

CURRICULUM OUTLINE

Automotive Service Technician

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CURRICULUM OUTLINE

AUTOMOTIVE SERVICE

TECHNICIAN



STRUCTURE OF THE CURRICULUM OUTLINE

To facilitate understanding of the occupation, this standard contains the following sections:

Description of the Automotive Service Technician trade: an overview of the trade's duties, work environment, job requirements, similar occupations and career progression

Trends in the Automotive Service Technician trade: some of the trends identified by industry as being the most important for workers in this trade

Essential Skills Summary: an overview of how each of the 9 essential skills is applied in this trade

Task Matrix and Recommended Training Levels: a chart which outlines graphically the Major Work Activities, Tasks and Sub-tasks and their the recommended training levels for each of the sub-tasks

Elements of harmonization of apprenticeship training: includes number of levels of apprenticeship, total training hour and recommended apprenticeship levels

Sequencing of apprenticeship training topics and related subtasks: a chart which outlines the model for apprenticeship training sequencing and a cross-reference of the sub-tasks covered by each topic

Major Work Activity (MWA): the largest division within the standard that is comprised of a distinct set of trade activities

Task: distinct actions that describe the activities within a major work activity

Task Descriptor: a general description of the task

Sub-task: distinct actions that describe the activities within a task

Recommended Apprenticeship Level: as part of the interprovincial discussions on harmonization, this is the recommended level of apprenticeship technical training where this sub-task would be trained

Essential Skills: the most relevant essential skills for this sub-task

Knowledge

Learning Outcomes: describes what should be learned relating to a sub-task while participating in technical or in-school training

Learning Objectives: topics to be covered during technical or in-school training in order to meet the learning outcomes for the sub-task

Range Variables: elements that provide a more in-depth description of a term used in the performance criteria, evidence of attainment, learning outcomes, or learning objectives

Appendix A – Acronyms: a list of acronyms used in the standard with their full name

Appendix B – Tools and Equipment: a non-exhaustive list of tools and equipment used in this trade

Appendix C – Glossary: definitions or explanations of selected technical terms used in the standard

A complete version of the occupational standard, which provides additional detail for the trade activities, skills and knowledge can be found at www.red-seal.ca

DESCRIPTION OF THE AUTOMOTIVE SERVICE TECHNICIAN TRADE

Automotive Service Technician is this trade's official Red Seal occupational title approved by the CCDA. This standard covers tasks performed by Automotive Service Technicians whose occupational title has been identified by some provinces and territories of Canada under the following names:

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
Automotive Service Technician	■	■	■	■	■	■	■	■	■	■	■	■	■

Automotive service technicians possess the full range of knowledge and abilities required to perform preventative maintenance, diagnose problems and repair vehicle systems including engines, vehicle management, hybrids, steering, braking, tires, wheels, drivetrains, suspension, electrical, electronics, heating, ventilation and air conditioning (HVAC), restraints, trim and accessories of automotive vehicles and light trucks.

Automotive service technicians may be employed by automotive repair shops, dealerships, automotive specialty repair shops, large organizations that may own a fleet of vehicles and motor vehicle body repair companies.

While the scope of the automotive service technician trade includes many aspects of vehicle service and repair, an increasing number of technicians specialize in specific areas of automotive vehicle repair due to the complexity of today's motor vehicle systems.

Technicians usually work indoors and can expect a work environment that includes noise, fumes, odours, hazardous compounds, drafts, vibrations, and confined spaces. The work often requires considerable standing, bending, crawling, lifting, pulling and reaching.

Some important attributes of automotive service technicians are: good hand-eye coordination, mechanical aptitude, time management skills, logical thinking and decision making skills, excellent communication skills, computer skills and the ability to continue learning as technology advances. It is also imperative to have a valid driver's licence.

With additional training, experienced automotive service technicians may advance to shop supervisor or service manager positions. Also technicians can transfer their skills and knowledge to related occupations such as automotive instructor, truck and transport mechanic, agricultural equipment technician or heavy duty equipment technician. Some technicians may open their own garage or automotive specialty shop.

ESSENTIAL SKILLS SUMMARY

Essential skills are needed for work, learning and life. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Through extensive research, the Government of Canada and other national and international agencies have identified and validated nine essential skills. These skills are used in nearly every occupation and throughout daily life in different ways.

