b>	<b>Demonstrate and explain the use of electric automotive technology tools according to current industry standards.</b>	<b>SKILL LEVEL</b>
2.C.03.01	Identify and explain the purpose of a bench grinder.	B, E
2.C.03.02	Demonstrate and describe safety procedures to follow when using a bench grinder.	B, E
2.C.03.03	Identify and explain the purpose of a drill press.	B, E
2.C.03.04	Demonstrate and describe the safety procedures to follow when using a drill press.	B, E
<b>Performance Example:</b> Student will operate a bench grinder according to current industry safety standards.		
<b>2.D</b>	<b>Precision Measuring</b>	
	<b>Hours of Instruction</b>	25
<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard pneumatic tools should be available for quality instruction. (I.e. ASE Educational Foundation certification tools) (See Automotive Service Excellence Education Foundation Appendix B)		

<b>2.D.01</b>	<b>Describe and demonstrate the use of commonly used low precision measuring tools.</b>	<b>SKILL LEVEL</b>
2.D.01.01	Identify and demonstrate the use of inside and outside calipers.	B, E
2.D.01.02	Identify and demonstrate the use of a hole gauge.	B, E
2.D.01.03	Identify and demonstrate the use of a steel rule, measuring tape, and combination square.	B, E
<b>2.D.02</b>	<b>Describe commonly used high precision measuring tools.</b>	<b>SKILL LEVEL</b>
2.D.02.01	Identify and demonstrate the use of an outside and inside micrometer.	B, E, A
2.D.02.02	Identify and demonstrate the use of a depth micrometer.	B, E, A
2.D.02.03	Identify and demonstrate the use of a dial indicator.	B, E, A
	<b>Performance Example:</b> Student will use a variety of measuring tools to verify accurate brake rotor dimensions.	
<b>2.E</b>	<b>Fasteners</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B	
<b>2.E.01</b>	<b>Identify and demonstrate the use of commonly used fasteners.</b>	<b>SKILL LEVEL</b>
2.E.01.01	Identify bolt head markings and bolt grading.	E, A
	<b>Performance Example:</b> Student will distinguish between SAE and metric dimensional fasteners.	
<b>2.E.02</b>	<b>Explain the concept of fastener torque.</b>	<b>SKILL LEVEL</b>
2.E.02.01	Explain how to find fastener torque specifications.	B
2.E.02.02	Explain how to use a general fastener torque chart.	B
2.E.02.03	Explain what torque sequence refers to.	B
2.E.02.04	Explain and demonstrate the basic rules to follow when using a torque wrench.	B
2.E.02.05	Explain the concept of torque yield fasteners.	B
	<b>Performance Example:</b> Student will torque wheel fasteners to manufacturer's specifications using the vehicle's specific tightening sequence.	
<b>2.F</b>	<b>Vehicle Service Information</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Access to appropriate current vehicle service information.	
<b>2.F.01</b>	<b>Access and use service information to perform step-to-step diagnosis and repair.</b>	<b>SKILL LEVEL</b>
2.F.01.01	Research applicable vehicle and service information, such as suspension, steering system operation, vehicle service history, service precautions, technical service bulletins and recalls.	B
2.F.01.02	Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).	B
	<b>Performance Example:</b>	

<b>2.G</b>	Student will research the vehicle identification number (VIN) of the vehicle being serviced to obtain correct engine size.	
	<b>Wheels and Tires</b>	
	<b>Hours of Instruction</b>	50
<b>2.G.01</b>	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	
	<b>Perform appropriate wheel and tire inspection.</b>	<b>SKILL LEVEL</b>
	2.G.01.01 Diagnose tire wear patterns and determine necessary action.	B, E
<b>2.G.02</b>	2.G.01.02 Inspect tires for sizing, tread wear and pattern. Determine necessary action. Check and adjust air pressure.	B, E
	2.G.01.03 Measure wheel, tire, axle and hub run out.	B, E
	2.G.01.04 Measure loaded run out and tire rigidity simultaneously using wheel balancing equipment.	B, E
<b>2.G.02</b>	<b>Performance Example:</b> Student will inspect tire size, compare with manufacturer tire size recommendations and determine necessary action.	
	<b>Perform appropriate wheel and tire mounting.</b>	<b>SKILL LEVEL</b>
	2.G.02.01 Dismount/mount tire on/off wheel rim.	B, E
<b>2.G.03</b>	2.G.02.02 Remove and install a tire and wheel assembly and torque wheel fasteners.	B, E
	2.G.02.03 Inspect and replace wheel studs.	B, E
	2.G.02.04 Rotate tires according to the manufacturer's recommendations.	B, E
<b>2.G.04</b>	<b>Performance Example:</b> Student will dismount and mount a tire on a wheel rim with tire pressure monitoring system (TPMS) and rotate according to manufacturer's recommendations.	
	<b>Perform appropriate wheel and tire balancing.</b>	<b>SKILL LEVEL</b>
	2.G.03.01 Balance wheel and tire assembly as required.	B, E
<b>2.G.04</b>	2.G.03.02 Balance a tire on wheel, measure loaded run out and tire stiffness simultaneously to determine recommended location of wheel and tire assemblies to minimize tire pull.	B, E
	<b>Performance Example:</b> Student will balance a wheel and tire assembly using different modes on a dynamic wheel balancer	
	<b>Diagnose and repair tire and tire pressure monitoring systems (TPMS) components.</b>	<b>SKILL LEVEL</b>
<b>2.G.04.01</b>	2.G.04.01 Inspect a tire for leaks and repair a tire puncture.	B, E
	2.G.04.02 Remove and replace a valve stem.	B, E
	2.G.04.03 Identify tire pressure monitoring system equipped vehicles.	B, E
<b>2.G.04.04</b>	2.G.04.04 Identify different types (direct and indirect) of TPMS systems and components.	B, E
	2.G.04.05 Set up and use tire pressure monitoring system, service, and resetting equipment.	B, E
	<b>Performance Example:</b>	

	Student will verify if there is a TPMS sensor, then dismount, mount, and balance a new tire on the rim.	
<b>2.H</b>	<b>Suspension Systems</b>	
	<b>Hours of Instruction</b>	50
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	
<b>2.H.01</b>	<b>Inspect suspension system for noises, body sway and uneven ride height concerns.</b>	<b>SKILL LEVEL</b>
2.H.01.01	Inspect short and long arm suspension system for noises, body sway and uneven ride height concerns.	B, E
2.H.01.02	Inspect strut suspension systems for noises, body sway and uneven ride height concerns	B, E
2.H.01.03	Inspect leaf spring suspension system for noises, body sway and uneven ride height concerns.	B, E
	<b>Performance Example:</b> Student will verify correct curb ride height using a tape measure and follow manufacturer's recommendations and specifications to determine necessary action.	
<b>2.H.02</b>	<b>Lubricate suspension and steering systems.</b>	<b>SKILL LEVEL</b>
2.H.02.01	Lubricate suspension and steering systems per manufacturer's recommendations.	B, E
	<b>Performance Example:</b> Student will identify and lubricate all applicable suspension components.	
<b>2.H.03</b>	<b>Remove, inspect, and install suspension components.</b>	<b>SKILL LEVEL</b>
2.H.03.01	Remove, inspect, and install upper and lower control arms, bushings, shafts and rebound bumpers.	B, E
2.H.03.02	Remove, inspect, and install strut rods (compression/tension) and bushings.	B, E
2.H.03.03	Remove, inspect, and install upper and/or lower ball joints.	B, E
2.H.03.04	Remove, inspect, and install steering knuckle assemblies.	B, E
2.H.03.05	Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.	B, E
2.H.03.06	Remove, inspect, and install and adjust suspension system torsion bars; inspect mounts.	B, E
2.H.03.07	Remove, inspect, and install stabilizer bar bushings, brackets and links.	B, E
2.H.03.08	Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers) and upper strut bearings/mounts.	B, E
2.H.03.09	Remove, inspect, and install coil springs and spring insulators.	B, E
2.H.03.10	Remove, inspect, and install transverse links, control arms, bushings, and mounts.	B, E
2.H.03.11	Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	B, E
2.H.03.12	Inspect, remove, and replace shock absorbers.	B, E

2.H.03.13	Inspect, remove, and replace self-leveling suspension components.	B, E, A
	<b>Performance Example:</b> Student will inspect suspension components for wear, replace and lubricate as necessary	
<b>2.H.04</b>	<b>Diagnose and repair wheel bearing failures and concerns.</b>	<b>SKILL LEVEL</b>
2.H.04.01	Diagnose wheel bearing noise, wheel shimmy and vibration concerns; determine necessary action.	B, E
2.H.04.02	Remove, clean, inspect, wheel bearings, seals, hub, and spindle; determine necessary action.	B, E, A
	<b>Performance Example:</b> Student will remove and install a sealed wheel bearing assembly.	
<b>2.I</b>	<b>Steering Systems</b>	
	<b>Hours of Instruction</b>	50
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	
<b>2.I.01</b>	<b>Identify and diagnose power steering concerns and perform necessary service.</b>	<b>SKILL LEVEL</b>
2.I.01.01	Identify power steering gear binding, uneven turning effort, looseness, hard steering, and fluid leakage.	B, E
2.I.01.02	Inspect power steering fluid levels and condition.	B, E
2.I.01.03	Flush, fill and bleed the power steering system.	B, E
2.I.01.04	Diagnose power steering fluid leakage; determine necessary action.	B, E
2.I.01.05	Remove, inspect, replace, and adjust the power steering pump belt.	B, E
2.I.01.06	Remove and reinstall the power steering pump.	B, E
2.I.01.07	Inspect and replace power steering hoses and fittings.	B, E
2.I.01.08	Identify and inspect electric power steering components.	E, A
	<b>Performance Example:</b> Student will inspect steering system to locate source of binding.	
<b>2.I.02</b>	<b>Identify and diagnose mechanical steering concerns and perform necessary service.</b>	<b>SKILL LEVEL</b>
2.I.02.01	Remove and replace manual or power steering gear; inspect mounting bushings and brackets.	B, E
2.I.02.02	Inspect and replace manual or power rack and pinion steering gear inner tie rod ends and bellows boot.	B, E
2.I.02.03	Inspect and replace pitman arm, center link/intermediate rod, idler arm, mountings, and steering linkage dampener.	B, E
2.I.02.04	Inspect, replace, and adjust the tie rod ends, tie rod sleeves and clamps on a linkage type steering system.	B, E
	<b>Performance Example:</b> Student will inspect steering system for wear and identify faulty component.	
<b>2.I.03</b>	<b>Identify and interpret steering column concerns and perform necessary service.</b>	<b>SKILL LEVEL</b>
2.I.03.01	Disable and enable supplemental restraint system (SRS).	E, A
2.I.03.02	Remove and replace the steering wheel; align supplemental restraint system (SRS) coil (clock spring).	E, A



2.I.02.03	Identify steering column noises, excessive play and binding concerns (including tilt mechanism).	B, E, A
	<b>Performance Example:</b> Student will disable and enable supplemental restraint system (SRS) according to manufacturer's specification.	
<b>2.J</b>	<b>Wheel Alignment</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Wheel alignment equipment capable of performing the following framework competencies.	
<b>2.J.01</b>	<b>Perform appropriate pre-alignment inspections.</b>	<b>SKILL LEVEL</b>
2.J.01.01	Differentiate between steering and suspension concerns using principles of steering geometry (caster, camber, toe, etc.).	B, E
2.J.01.02	Inspect vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer and steering return concerns.	B, E
	<b>Performance Example:</b> Student will perform a pre-alignment inspection using a check list from either the vehicle manufacturer or the equipment manufacturer.	
<b>2.J.02</b>	<b>Perform four- wheel alignment to manufacturer's specifications.</b>	<b>SKILL LEVEL</b>
2.J.02.01	Measure and adjust caster.	B, E
2.J.02.02	Measure and adjust front and rear wheel camber.	B, E
2.J.02.03	Measure and adjust front and rear wheel toe.	B, E
2.J.02.04	Check steering wheel centering.	B, E
2.J.02.05	Check and measure toe-out-on-turns (turning radius), determine necessary action.	B, E, A
2.J.02.06	Check and measure steering axis inclination (SAI) and included angle, determine necessary action.	B, E, A
2.J.02.07	Check and measure rear wheel thrust angle, determine necessary action.	B, E, A
2.J.02.08	Check and measure front wheel set back, determine necessary action.	B, E, A
2.J.02.09	Perform post alignment calibration procedures according to manufacturer's specifications.	B, E, A
	<b>Performance Example:</b> Student will attach alignment measuring equipment and measure caster, camber, and toe.	
<b>2.K</b>	<b>Automotive Basic Maintenance</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Equipment Needed: Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B), maintenance light reset equipment.	
<b>2.K.01</b>	<b>Perform appropriate basic maintenance service skills.</b>	<b>SKILL LEVEL</b>
2.K.01.01	Perform oil/filter change, reset maintenance reminder light where applicable.	B, E
2.K.01.02	Inspect all fluids and determine necessary action.	B, E

	2.K.01.03	Inspect air and cabin filters; determine necessary action.	B, E
	2.K.01.04	Replace a serviceable fuel filter.	B, E
	2.K.01.05	Inspect exhaust system and undercarriage; determine necessary action.	B, E
	2.K.01.06	Inspect transmission/transaxle, front and rear differential fluids; determine necessary action.	B, E
	2.K.01.07	Inspect automotive drive belts and cooling system hoses; determine necessary action.	B, E
	2.K.01.08	Lubricate suspension and steering systems per manufacturer's recommendations.	B, E
	<b>Performance Example:</b> Student will perform a multi-point inspection to include an oil and filter change, as well as an undercarriage inspection.		
<b>2.L</b>	<b>Heating, Ventilation and Air Conditioning (HVAC)</b>		
	<b>Hours of Instruction</b>		40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)		
<b>2.L.01</b>	<b>Describe and perform appropriate automotive refrigerant handling according to current industry standards.</b>		<b>SKILL LEVEL</b>
	2.L.01.01	Follow EPA regulations for refrigerant handling.	E, A
	2.L.01.02	Identify refrigerant.	E, A
	2.L.01.03	Recover, evacuate, and recharge refrigerant.	E, A
	2.L.01.04	Recycle, label and store refrigerant.	E, A
	<b>Performance Example:</b> Student will identify the refrigerant type in a vehicle using service information.		
<b>2.L.02</b>	<b>Describe HVAC operation and general repair.</b>		<b>SKILL LEVEL</b>
	2.L.02.01	Research applicable vehicle service information, vehicle service history, service precautions, and technical service bulletins.	B, E
	2.L.02.02	Follow EPA regulations for refrigerant handling.	B, E
	2.L.02.03	Identify heating, ventilation, and air conditioning (HVAC) components and configuration.	B, E
	2.L.02.04	Identify and interpret HVAC issues, determine necessary action.	B, E
	<b>Performance Example:</b> Conduct performance A/C system testing; identify problems.		
<b>2.M</b>	<b>Brake System Research and Service</b>		
	<b>Hours of Instruction</b>		40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Access to appropriate current service vehicle information		
<b>2.M.01</b>	<b>Research brake system concerns and vehicle information.</b>		<b>SKILL LEVEL</b>
	2.M.01.01	Identify and interpret brake system concern; determine necessary action.	B, E



2.M.01.02	Research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions and technical service bulletins.	B, E
2.M.01.03	Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	E, A
	<b>Performance Example:</b> Student uses automotive information system to research applicable brake-related technical service bulletins and report findings.	
<b>2.N</b>	<b>Hydraulic Brake Systems</b>	
	<b>Hours of Instruction</b>	40
	Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	
<b>2.N.01</b>	<b>Diagnose and identify pressure concerns in the brake system using hydraulic principles (Pascal's Law).</b>	<b>SKILL LEVEL</b>
2.N.01.01	Measure brake pedal height; determine necessary action.	B, E
2.N.01.02	Check master cylinder for internal and external leaks and proper operations; determine necessary action.	B, E
2.N.01.03	Remove, bench bleed, and reinstall master cylinder.	B, E
2.N.01.04	Identify poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action.	E, A
2.N.01.05	Inspect brake lines, flexible hoses and fittings for leaks, dents, kinks, rust cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.	B, E
	<b>Performance Example:</b> Student measures brake pedal height using a tape measure and compare the measurement to specifications.	
<b>2.N.02</b>	<b>Perform appropriate maintenance and repair of hydraulic brake systems</b>	<b>SKILL LEVEL</b>
2.N.02.01	Fabricate and/or install brake lines (double flare and ISO types); replace hoses, fittings and supports, as needed.	B, E, A
2.N.02.02	Identify, handle, store, and fill brake fluids to proper level.	B, E
2.N.02.03	Inspect, test and/or replace components of brake warning light system.	E, A
2.N.02.04	Bleed (Gravity, manual, pressure, vacuum) brake system.	B, E
2.N.02.05	Flush and fill hydraulic braking system.	B, E
	<b>Performance Example:</b> Student selects the DOT rated brake fluid for the vehicle being serviced according to the vehicle manufacturer's recommendations.	
<b>2.0</b>	<b>Drum Brake Systems</b>	
	<b>Hours of Instruction</b>	50
	<b>Equipment Needed</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	
<b>2.0.01</b>	<b>Remove and inspect brake drums; determine necessary action.</b>	<b>SKILL LEVEL</b>
2.0.01.01	Remove and inspect brake drums; determine necessary action.	B, E

2.0.01.02	Refinish brake drum.	B, E, A
	<b>Performance Example:</b> Student de-adjusts, removes, and installs a brake drum, re-adjust as necessary.	
<b>2.0.02</b>	<b>Remove and inspect brake shoes and drum brake components; determine necessary action.</b>	<b>SKILL LEVEL</b>
2.0.02.01	Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware and backing support plates; lubricate and reassemble.	B, E
2.0.02.02	Remove, inspect, and install wheel cylinders.	B, E
2.0.02.03	Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.	B, E
2.0.02.04	Install wheel, torque wheel fasteners, and make final checks and adjustments.	B, E
	<b>Performance Example:</b> Student removes and installs brake shoes.	
<b>2.P</b>	<b>Disc Brake Systems</b>	
	<b>Hours of Instruction</b>	75
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	
<b>2.P.01</b>	<b>Remove and inspect brake caliper assembly; determine necessary action.</b>	<b>SKILL LEVEL</b>
2.P.01.01	Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.	B, E
2.P.01.02	Clean and inspect caliper mounting, slides, and pins for wear and damage; determine necessary action.	B, E
2.P.01.03	Remove, clean and inspect pads and retaining hardware; measure brake pad thickness, compare to manufacturer's specifications, determine necessary action.	B, E
2.P.01.04	Retract caliper piston on vehicles equipped with an integrated parking brake system.	B, E
2.P.01.05	Reassemble, lubricate and reinstall caliper, pads and related hardware; seat pads and inspect for leaks.	B, E
2.P.01.06	Install wheel, torque wheel fasteners and make final checks and adjustments.	B, E
	<b>Performance Example:</b> Student removes the brake calipers and checks the caliper slides/pins for proper operation.	
<b>2.P.02</b>	<b>Remove and inspect brake rotors; determine necessary action.</b>	<b>SKILL LEVEL</b>
2.P.02.01	Inspect and measure rotor with a dial indicator and a micrometer and compare readings to manufacturer's specifications; determine necessary action.	B, E
2.P.02.02	Remove and refinish rotor according to manufacturer's recommendations.	B, E
2.P.02.03	Prep hub mating service and reinstall brake rotor.	B, E
	<b>Performance Example:</b>	