A series of CCDA-endorsed tools have been developed to support apprentices in their training and to be better prepared for a career in the trades. The tools can be used independently or with the assistance of a tradesperson, trainer, employer, teacher or mentor to:

- understand how essential skills are used in the trades;
- learn about individual essential skills strengths and areas for improvement; and
- improve essential skills and increase success in an apprenticeship program.

Tools are available online or for order at: <http://www.esdc.gc.ca/eng/jobs/les/tools/index.shtml>.

The application of these skills may be described throughout this document within the competency statements which support each subtask of the trade. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at www.red-seal.ca.

READING

Automotive service technicians must read and comprehend a variety of materials including repair manuals, manufacturers' bulletins and safety documents. They refer to government regulations, vehicle inspection procedures, hazardous material handling and disposal and safety requirements of vehicles.

DOCUMENT USE

Automotive service technicians interpret technical drawings and flowcharts. They locate data such as classifications, product and material specifications, identification numbers, quantities and costs. Automotive service technicians often use specification tables. They scan a variety of manufacturers' labels for part numbers, serial numbers, sizes, colours and other information and adhere to hazard and safety icons.

WRITING

Automotive service technicians complete workplace documents such as written explanations to the client, work orders, inspection reports and incident reports.

ORAL COMMUNICATION

Automotive service technicians gather information from different sources about vehicle faults and needed repairs, explain the results of inspections and repairs, and discuss maintenance procedures. They exchange technical repair and troubleshooting information with others such as service managers, apprentices, co-workers, colleagues and suppliers.

NUMERACY

Automotive service technicians take a variety of measurements using digital and analog equipment. They estimate the amount of time required to complete repairs. Automotive service technicians compare measurements of energy, dimension, speed, horsepower, temperature and torque to specifications. They analyze pressure, power, torque, compression and electrical readings to assess vehicle performance and troubleshoot faults.

THINKING

Automotive service technicians use thinking skills and visual analysis to diagnose and repair problems. They evaluate the severity of vehicle defects and deficiencies and the quality of repairs. Automotive service technicians decide the most efficient course of action to complete a job.

WORKING WITH OTHERS

Most automotive service technicians work independently on jobs outlined in work orders. They may assist others with jobs that require two people or are within their specific area of expertise. They collaborate effectively with colleagues including salespersons, partspersons and management to resolve concerns, situations and problems.

DIGITAL TECHNOLOGY

Automotive service technicians use computerized scanning equipment, onboard vehicle diagnostics and hand-held diagnostic tools to gain operational information about vehicles. They access the Internet and databases to retrieve repair information. Automotive service technicians use digital technology to exchange information with other technicians, service managers, colleagues in other locations and manufacturer support specialists. Keyboarding and basic computer skills are an asset.

CONTINUOUS LEARNING

Constant change in the industry makes it vital for automotive service technicians to stay current with the latest technology. They learn on the job, in organized information activities and in work discussion groups. Their training is provided by vehicle manufacturers, parts suppliers, employers and associations. They also advance skills by reading work-related magazines, periodicals and automotive websites.

TRENDS IN THE AUTOMOTIVE SERVICE TECHNICIAN TRADE

There is a push from consumers and governments towards lowering emissions and improving fuel economy. Maintenance service requirements, schedules, history and reminders are becoming more important. Vehicle components are being built with lighter and stronger materials. More complex and powerful vehicle management systems are being used.

Hybrids and electric vehicles are becoming more popular. More efficient gas and cleaner diesel fueled vehicles are becoming the norm. The need for enhanced training continues in the industry.

Vehicle communication networks that integrate multiple systems such as safety, suspension, steering and braking are becoming standard. A well-developed understanding of a range of technologies is required. This includes audio system and vehicle monitoring through satellite communications, new styles of automated braking systems [collision monitoring braking systems (CMB), adaptive cruise control], lane changing and parking assistance (blind spot detection, backup cameras), dual clutch transmission (DCT), complex communication networks and gasoline direct injection (GDI). Technicians must become aware of these new systems.

As a result of the introduction of a range of sophisticated technologies, there is a movement towards specialization in the trade. On-line learning is readily available for technicians and is being used for their training and professional development. The Internet is also frequently used as an on-the-job resource for research and information sharing.

There has been a greater emphasis on environmentally-friendly and less hazardous products with better recycling, disposal and handling procedures. Technicians must be conscious of the detrimental effects of hazardous materials on workers and the environment as well as being informed on the relevant regulations.