	Student removes the brake rotor and using a high precision measuring device measures the rotors brake surface in several locations comparing to factory specifications.	
<b>2.Q</b>	<b>Power Brake Systems</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	
<b>2.Q.01</b>	<b>Identify and describe the operation of a vacuum brake assist unit.</b>	<b>SKILL LEVEL</b>
2.Q.01.01	Test pedal free travel with and without engine running; check power assist operation.	B, E
2.Q.01.02	Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	B, E
2.Q.01.03	Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.	B, E
	<b>Performance Example:</b> Student will perform a test of the brake booster check valve and verify operation according to manufacturer's specifications.	
<b>2.Q.02</b>	<b>Identify and describe the operation of a brake hydraulic assist unit.</b>	<b>SKILL LEVEL</b>
2.Q.02.01	Test pedal free travel with and without engine running; check power assist operation.	B, E
2.Q.02.02	Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.	B, E
	<b>Performance Example:</b> Student will be able to identify hydraulic assist brake components.	
<b>2.R</b>	<b>Parking Brake Components and Systems</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	
<b>2.R.01</b>	<b>Diagnose and repair parking brake failures and concerns.</b>	<b>SKILL LEVEL</b>
2.R.01.01	Check parking brake operation; determine necessary action.	B, E
2.R.01.02	Check parking brake cables and components for wear, rusting, binding and corrosion; clean, lubricate or replace as needed.	B, E
	<b>Performance Example:</b> Student will apply and release parking brake and determine if cables are moving freely.	
<b>2.R.02</b>	<b>Diagnose and repair electrical brake circuit failures and concerns.</b>	<b>SKILL LEVEL</b>
2.R.02.01	Identify and check operation of parking brake indicator light system and perform repairs as needed.	B, E
2.R.02.02	Identify and check operation of electric parking brake system and perform repairs as needed.	B, E

<b>Performance Example:</b> Student will apply parking brake and check operation of brake warning lamp.	
<b>2.S</b>	<b>Antilock Brake System</b>
	<b>Hours of Instruction</b> 40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B), SCAN TOOL FOR AUTOMOTIVE PROGRAM, Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States., Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.
<b>2.S.01</b>	<b>Identify, inspect, and diagnose antilock brake system (ABS) components.</b>
2.S.01.01	Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment.
2.S.01.02	Diagnose and repair wheel speed sensors using scan tool.
	<b>Performance Example:</b> Student will use the appropriate scan tool to retrieve possible ABS trouble codes.
<b>2.S.02</b>	<b>Service antilock brake system high pressure hydraulic system to manufacturer`s specifications.</b>
2.S.02.01	Depressurize high-pressure components of the antilock brake systems (ABS).
2.S.02.02	Bleed the antilock brake system (ABS) front and rear hydraulic circuits.
	<b>Performance Example:</b> Student will bleed an ABS system according to the manufacturer's recommendation.
<b>2.T</b>	<b>General Electrical Systems</b>
	<b>Hours of Instruction</b> 60
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)
<b>2.T.01</b>	<b>Research and identify electrical system concern; determine necessary action.</b>
2.T.01.01	Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions and technical service bulletins.

2.T.01.02	Identify electrical integrity for series, parallel and series-parallel circuits using principles of electricity (Ohm's Law).	B, E, A
2.T.01.03	Use wiring diagrams during diagnosis of electrical circuit problems.	B, E, A
	<b>Performance Example:</b> Student will research and report applicable service information to obtain correct wiring diagram.	
<b>2.T.02</b>	<b>Research and identify electrical system concern; determine necessary action.</b>	<b>SKILL LEVEL</b>
2.T.02.01	Check electrical circuits with a test light; determine necessary action.	B, E, A
2.T.02.02	Measure source voltage and perform voltage drop tests in electrical circuits using the voltmeter scale on a digital multimeter (DMM); determine necessary action.	B, E, A
2.T.02.03	Measure current flow in electrical circuits and components using the ammeter scale on a DMM; determine necessary action.	B, E, A
2.T.02.04	Check continuity and measure resistance in electrical circuits and components using an ohmmeter scale on a DMM; determine necessary action.	B, E, A
2.T.02.05	Check electrical circuits using fused jumper wires; determine necessary action.	B, E, A
2.T.02.06	Locate shorts, grounds, opens and resistance problems in electrical; determine necessary action.	B, E, A
	<b>Performance Example:</b> Student will measure circuit source voltage using a DMM.	
<b>2.T.03</b>	<b>Repair common electrical circuits.</b>	<b>SKILL LEVEL</b>
2.T.03.01	Inspect and test fusible links, circuit breakers and fuses; wiring, harnesses, and connectors, determine necessary action.	B, E, A
2.T.03.02	Perform solder repair of electrical wiring.	B, E, A
2.T.03.03	Inspect and test switches, connectors, relays, devices and wires of electrical circuits; perform necessary action.	B, E, A
	<b>Performance Example:</b> Student will repair a wire choosing the appropriate solder type and wire gauge necessary for the repair.	
<b>2.U</b>	<b>Automotive Batteries</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) SCAN TOOL FOR AUTOMOTIVE PROGRAM, Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States., Capability of communicating with all vehicle systems (i.e. ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	

<b>2.U.01</b>	<b>Identify, maintain and service the various types of commonly used automotive batteries.</b>	<b>SKILL LEVEL</b>
2.U.01.01	Perform battery state-of-charge test; determine necessary action.	B, E
2.U.01.02	Measure and identify the possible cause(s) of excessive key-off battery drain (parasitic draw).	B, E
2.U.01.03	Maintain or restore electronic memory functions.	B, E
2.U.01.04	Inspect, clean, fill and repair/replace battery, battery cables, connectors, clamps and hold downs.	B, E
2.U.01.05	Identify battery type, perform applicable battery charge procedures.	B, E
2.U.01.06	Start a vehicle using jumper cables or auxiliary power supply.	B, E
	<b>Performance Example:</b> Student will determine cold cranking amps of battery and perform a battery load capacity test.	
<b>2.V</b>	<b>Automotive Starting System</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.V.01</b>	<b>Diagnose and repair starting systems.</b>	<b>SKILL LEVEL</b>
2.V.01.01	Perform starter current draw tests; determine necessary action.	B, E
2.V.01.02	Perform starter circuit voltage drop tests; determine necessary action.	B, E
2.V.01.03	Inspect and test starter relays and solenoids; determine necessary action.	B, E
2.V.01.04	Remove and install starter in a vehicle.	B, E, A
2.V.01.05	Inspect fly wheel and ring gear for wear and cracks.	B, E
2.V.01.06	Inspect and test switches, connectors and wires of starter control circuits; perform necessary action.	B, A
2.V.01.07	Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition.	B, E, A
2.V.01.08	Demonstrate knowledge of an automatic start-stop system.	B, E
	<b>Performance Example:</b> Student will test and replace starter in a vehicle.	
<b>2.W</b>	<b>Automotive Charging System</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B)	



	Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.W.01</b>	<b>Diagnose and repair charging systems.</b>	<b>SKILL LEVEL</b>
2.W.01.01	Perform charging system output test; determine necessary action.	B, E
2.W.01.02	Diagnose charging system for the cause of undercharge, no-charge and overcharge conditions.	B, E
2.W.01.03	Inspect, adjust, or replace generator (alternator) drive belts, pulleys and tensioners; check pulley and belt alignment.	B, E
2.W.01.04	Remove, inspect, and install generator (alternator).	B, E, A
2.W.01.05	Perform charging circuit voltage drop tests; determine necessary action.	B, E, A
	<b>Performance Example:</b> Student will perform various charging system tests to determine the cause of low alternator output.	
<b>2.X</b>	<b>Electrical Accessories</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.X.01</b>	<b>Diagnose and repair lighting systems.</b>	<b>SKILL LEVEL</b>
2.X.01.01	Inspect, replace, and aim headlights and bulbs.	B, E, A
2.X.01.02	Identify system voltage and safety precautions associated with high intensity discharge headlights.	B, E, A
2.X.01.03	Inspect, diagnose, and repair all exterior lamps (i.e., headlight, brake, turn, or signal, reverse, fogs, etc.); perform necessary action.	B, E
	<b>Performance Example:</b> Student will replace a faulty headlight bulb and check for proper headlight aim.	

<b>2.X.02</b>	<b>Diagnose and repair gauges, warning devices and driver information systems.</b>	<b>SKILL LEVEL</b>
2.X.02.01	Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.	B, E, A
2.X.02.02	Inspect and test sensors, connectors, and wires of electronic instrument circuits; determine necessary action.	B, E, A
	<b>Performance Example:</b> Student will test oil pressure gauge circuit and determine cause of failure.	
<b>2.X.03</b>	<b>Diagnose and repair horn and wiper/washer systems.</b>	<b>SKILL LEVEL</b>
2.X.03.01	Diagnose incorrect horn operation; perform necessary action.	B, E, A
2.X.03.02	Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.	B, E, A
2.X.03.03	Diagnose incorrect washer operation; perform necessary action.	B, E, A
	<b>Performance Example:</b> Student will replace horn assembly and recheck for proper operation.	
<b>2.X.04</b>	<b>Diagnose and repair accessories.</b>	<b>SKILL LEVEL</b>
2.X.04.01	Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.	B, E, A
2.X.04.02	Diagnose incorrect heated glass operation; determine necessary action.	B, E, A
2.X.04.03	Diagnose incorrect electric lock operation; determine necessary action.	B, E, A
2.X.04.04	Diagnose incorrect operation of cruise control systems; determine necessary action.	E, A
2.X.04.05	Activate bi-directional controls when applicable using a scan tool.	E, A
2.X.04.06	Describe the operation of keyless entry/remote-start systems.	B, E
	<b>Performance Example:</b> Student will remove and replace a window motor and confirm operation according to manufacturer's specifications.	
<b>2.Y</b>	<b>Basic Hybrid/Electric Vehicle (EV) Theory</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.Y.01</b>	<b>Identify and describe hybrid/EV electrical circuits.</b>	<b>SKILL LEVEL</b>



2.Y.01.01	Identify and describe high-voltage circuits of hybrid/EV vehicle and related safety precautions	B, E, A
2.Y.01.02	Identify and describe hybrid/EV vehicle auxiliary (12v) battery service, repair, and test procedures.	B, E, A
2.Y.01.03	Describe the operation of a regenerative braking system.	E, A
2.Y.01.04	Identify and describe hybrid/EV vehicle power steering system electrical circuits and safety precautions.	E, A
2.Y.01.05	Describe hybrid vehicle internal combustion engine service precautions.	B, E
	<b>Performance Example:</b> Student uses service information to determine the location of the (12v) battery.	E, A
<b>2.Z</b>	<b>General Engine Problems</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.Z.01</b>	<b>Identify, test and repair leaks, abnormal sounds and odors commonly associated with engine malfunctions.</b>	<b>SKILL LEVEL</b>
2.Z.01.01	Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	B, E
2.Z.01.02	Identify abnormal engine noise or vibration concerns; determine necessary action.	B, E
2.Z.01.03	Identify abnormal exhaust color, odor, and sound; determine necessary action.	B, E
2.Z.01.04	Perform oil pressure tests; determine necessary action.	B, E, A, A+
	<b>Performance Example:</b> Student will remove and replace a valve cover gasket to repair an engine oil leak.	
<b>2.Z.02</b>	<b>Perform general engine diagnostic procedures.</b>	<b>SKILL LEVEL</b>
2.Z.02.01	Interpret engine performance concern; determine necessary action.	E, A
2.Z.02.02	Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.	B, E
2.Z.02.03	Inspect and test mechanical and electrical fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action.	B, E
2.Z.02.04	Inspect the integrity and test the catalytic converter and heat shield(s); perform necessary action.	B, E

2.Z.02.05	Verify accurate camshaft timing.	B, E, A
2.Z.02.06	Perform cylinder power balance test; determine necessary action.	B, E
2.Z.02.07	Perform cylinder compression tests; determine necessary action.	B, E
2.Z.02.08	Perform cylinder leakage test; determine necessary action.	B, E
2.Z.02.09	Identify engine mechanical, electrical, fuel and ignition concerns with engine diagnostic equipment.	B, E, A
2.Z.02.10	Retrieve and record stored On Board Diagnostics II (OBD II) diagnostic trouble codes; clear codes.	B, E
<b>Performance Example:</b> Student will perform a fuel pressure test and determine necessary action.		
<b>2.Z.03</b>	<b>Inspect, diagnose, and repair cooling system concerns.</b>	<b>SKILL LEVEL</b>
2.Z.03.01	Verify engine operating temperature; determine necessary action.	B, E
2.Z.03.02	Remove and replace thermostat, radiator, and water pump.	B, E, A
2.Z.03.03	Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank and hoses; perform necessary action.	B, E
2.Z.03.04	Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams and fan control devices; perform necessary action.	B, E
2.Z.03.05	Identify causes of engine overheating.	B, E, A, A+
2.Z.03.06	Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.	E, A, A+
2.Z.03.07	Inspect and test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.	B, E, A, A+
<b>Performance Example:</b> Student will pressurize a cooling system to locate the source of a leak.		
<b>2.Z.04</b>	<b>Forced induction systems.</b>	<b>SKILL LEVEL</b>
2.Z.04.01	Research applicable vehicle service information, vehicle service history, service precautions, and technical service bulletins.	E, A
2.Z.04.02	Identify components and configuration of forced air induction system.	E, A
<b>Performance Example:</b> Verify proper operation of forced induction system.		
<b>2.AA</b>	<b>Ignition Systems</b>	
<b>Hours of Instruction</b>		<b>40</b>
<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems		

	(Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.AA.01</b>	<b>Diagnose and repair engine performance concerns relative to the ignition primary circuit.</b> <b>Hours of Instruction</b>	<b>SKILL LEVEL</b>
2.AA.01.01	Inspect and test ignition primary circuit wiring and components; perform necessary action.	B, E, A
2.AA.01.02	Inspect and test ignition system pick-up sensor or triggering devices; perform necessary action.	B, E, A
2.AA.01.03	Inspect, and test ignition coil(s); perform necessary action.	B, E
2.AA.01.04	Inspect, diagnose, and replace spark plugs).	B, E
2.AA.01.05	Identify ignition system related problems such as no-starting engine misfire, spark knock, power loss, concerns on vehicles with electronic ignition (i.e., distributor less and distributor) systems.	B, E, A
	<b>Performance Example:</b> Student will test for input voltage at ignition coil.	
<b>2.AA.02</b>	<b>Diagnose and repair engine performance concerns relative to the ignition secondary circuit.</b>	<b>SKILL LEVEL</b>
2.AA.02.01	Inspect and test ignition system secondary circuit wiring and components; perform necessary action.	B, E
	<b>Performance Example:</b> Student will use a spark tester to determine secondary voltage output.	
<b>2.BB</b>	<b>Emissions Control Systems</b>	
	<b>Hours of Instruction</b>	40
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.BB.01</b>	<b>Identify and diagnose common causes of positive crankcase ventilation and evaporative emissions system concerns.</b>	<b>SKILL LEVEL</b>
2.BB.01.01	Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.	B, E
2.BB.01.02	Diagnose test and repair components and hoses of evaporative emissions control system; perform necessary action.	B, E
	<b>Performance Example:</b> Student will perform a leak test on evaporative emission system.	
<b>2.BB.02</b>	<b>Identify and diagnose common causes of catalytic converter, secondary air and exhaust gas recirculation system concerns.</b>	<b>SKILL LEVEL</b>
2.BB.02.01	Inspect and test catalytic converter performance.	B, E, A

2.BB.02.02	Diagnose, test, and repair components of secondary air injection systems; perform necessary action.	B, E, A
2.BB.02.03	Identify emission and drivability problems caused by malfunctions in the exhaust gas recirculation (EGR) system.	B, E, A
2.BB.02.04	Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters, and hoses; perform necessary action.	B, E, A
<b>Performance Example:</b> Student will perform catalytic converter efficiency test.		
<b>2.BB.03</b>	<b>Drive Train.</b>	<b>SKILL LEVEL</b>
2.BB.03.01	Inspect, remove, and replace constant velocity (CV) axles	B, E
2.BB.03.02	Inspect, remove, or replace power train mounts.	B, E
2.BB.03.03	Diagnose universal joint noise and vibration concerns; perform necessary action.	B, E
2.BB.03.04	Inspect fly wheel and ring gear for wear and cracks.	B, E
2.BB.03.05	Inspect and lubricate shift linkage bushings.	B, E
2.BB.03.06	Clean and inspect differential housing vents.	B, E
<b>Performance Example:</b> Student will inspect for torn or damage CV boot.		
<b>2.CC</b>	<b>Demonstrate appropriate engine repair techniques. (A+)</b>	
	<b>Hours of Instruction</b>	25
<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.		
<b>2.CC.01</b>	<b>Perform appropriate cylinder head repair.</b>	<b>SKILL LEVEL</b>
2.CC.01.01	Diagnose, remove, and replace cylinder head(s).	A+
2.CC.01.02	Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition; determine necessary action.	A+
<b>2.CC.02</b>	<b>Demonstrate appropriate valve, valve train, and camshafts service techniques.</b>	<b>SKILL LEVEL</b>
2.CC.02.01	Identify overhead cam, dual overhead cam, and overhead valve engines.	A+
2.CC.02.02	Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action	A+

2.CC.02.03	Check drive gear wear and backlash, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and valve timing components; verify correct camshaft timing.	A+
2.CC.02.04	Inspect and replace camshaft and drive belt/chain.	A+
2.CC.02.05	Establish camshaft position sensor indexing.	A+
<b>2.CC.03</b>	<b>Identify, assess, and repair cylinder block and internal components.</b>	<b>SKILL LEVEL</b>
2.CC.03.01	Identify block cylinder arrangement.	A+
2.CC.03.02	Remove, inspect, or replace crankshaft vibration damper (harmonic balancer).	A+
2.CC.03.03	Measure crankshaft end play, compare to specification; determine necessary action.	A+
<b>2.CC.04</b>	<b>Engine Lubrication</b>	
2.CC.04.01	Inspect auxiliary coolers; determine necessary action.	A+
2.CC.04.02	Inspect, test, and replace oil temperature and pressure switches and sensors.	A+
<b>2.DD</b>	<b>Automatic Transmission/Transaxle (A+)</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B) Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e. ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.DD.01</b>	<b>Demonstrate appropriate vehicle service techniques. (A+)</b>	<b>SKILL LEVEL</b>
2.DD.01.01	Identify and interpret transmission/transaxle concern, differentiate between engine performance and transmission/transaxle concerns; determine necessary action.	A+
2.DD.01.02	Research applicable vehicle and service information fluid type, vehicle service history, service precautions, and technical service bulletins.	A+
2.DD.01.03	Diagnose fluid loss condition concerns; determine necessary action.	A+
2.DD.01.04	Check fluid level in a transmission or a transaxle not equipped with a dipstick.	A+
2.DD.01.05	Perform pressure tests (including transmissions/transaxles equipped with electronic pressure control); determine necessary action.	A+
2.DD.01.06	Diagnose noise and vibration concerns; determine necessary action	A+
2.DD.01.07	Perform stall test; determine necessary action.	A+
2.DD.01.08	Perform lock-up converter system tests; determine necessary action.	A+

2.DD.01.09	Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.	A+
2.DD.01.10	Diagnose electronic transmission/transaxle control systems using appropriate test.	A+
2.DD.01.11	Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).	A+
2.DD.01.12	Inspect, adjust, and replace external manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch.	A+
2.DD.01.13	Inspect for leakage; replace external seals, gaskets, and bushings.	A+
2.DD.01.14	Inspect, test, adjust, repair, or replace electrical/electronic components and circuits including computers, solenoids, sensors, relays, terminals, connectors, switches, and harnesses.	A+
<b>2.DD.02</b>	<b>Demonstrate appropriate out of vehicle service techniques.</b>	<b>SKILL LEVEL</b>
2.DD.02.01	Remove and reinstall transmissions/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces.	A+
2.DD.02.02	Inspect, leak test, and flush or replace transmission/transaxle oil cooler, lines, and fittings.	A+
2.DD.02.03	Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot.	A+
2.DD.02.04	Describe the operational characteristics of a continuously variable transmission (CVT).	A+
<b>2.EE</b>	<b>Manual Transmission and Drivetrain (A+)</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B).	
<b>2.EE.01</b>	<b>Demonstrate appropriate hub, joint, shaft, and yolk techniques.</b>	<b>SKILL LEVEL</b>
2.EE.01.01	Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action.	A+
2.EE.01.02	Diagnose universal joint noise and vibration concerns; perform necessary action.	A+
2.EE.01.03	Inspect, remove, and replace front wheel drive (FWD) bearings, hubs, and seals.	A+
2.EE.01.04	Inspect, service, and replace shafts, yokes, boots, and universal/CV joints.	A+
2.EE.01.05	Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles.	A+
<b>2.EE.02</b>	<b>Demonstrate appropriate differential repair and service techniques</b>	<b>SKILL LEVEL</b>
2.EE.02.01	Clean and inspect differential housing; check for leaks; inspect housing vent.	A+
2.EE.02.02	Diagnose noise and vibration concerns; determine necessary action.	A+



2.EE.02.03	Inspect and replace companion flange and pinion seal; measure companion flange run out.	A+
<b>2.FF</b>	<b>Drive Axles (A+)</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B). Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.FF.01</b>	<b>Perform appropriate axle shaft service techniques.</b>	<b>SKILL LEVEL</b>
2.FF.01.01	Remove and replace drive axle shafts	A+
2.FF.01.02	Inspect and replace drive axle shaft seals, bearings, and retainers.	A+
2.FF.01.03	Measure drive axle flange runout and shaft end play; determine necessary action.	A+
2.FF.01.04	Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action.	A+
<b>2.GG</b>	<b>Four Wheel Drive (A+)</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B). Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.GG.01</b>	<b>Inspect, adjust, and repair transfer cases and locking hubs.</b>	<b>SKILL LEVEL</b>
2.GG.01.01	Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.	A+
2.GG.01.02	Inspect locking hubs; perform necessary action(s).	A+
2.GG.01.03	Check for leaks at drive assembly seals; check vents; check lube level.	A+
2.GG.01.04	Identify concerns related to variations in tire circumference and/or final drive ratios.	A+

2.GG.01.05	Diagnose, test, adjust, and replace electrical/electronic components of four-wheel drive systems.	A+
<b>2.HH</b>	<b>Manual Transmissions/Transaxle and Clutch Assembly (A+)</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B). Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.HH.01</b>	<b>Assess and repair manual transmissions/transaxles.</b>	<b>SKILL LEVEL</b>
2.HH.01.01	Identify and interpret manual drive train concerns; determine necessary action.	A+
2.HH.01.02	Research applicable vehicle and service information, fluid type, vehicle service history, service precautions, and technical service bulletins.	A+
2.HH.01.03	Inspect, remove or replace manual transmission/transaxle.	A+
2.HH.01.04	Describe the operational characteristics of an electronically controlled manual transmission/transaxle.	A+
2.HH.01.05	Diagnose noise concerns through the application of transmission/transaxle power flow principles.	A+
2.HH.01.06	Diagnose hard shifting and jumping out of gear concerns; determine necessary action.	A+
2.HH.01.07	Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action.	A+
<b>2.HH.02</b>	<b>Inspect, diagnose, and repair clutch assembly.</b>	<b>SKILL LEVEL</b>
2.HH.02.01	Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action.	A+
2.HH.02.02	Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action.	A+
2.HH.02.03	Inspect and replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing and linkage, and pilot bearing/bushing.	A+
2.HH.02.04	Bleed clutch hydraulic system.	A+
2.HH.02.05	Check and adjust clutch master cylinder fluid level; check for leaks.	A+
2.HH.02.06	Measure flywheel run-out and crankshaft end play; determine necessary action.	A+
<b>2.II</b>	<b>Heating and Air Conditioning (A+)</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality	



	instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B). Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.II.01</b>	<b>Heating System.</b>	<b>SKILL LEVEL</b>
2.II.01.01	Inspect and test heater control valve(s); perform necessary action.	A+
2.II.01.02	Inspect heater blend door for proper operation.	A+
<b>2.II.02</b>	<b>Inspect, diagnose, and repair air conditioning systems.</b>	<b>SKILL LEVEL</b>
2.II.02.01	Identify abnormal operating noises in the A/C system; determine necessary action.	A+
2.II.02.02	Select and connect gauge set; record temperature and pressure readings according to current industry standards.	A+
2.II.02.03	Leak test A/C system; determine necessary action.	A+
2.II.02.04	Inspect condition of refrigerant oil removed from A/C system; determine necessary action.	A+
2.II.02.05	Identify the source of A/C system odors.	A+
<b>2.II.03</b>	<b>Inspect, diagnose, and repair heating and air conditioning controls.</b>	<b>SKILL LEVEL</b>
2.II.03.01	Inspect and test A/C-heater blower motors, resistors, switches, relays, wiring, and protection devices; perform necessary action.	A+
2.II.03.02	Diagnose A/C compressor clutch control systems; determine necessary action.	A+
2.II.03.03	Diagnose malfunctions in the vacuum, mechanical, and electrical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action.	A+
2.II.03.04	Inspect and test A/C-heater control panel assembly; determine necessary action.	A+
2.II.03.05	Inspect and test A/C-heater control cables, motors, and linkages; perform necessary action.	A+
2.II.03.06	Inspect A/C-heater ducts, doors, hoses, cabin filters, and outlets; perform necessary action.	A+
2.II.03.07	Diagnose temperature control problems in the heater/ventilation system; determine necessary action.	A+
2.II.03.08	Check operation of automatic or semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action.	A+
<b>2.JJ</b>	<b>Engine Performance (A+)</b>	
	<b>Hours of Instruction</b>	
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality	

	instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B). Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.JJ.01</b>	<b>Inspect, diagnose and repair performance issues with no Diagnostic Trouble Codes (DTC)</b>	<b>SKILL LEVEL</b>
2.JJ.01.01	Diagnose hot or cold no-starting, hard starting, poor drivability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles.	A+
2.JJ.01.02	Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.	A+
2.JJ.01.03	Perform exhaust system back-pressure test; determine necessary action.	A+
<b>2.JJ.02</b>	<b>Inspect, diagnose and repair performance issues with Diagnostic Trouble Codes (DTC)</b>	<b>SKILL LEVEL</b>
2.JJ.02.01	Check for module communication errors using a scan tool	A+
2.JJ.02.02	Obtain and interpret scan tool data., stalling, poor mileage, dieseling, and emissions problems on vehicles.	A+
2.JJ.02.03	Diagnose the causes of emissions or drivability concerns resulting from malfunctions in the computerized engine control system with stored diagnostic trouble codes.	A+
<b>2.KK</b>	<b>New/Emerging Technologies (A+)</b>	
	<b>Hours of Instruction</b>	25
	<b>Equipment Needed – (Must Meet Industry Standards)</b> Sufficient quantities of industry standard tools should be available for quality instruction. (i.e., ASE Educational Foundation Certification tools) (See Automotive Service Excellence Education Foundation Appendix B). Diagnostic scan tool capable of bi-directional interfacing and programmable capabilities on CAN and ISO communication networks with all makes and models sold in the United States. Capability of communicating with all vehicle systems (i.e., ABS/TC (antilock brake/traction control, ECM (engine control module), TCM (transmission control module), BCM (body control module), RDCM (rear differential control module), TCCM (Transfer Case Control Module), CCM (Climate Control Module), Entertainment systems (Audio, Bluetooth, etc.), SODM (side object detection module, lane departure) other unstated vehicle specific systems.	
<b>2.KK.01</b>	<b>Identify driver assist technology systems. (A+)</b>	<b>SKILL LEVEL</b>
2.KK.01.01	Identify and describe autonomous systems.	A+
2.KK.01.02	Identify and describe adaptive cruise control.	A+

2.KK.01.03	Identify and describe lane departure systems.	A+
2.KK.01.04	Identify and describe blind spot monitoring systems.	A+
2.KK.01.05	Identify and describe autonomous braking system.	A+
2.KK.01.06	Identify and describe parking aid systems.	A+
2.KK.01.07	Identify and describe adaptive lighting systems.	A+
2.KK.01.08	Identify and describe in-vehicle Wi-Fi systems.	A+

## **Strand 3: Embedded Academics**

### **Embedded Academics Grades 9 –14 for Chapter 74 Vocational Technical Education Programs**

Due to the thoughtful planning that went into the revisions of the English Language Arts & Literacy (2017), Mathematics (2017), Science and Technology Engineering (2016), and Digital Literacy Frameworks (2016), the current Vocational Technical Education Frameworks can move forward with a new level of embedded academics that are more content focused and more meaningful to students as they attain transferrable skills. Core content area experts carefully developed the literacy standards and academic practices in the aforementioned Massachusetts Frameworks documents which are highlighted. The Standards for Literacy in Content Areas, the Standards for Mathematical Practice, the High School Science & Engineering Practices, and the Digital Literacy & Computer Science Practices complement but do not take the place of the grade-level or course-level content standards in any of the discipline-specific Vocational Technical Education Frameworks.

Mathematics, science, technology, reading, writing, speaking, and listening skills and standards focus on understanding and practicing discipline-specific literacy, math, STE, and communication skills, using resources and characteristics of specific Vocational Technical Education programs. The philosophy of the embedded academics is not to have vocational teachers become traditional content teachers of English, science, and mathematics but is intended to reinforce the concept that it is the responsibility of all teachers to embed rich academic experiences in Vocational Technical Education. This will ensure that students recognize the transferrable skills that are essential for success in 21st century careers and in college. In rigorous Vocational Technical Education, students have hands-on and real-world experiences which develop relevant connections both from academic areas to Vocational Technical areas and vice versa.

The performance examples included in Strand Three are models developed using the portrait from the English Language Arts & Literacy (2017) of Students Who Are Ready for College, Careers, and Civic Participation. The examples illustrate how individual vocational teachers may use academic practices and literacy standards from the Massachusetts Frameworks listed above to seamlessly embed and explicitly teach relevant academics through Vocational Technical Education.

Vocational Technical Education of the past and of the 21st century naturally embed the elements of the portrait of Students Who are Ready for College, Careers, and Civic Participation through the hands-on and real-world experiences that students engage in throughout their tenure as Vocational Technical students. The following guidelines and practices that are collated in this document for easy reference are directly from the English Language Arts & Literacy (2017), Mathematics (2017), Science & Technology Engineering (2016), and Digital Literacy Frameworks (2016).

## Automotive Performance Task 1

Students acting in the role of an automotive technicians will generate estimates after performing brake inspections and determining what will be needed to complete a front disc brake job. Each technician will need to identify which tools to use, to decide if the present parts are within manufacturer specifications to reuse, to select which parts to order, and to create a written estimate. In order to create the estimate, the technician will use online service information for relevant technical terms, such as runout, rotor thickness, lining thickness, caliper slide condition, and hydraulic system parts and components. The project consists of measuring the components, comparing those measurements to manufacturer specifications, and determining if the components need to be replaced. After creating the estimate, each technician will communicate the estimate to the customer both verbally and in writing before disassembling the brake system and reassembling with new components. Upon completion of the project, the technician will create a detailed invoice for the customer. The technician will also communicate to the customer what steps s/he should take to maintain the life of the brakes as well as break-in procedures both verbally and in writing for future reference. Through the duration of the project, technician should follow all necessary safety guidelines including required PPE.

### Embedded Math:

- [SMP.1] Make sense of problems and persevere in solving them.
- [SMP.5] Use appropriate tools strategically.
- [SMP.6] Attend to precision.

### Embedded Science & Engineering:

- [SEP.1] Asking questions (for science) & defining problems (for engineering).
- [SEP.3] Planning and carrying out investigations.
- [SEP.4] Analyzing and interpreting data.
- [SEP.8] Obtaining, evaluating, and communicating information.

### Embedded Reading in Science & Technical Subjects:

- [RCA-ST.11-12.4] Determine the meaning of general academic vocabulary as well as symbols, notation, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to auto collision texts and topics.
- [RCA-ST.11-12.8] Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- [RCA-ST.11-12.9] Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- [RCA-ST.11-12.10] Independently and proficiently read and comprehend science/technical texts exhibiting complexity appropriate for the grade/course.

### Embedded Writing in Content Areas:

- [WCA.11-12.2a] Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include text features (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- [WCA.11-12.2d] Use precise language, domain-specific vocabulary and techniques to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.

- [WCA.11-12.2e] Establish and maintain a style appropriate to audience and purpose (e.g., formal for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
- [WCA.11-12.4] Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

**Embedded Digital Literacy:**

- [DLCS.4] Analyzing
- [DLCS.7] Researching

**Embedded Speaking & Listening in Content Areas:**

- [SLCA.11-12.4] Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, vocabulary, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

**Career & Technical Standards:**

- [2.D.02.01] Identify and demonstrate the use of an outside and inside micrometer.
- [2.D.02.03] Identify and demonstrate the use of a dial indicator.
- [2.M.01.01] Identify and interpret brake system concern; determine necessary action.
- [2.M.01.02] Research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions and technical service bulletins
- [2.P.01.01] Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.
- [2.P.01.02] Clean and inspect caliper mounting, slides, and pins for wear and damage; determine necessary action.
- [2.P.01.03] Remove, clean and inspect pads and retaining hardware; measure brake pad thickness, compare to manufacturer's specifications, determine necessary action.
- [2.P.01.05] Reassemble, lubricate, and reinstall caliper, pads and related hardware; seat pads and inspect for leaks.
- [2.P.01.06] Install wheel, torque wheel fasteners and make final checks and adjustments.
- [2.P.02.01] Inspect and measure rotor with a dial indicator and a micrometer and compare readings to manufacturer's specifications; determine necessary action.
- [2.P.02.03] Prep hub mating service and reinstall brake rotor.

## Automotive Performance Task 2

Students will act in the role of automotive technicians working for a local repair facility. Individually, each technician will perform an evacuation procedure, including identifying refrigeration type on an automotive air conditioning system. The technician will follow procedures from an online service information adhering to EPA guidelines. Tasks includes using proper manifold gauge procedures, manipulating service valves, completing an evacuation process, and converting a range of measurements into relevant data. The technician will establish and maintain safety procedures while recharging the refrigeration system. The final elements of the project are for the technician to explain the flow of refrigerant to the customer (instructor) and share written documentation of the flow and the systematic plan for perform an AC system performance check including all safety precautions before actually performing an AC system performance check. The technician should demonstrate mastery of all necessary safety procedures and requirements including required PPE.

### Embedded Academics Math:

- [SMP.1] Make sense of problems and persevere in solving them.
- [SMP.4] Model with mathematics.
- [SMP.5] Use appropriate tools strategically.
- [SMP.6] Attend to precision.

### Embedded Science & Engineering:

- [SEP.1] Asking questions (for science) & defining problems (for engineering).
- [SEP.3] Planning and carrying out investigations.
- [SEP.4] Analyzing and interpreting data.
- [SEP.8] Obtaining, evaluating, and communicating information.

### Embedded Academics Reading in Science & Technical Subjects:

- [RCA-ST.11-12.3] Follow precisely a complex multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- [RCA-ST.11-12.4] Determine the meaning of general academic vocabulary as well as symbols, notation, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to auto collision texts and topics.
- [RCA-ST.11-12.9] Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

### Embedded Academics Writing in Content Areas:

- [WCA.11-12.2d] Use precise language, domain-specific vocabulary and techniques to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- [WCA.11-12.2e] Establish and maintain a style appropriate to audience and purpose (e.g., formal for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
- [WCA.11-12.4] Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- [WCA.11-12.9] Draw evidence from informational texts to support analysis, interpretation, reflection, and research. (See grades 11–12 Reading Standard 1 for more on the use of textual evidence.)

**Embedded Academics Digital Literacy:**

[DLCS.4] Analyzing

[DLCS.7] Researching

**Embedded Academics Speaking & Listening in Content Areas:**

[SLCA.11-12.4] Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, vocabulary, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

**Career & Technical Standards:**

[2.A.02.01] Describe and demonstrate the importance of safety procedures to be used when servicing high pressurized systems (fuel systems, brakes, air conditioning, suspension, hydraulic systems, etc.).

[2.L.01.01] Follow EPA regulations for refrigerant handling.

[2.L.01.02] Identify refrigerant.

[2.L.01.03] Recover, evacuate and recharge refrigerant.

[2.L.01.04] Recycle, label and store refrigerant.

[2.L.02.01] Research applicable vehicle service information, vehicle service history, service precautions, and technical service bulletins.

[2.L.02.02] Follow EPA regulations for refrigerant handling.

[2.L.02.03] Identify heating, ventilation, and air conditioning (HVAC) components and configuration.

[2.L.02.04] Identify and interpret HVAC issues, determine necessary action.



## Automotive Performance Task 3:

Student acting in the role as an automotive technician will perform a wheel alignment check to identify the cause of poor tire wear and pulling using an industry standard four-wheel alignment machine. The automotive technician will research the alignment angles that affect tire wear and pulling. The automotive technician will measure all the relevant angles to determine which one is out of specification. The technician will perform physical adjustments to return the vehicle to manufacturer's specifications. The technician will perform post alignment procedures according to the manufacturer's specifications. The technician will develop a written repair plan that includes sequential repair procedures to return the vehicle to factory specifications. The technician will document the repair plan in writing and communicate/share the repair plan with the customer (instructor and/or other students) before performing the wheel alignment.

### Embedded Academics Math:

- [SMP.1] Make sense of problems and persevere in solving them.
- [SMP.2] Reason abstractly and quantitatively.
- [SMP.5] Use appropriate tools strategically.
- [SMP.6] Attend to precision.

### Embedded Science & Engineering:

- [SEP.1] Asking questions (for science) & defining problems (for engineering).
- [SEP.3] Planning and carrying out investigations.
- [SEP.4] Analyzing and interpreting data.
- [SEP.6] Constructing explanations and designing solutions.
- [SEP.8] Obtaining, evaluating, and communicating information.

### Embedded Academics Reading in Science & Technical Subjects:

- [RCA-ST.11-12.4] Determine the meaning of general academic vocabulary as well as symbols, notation, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
- [RCA-ST.11-12.7] Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.
- [RCA-ST.11-12.9] Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

### Embedded Academics Writing in Content Areas:

- [WCA.11-12.4] Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

### Embedded Academics Digital Literacy:

- [DLCS.4] Analyzing
- [DLCS.5] Communicating
- [DLCS.7] Researching

### Embedded Academics Speaking & Listening in Content Areas:

- [SLCA.11-12.2] Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
- [SLCA.11-12.6] Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

**Career & Technical Standards:**

- [2.J.01.01] Differentiate between steering and suspension concerns using principles of steering geometry (caster, camber, toe, etc.).
- [2.J.01.02] Inspect vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer and steering return concerns.
- [2.J.02.01] Measure and adjust caster.
- [2.J.02.02] Measure and adjust front and rear wheel camber.
- [2.J.02.03] Measure and adjust front and rear wheel toe.
- [2.J.02.04] Check steering wheel centering.
- [2.J.02.05] Check and measure toe-out-on-turns (turning radius), determine necessary action.
- [2.J.02.06] Check and measure steering axis inclination (SAI) and included angle, determine necessary action.
- [2.J.02.07] Check and measure rear wheel thrust angle, determine necessary action.
- [2.J.02.08] Check and measure front wheel set back, determine necessary action.
- [2.J.02.09] Perform post alignment calibration procedures according to manufacturer's specifications.

## Appendices

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***Disclaimer: Reference in the Appendices Section to any specific commercial products, processes, or services, or the use of any trade, firm or corporation name is for the information and convenience of the public and does not constitute endorsement or recommendation by the Massachusetts Department of Elementary and Secondary Education or the Massachusetts Association of Vocational Administrators.***

## **Appendix A**

### **Industry Recognized Credentials (IRCs)**

An **Industry Recognized Credential** is verification of an individual's qualification or competence. An authoritative third party issues the credential. **IRCs** are valued in the labor market and are a validation of an individual's knowledge and skill.

Industry-recognized credentials are accepted by multiple employers across an industry. They are often endorsed by recognized trade associations or organizations representing a significant part of an industry or sector.

IRCs are identified as either “**Essential**” or “**Optional**”.

**Essential IRCs** indicate credentials that are in high demand by employers.

School districts that offer VTE programs with “**Essential**” IRCs must ensure that adequate time and resources are available for students to be instructed in the standards necessary to be prepared for the certification examination, as well as, provide opportunities for students to obtain these certifications.

**Optional IRCs** provide credentials that enhance employment opportunities.

	<b>Essential</b>	<b>Optional</b>	<b>Hours of Instruction needed to attain this Credential</b>
OSHA General Industry – 10 Hours (OSHA G10)	X		10
SP/2 Safety Certification	X		10
ASE certification in Suspension and Steering		X	
ASE certification in Brakes		X	
ASE certification in Electrical/Electronic Systems		X	
ASE certification in Engine Performance		X	
ASE certification in Manual Drive Train and Axles		X	
ASE certification in Engine Repair		X	
ASE certification in Heating and Air Conditioning		X	
ASE certification in Maintenance and Light Repair		X	
ASE certification in Automobile Service Technology		X	
ASE certification in Automatic Transmission/Transaxle		X	
ASE Refrigerant Certification		X	
American Lift Institute Certification		X	
SNAP ON DVOM Certification		X	

## **Appendix B**



**Education Foundation**

### **ASE Education Foundation - Tools and Equipment - Weblink**

#### **HAND TOOLS**

(Contained in individual sets or the tool crib in sufficient quantities to permit efficient instruction)

Air Blow Gun (meeting OSHA requirements)  
Allen (Wrench or Socket) Set - Standard (.050" - 3/8")  
Allen (Wrench or Socket) Set - Metric (2mm - 8mm, 10mm, 12mm)  
Battery Post Cleaner  
Battery Terminal Pliers  
Battery Terminal Puller  
Chisels:  
Cape 5/16"  
Cold 3/8", 3/4"  
Chisel Holder  
Claw Type Pickup Tool  
Combination Wrenches:  
Standard (1/4" - 1 1/4") (optional)  
Metric (7mm - 24mm)  
Crowfoot Wrench Set - Metric  
Crowfoot Wrench Set - Standard (optional)  
Ear Protection  
Feeler Gauge (Blade Type):  
.002" - .040"  
.006mm - .070mm  
Files:  
Coarse 6" and 12"  
Fine 6" and 12"  
Half Round 12"  
Round 6" and 12"  
Flare Nut (tubing) Wrenches:  
3/8" - 3/4"  
10mm - 17mm  
Flashlight  
Fuse Puller  
Fused Jumper Wire Set (with various adapters)  
Hack Saw  
Hammers:  
16 oz. Ball Peen  
Brass  
Dead Blow Plastic Mallet  
Plastic Tip  
Rubber Mallet

Inspection Mirror  
 Magnetic Pickup Tool  
 Pliers:  
 Combination 6"  
 Hose Clamp  
 Locking Jaw  
 Needle Nose 6"  
 Side Cutting  
 Slip Joint (Water Pump)  
 Pry Bars:  
 Rolling Head  
 Straight  
 Punches:  
 Center  
 Brass Drift  
 Pin 1/8", 3/16", 1/4", 5/16 "  
 Taper 3/8", 1/2", 5/8"  
 Safety Glasses (meeting OSHA requirements)  
 Scraper:  
 Plastic  
 Gasket 1"  
 Screwdriver - Blade Type:  
 Stubby  
 6", 9", 12"  
 Offset  
 Screwdriver - Phillips:  
 Stubby #1, #2  
 6" #1, #2  
 12" #3  
 Offset #2  
 Screwdriver - Impact Driver Set  
 Socket Set - 1/4" Drive:  
 1/4" - 1/2" Standard Depth (optional)  
 1/4" - 1/2" Deep (optional)  
 6mm - 12mm Standard Depth  
 6mm - 12mm Deep  
 Flex/Universal Type  
 3", 6" Extensions  
 Ratchet  
 Socket Set - 3/8" Drive:  
 5/16" - 3/4" Standard Depth (6 point)(optional)  
 3/8" - 3/4" Deep (6 point)(optional)  
 10mm - 19mm Standard Depth  
 10mm - 19mm Deep  
 3", 5", 10" Extensions  
 Flexhead Ratchet  
 Ratchet  
 Spark Plug Sockets 5/8", 13/16", 9/16"3  
 Spark Plug Sockets 14mm  
 Speed Handle

Universal Joint  
Flexible Socket Set 3/8" - 3/4" (optional)  
Flexible Socket Set 10mm - 19mm  
Socket Set - 1/2" Drive:  
7/16" - 1 1/8" Standard Depth (optional)  
7/16" - 1 1/8" Deep (optional)  
10mm - 24mm Standard Depth  
10mm - 24mm Deep  
3", 6", 12" Extensions  
Flex Handle (Breaker Bar)  
Ratchet  
Spark Plug Feeler Gauge (Gap Tool)  
Tape Measure – Standard and Metric  
Test Light (12V and self-powered)  
Tire Pressure Gauge  
Tire Tread Depth Gauge  
Torque Wrench:  
3/8" Drive (10 - 250 lb. in.)  
3/8" Drive (5 - 75 lb. ft.)  
1/2" Drive (50 - 250 lb. ft.)  
Torx® Set (screwdrivers and/or sockets):  
T-8 to T-60  
Wire Brush

### **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 of these general tools and equipment readily available and in sufficient quantity to provide quality instruction.

Air Chisel Set (various bits)  
Air Compressor and Hoses  
Air Pressure Regulator  
Air Ratchet (3/8" drive)  
Automotive Stethoscope (electronic recommended)  
Axle Stands (Jack Stands)  
Axle Support Stands (Screw Jacks)  
Battery Charger  
Battery/Starter/Charging System Tester  
Bearing Packer (hand operated)  
Belt Tension Gauge  
Bench or Pedestal Grinder  
Coolant/Combustion Gas Detector (recommended)  
Coolant Tester  
Cooling System Pressure Tester and Adapters  
Creeper  
Cylinder Leakage Tester  
Dial Indicator with Flex Arm and Clamp Base  
Digital Multimeter (DMM) with various lead sets (sufficient quantities to meet instruction goals)  
Drain Pans



Drill - 3/8" variable speed, reversible  
 Drill - 1/2" variable speed, reversible  
 Electric Heat Gun  
 Engine Coolant Recovery Equipment or Recycler or Coolant Disposal Contract Service  
 Extension Cords  
 Face Shields  
 Fender Covers  
 Floor Jack (1½ Ton Minimum)  
 Hand-held Vacuum Pump  
 Hoist(s)  
 Hood Prop  
 Hydraulic Press with adapters  
 Impact Socket Sets - 3/8" Drive (Standard - optional)  
 Impact Socket Set - 3/8" Drive(8mm-19mm)  
 Impact Sockets - 1/2" Drive (7/16" - 1 1/8")(optional)  
 Impact Sockets - 1/2" Drive (12mm – 24mm)  
 Impact Sockets – 1/2" Drive Deep (30 mm, 32 mm, 36mm)5  
 Impact Wrench - 1/2" Drive  
 Impact Wrench - 3/8" Drive  
 Jumper Cables  
 Master Puller Set  
 Micrometer (Depth)  
 Micrometers - (Outside Type) 0-1", 1-2", 2-3", 3-4", 4-5"  
 Oil Can - Pump Type  
 Oil Filter Wrench and Sockets  
 Oxy-Acetylene Torch Set  
 Parts Cleaning Tank and Gloves (non-solvent based cleanser suggested)  
 Remote Starter Switch  
 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  
 Snap Ring Pliers Set - external  
 Snap Ring Pliers Set - internal  
 Soldering Gun  
 Soldering Iron (Pencil Tip)  
 Spark Plug Boot Puller  
 Tap and Die Set - Standard (optional)  
 Tap and Die Set – Metric  
 Temperature Sensing Device  
 Thread Repair Insert Kit  
 Tire Inflator Chuck  
 Trouble/Work Lights (Non-incandescent)  
 Tube Quick Disconnect Tool Set  
 Tubing Bender  
 Tubing Cutter/Flaring Set (Double-lap and ISO)  
 Twist Drill Set Ultra Violet Leak Detection Device (Black Light)  
 Used Oil Receptacle with extension neck and funnel  
 Valve Core Removing Tool

Calipers  
0 - 6"  
0 - 125mm  
Wheel Chocks  
Workbenches with vises<sup>6</sup>

## **SPECIALTY TOOLS AND EQUIPMENT WITHIN EACH ACCREDITATION CATEGORY**

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.

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.

### **MAINTENANCE & LIGHT REPAIR SUSPENSION & STEERING**

Brake Pedal Depressor  
Hand Grease Gun  
Shock Absorber Tools  
Spring Compressor Tool  
Tire Mounting Machine (rim clamp type)  
Tire Pressure Monitoring System Tool (TPMS) as appropriate  
Tire Patching Tools and Supplies  
Wheel Balancer - Electronic Type  
Wheel Weight Pliers

### **BRAKES**

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 Kit  
Brake Lathe (bench with disc and drum service attachments)  
Brake Lathe (on car)  
Brake Shoe Adjusting Gauge  
Brake Spring Remover/Installer  
Brake Spring Pliers  
Brake Spoon  
Piston Retraction Set  
Wheel Stud Service Kit<sup>7</sup>

### **ENGINE PERFORMANCE**

Compression Tester  
Cylinder Power Balance Tester (scan tool/manual method)  
Infrared Thermometer (or appropriate substitute)  
Vacuum/Pressure Gauge

### **ELECTRICAL/ELECTRONIC SYSTEMS**

Connector Pick Tool Set  
Door Panel Trim Tool(s)

Headlight Aimer or Screen  
Heat Gun (or equivalent for heat shrinking operations)  
Wire and Terminal Repair Kit

### **MANUAL DRIVE TRAIN AND AXLES**

Axle Nut Socket Set (or equivalent)  
Spindle Rethreader Die Set  
Universal Joint Tools

### **ENGINE REPAIR**

Antifreeze/Coolant Tester

### **SPECIALTY TOOLS AND EQUIPMENT**

#### **AUTOMOBILE SERVICE TECHNOLOGY**

#### **SUSPENSION & STEERING**

Ball Joint Press and other Special Tools  
Brake Pedal Depressor  
Bushing Driver Set  
Coil Spring Compressor Tool  
Chassis Ear (recommended)  
Frame Angle Gauge or Portable Digital Protractor (appropriate for tasks being taught)  
Hand Grease Gun  
Inner Tie Rod End Tool  
Pitman Arm Puller  
Power Steering Pump Pulley Special Tool Set (appropriate for tasks being taught)  
Shock Absorber Tools  
Steering Angle Gauge or Portable Digital Protractor (appropriate for tasks being taught)  
Steering Column Special Tool Set (appropriate for teaching tasks being utilized)  
Strut Spring Compressor Tool  
Tie Rod Puller  
Tire Mounting Machine  
Tire Patching Tools and Supplies  
Tire Pressure Monitoring System (TPMS) Tool (appropriate for tasks being taught)  
Wheel Alignment Equipment-4 wheel (including alignment tools)  
Wheel Balancer - Electronic Type  
Wheel Weight Pliers

#### **BRAKES**

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 Kit  
Brake Lathe (bench with disc and drum service attachments)  
Brake Lathe (on car)  
Brake Shoe Adjusting Gauge  
Brake Spring Remover/Installer  
Brake Spring Pliers  
Brake Spoon  
Master Cylinder Bleeder Kit

Caliper Piston Retraction Set  
Wheel Stud Service Kit<sup>9</sup>

### **HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)**

A/C Compressor Clutch Service Tools  
A/C Service Port Adapter Set  
Dye Injection Kit  
Hygrometer  
A/C Leak Detector (to meet current industry standard)  
A/C Manifold Gauge Set or equivalent (to meet current industry standard)  
A/C Refrigerant Recovery/Recycling/Recharging Station (to meet current industry standard)  
Thermometer(s) (digital)  
A/C Sealant Detector Kit

### **ENGINE PERFORMANCE**

Cylinder Power Balance Tester (Scan Tool/Manual Method)  
Evaporative Emissions Control System (EVAP) Leak Detector (Smoke or Nitrogen)  
Fuel Injection Pressure Gauge Sets with Adapters  
Infrared Thermometer (or appropriate substitute)  
Injector Pulse Tester  
Logic Probe (suggested)  
Oxygen Sensor Socket  
Pinch-off Pliers  
Sending Unit Socket(s)  
Spark Plug Thread Tap  
Spark Tester  
Vacuum/Pressure Gauge

### **AUTOMATIC TRANSMISSION/TRANSAXLE**

Transmission Jack(s)  
Transmission/Transaxle Flushing Equipment (recommended)  
Transmission/Transaxle Holding Fixtures  
Transmission/Transaxle Removal and Installation Equipment  
Transmission/Transaxle Special Tool Sets (appropriate for units being utilized)

### **ELECTRICAL/ELECTRONIC SYSTEMS**

Connector Pick Tool Set  
Molding and Trim 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<sup>10</sup>

### **MANUAL DRIVE TRAIN AND AXLES**

Axle Nut Socket Set (or equivalent)  
Clutch Alignment Set  
Clutch Pilot Bearing/Bushing Puller/Installer  
Constant Velocity Joint (CV) Service Tools:  
Boot Installation Tool

Boot Clamp Pliers or Crimping Ring  
Engine Support Fixture  
Rotating Torque Wrench (beam-type or equivalent)  
Universal Joint Tools  
Spindle Rethreader Die Set

### **ENGINE REPAIR**

Antifreeze/Coolant Tester  
Oil Pressure Gauge  
Straight Edge  
Torque Angle Gauge11

## **SPECIALTY TOOLS AND EQUIPMENT MASTER AUTOMOBILE SERVICE TECHNOLOGY**

### **SUSPENSION & STEERING**

Ball Joint Press and other Special Tools  
Brake Pedal Depressor  
Bushing Driver Set  
Coil Spring Compressor Tool  
Chassis Ear (recommended)  
Frame Angle Gauge or Portable Digital Protractor (appropriate for tasks being taught)  
Hand Grease Gun  
Inner Tie Rod End Tool  
Pitman Arm Puller  
Power Steering Pump Pulley Special Tool Set (appropriate for units being taught)  
Power Steering Pressure Gauges (recommended)  
Shock Absorber Tools  
Strut Spring Compressor Tool  
Steering Angle Gauge or Portable Digital Protractor (appropriate for tasks being taught)  
Steering Column Special Tool Set (appropriate for teaching units being utilized)  
Tie Rod Puller  
Tire Mounting Machine  
Tire Patching Tools and Supplies  
Tire Pressure Monitoring System (TPMS) Tool (appropriate for tasks being taught)  
Wheel Alignment Equipment-4 wheel (including alignment tools)  
Wheel Balancer - Electronic Type  
Wheel Weight Pliers

### **BRAKES**

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 Kit  
Brake Lathe (bench with disc and drum service attachments)  
Brake Lathe (on car)  
Brake Shoe Adjusting Gauge  
Brake Spring Remover/Installer  
Brake Spring Pliers  
Brake Spoon  
Master Cylinder Bleeder Kit

Caliper Piston Retraction Set  
Wheel Stud Service Kit<sup>12</sup>

### **HEATING AND AIR CONDITIONING**

A/C Compressor Clutch Service Tools  
A/C Service Port Adapter Set  
Dye Injection Kit  
Hygrometer  
A/C Leak Detector (to meet current industry standards)  
A/C Manifold Gauge Set or equivalent (to meet current industry standards)  
A/C Refrigerant Identification Equipment  
Refrigerant Recovery/Recycling/Recharging Station (to meet current industry standards)  
Thermometer(s) (digital)  
Sealant Detector Kit

### **ENGINE PERFORMANCE**

Cylinder Power Balance Tester  
Evaporative Emissions Control System (EVAP) Leak Detector (Smoke or Nitrogen)  
Four or Five Gas Exhaust Analyzer (Five Gas recommended)  
Fuel Injection Pressure Gauge Sets with Adapters  
\* Graphing Multimeter (GMM) and/or Digital Storage Oscilloscope (DSO)  
Infrared Thermometer (or appropriate substitute)  
Injector Pulse Tester  
Logic Probe (appropriate for tasks being taught)  
Oxygen Sensor Socket  
Pinch-off Pliers  
Sending Unit Socket(s)  
Spark Plug Thread Tap  
Spark Tester  
Vacuum/Pressure Gauge  
\* Also necessary to accomplish tasks in other MAST categories (Brakes and Electrical/Electronic Systems)

### **AUTOMATIC TRANSMISSION/TRANSAXLE**

Differential Set-up Tools  
Hydraulic Pressure Gauge Set  
Transmission Jack(s)  
Transmission/Transaxle Flushing Equipment (recommended)  
Transmission/Transaxle Removal and Installation Equipment  
Transmission/Transaxle Holding Fixtures  
Transmission/Transaxle Special Tool Sets (appropriate for units being utilized)

### **ELECTRICAL/ELECTRONIC SYSTEMS**

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

**MANUAL DRIVE TRAIN AND AXLES**

Axle Nut Socket Set (or equivalent)  
Clutch Alignment Set  
Clutch Pilot Bearing/Bushing Puller/Installer  
Constant Velocity Joint (CV) Service Tools:  
Boot Installation Tool  
Boot Clamp Pliers or Crimping Ring  
Engine Support Fixture  
Rotating Torque Wrench (beam-type or equivalent)  
Special Tools for Transmissions/Transaxles (appropriate for units being taught)  
Spindle Rethreader Die Set  
Universal Joint Tools

**ENGINE REPAIR**

Antifreeze/Coolant Tester  
Ball (Small Hole) Gauges  
Cam Bearing Driver Set (suggested)  
Camshaft Holding Tool (appropriate for units being taught)  
Cylinder Deglazer  
Dial Bore Indicator  
Engine Stands/Benches  
Inside Micrometer Set:  
0 - 6"  
0 - 125mm  
Micrometer (Depth)  
0 - 6"  
0 - 125mm  
Oil Pressure Gauge  
Outside Micrometer Set:  
0 - 6"  
0 - 125mm  
Portable Crane - 1/2 Ton  
Ring Compressor  
Ring Expander  
Ring Groove Cleaner  
Precision Straight Edge  
Telescopic Gauge Set  
Torque Angle Gauge<sup>14</sup>  
V-Blocks  
Valve Spring Compressor & Valve Spring Tester



# **DESE Statewide Articulation Agreement**

## **ARTICULATION AGREEMENT**

*Between*

Massachusetts Community Colleges

*And*

Massachusetts Chapter 74 State-Approved

*for more information, click*

<http://www.masscc.org/partnerships-initiatives/voc-schools-articulation-agreements>

## **Student Organizations**

- SkillsUSA [www.maskillsusa.org](http://www.maskillsusa.org)