There is a greater trend towards component replacement rather than repair. Technicians must be aware of the quality and compatibility of replacement or rebuilt components compared to the original equipment manufacturer (OEM) standards. More vehicle options are resulting in more customization of the vehicle based on customer preferences. It is important to listen to customers carefully before trying to repair an issue that may be a characteristic of a vehicle. Reviewing safety protocols of a system before working on it is paramount.

AUTOMOTIVE SERVICE TECHNICIAN

TASK MATRIX

A – PERFORMS COMMON OCCUPATIONAL SKILLS

Task A-1 Performs safety-related functions	A-1.01 Maintains safe work environment 1	A-1.02 Uses personal protective equipment (PPE) and safety equipment 1	
Task A-2 Uses tools, equipment and documentation	A-2.01 Uses tools and equipment 1	A-2.02 Uses fasteners, tubing, hoses and fittings 1	A-2.03 Uses hoisting and lifting equipment 1
	A-2.04 Uses technical information 1		
Task A-3 Uses communication and mentoring techniques	A-3.01 Uses communication techniques 1	A-3.02 Uses mentoring techniques 4	

B – DIAGNOSES AND REPAIRS ENGINE AND ENGINE SUPPORT SYSTEMS

Task B-4 Diagnoses engine systems	B-4.01 Diagnoses cooling systems 2	B-4.02 Diagnoses lubricating systems 2	B-4.03 Diagnoses engine assembly 2
	B-4.04 Diagnoses accessory drive systems 2		
Task B-5 Repairs engine systems	B-5.01 Repairs cooling systems 2	B-5.02 Repairs lubricating systems 2	B-5.03 Repairs engine assembly 2
	B-5.04 Repairs accessory drive systems 2		
Task B-6 Diagnoses gasoline engine support systems	B-6.01 Diagnoses gasoline fuel delivery and injection systems 3	B-6.02 Diagnoses gasoline ignition systems 3	B-6.03 Diagnoses gasoline intake/exhaust systems 3
	B-6.04 Diagnoses gasoline emission control systems 3		
Task B-7 Repairs gasoline engine support systems	B-7.01 Repairs gasoline fuel delivery and injection systems 3	B-7.02 Repairs gasoline ignition systems 3	B-7.03 Repairs gasoline intake/exhaust systems 3
	B-7.04 Repairs gasoline emission control systems 3		
Task B-8 Diagnoses diesel engine support systems	B-8.01 Diagnoses diesel fuel delivery and injection systems 4	B-8.02 Diagnoses diesel intake/exhaust systems 4	B-8.03 Diagnoses diesel emission control systems 4

Task B-9 Repairs diesel engine support systems	B-9.01 Repairs diesel fuel delivery and injection systems 4	B-9.02 Repairs diesel intake/exhaust systems 4	B-9.03 Repairs diesel emission control systems 4
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C – DIAGNOSES AND REPAIRS VEHICLE MODULE COMMUNICATIONS SYSTEMS

Task C-10 Diagnoses vehicle networking systems	C-10.01 Reads diagnostic trouble codes (DTCs) 3	C-10.02 Monitors data 3	C-10.03 Interprets test results 3
	C-10.04 Tests system circuitry and components 3		
Task C-11 Repairs vehicle networking systems	C-11.01 Updates component software 3	C-11.02 Replaces components 3	C-11.03 Verifies vehicle module communications system repair 3

D – DIAGNOSES AND REPAIRS DRIVELINE SYSTEMS

Task D-12 Diagnoses driveline systems	D-12.01 Diagnoses drive shafts and axles 1	D-12.02 Diagnoses manual transmissions/transaxles 2	D-12.03 Diagnoses automatic transmissions/transaxles 4
	D-12.04 Diagnoses clutches 2	D-12.05 Diagnoses transfer cases 3	D-12.06 Diagnoses final drive assemblies 2
Task D-13 Repairs driveline systems	D-13.01 Repairs drive shafts and axles 1	D-13.02 Repairs manual transmissions/transaxles 2	D-13.03 Repairs automatic transmissions/transaxles 4
	D-13.04 Repairs clutches 2	D-13.05 Repairs transfer cases 3	D-13.06 Repairs final drive assemblies 2

E – DIAGNOSES AND REPAIRS ELECTRICAL AND COMFORT CONTROL SYSTEMS

Task E-14 Diagnoses electrical systems and components	E-14.01 Diagnoses basic wiring and electrical systems 1	E-14.02 Diagnoses starting/charging systems and batteries 1,2	E-14.03 Diagnoses lighting and wiper systems 2
	E-14.04 Diagnoses entertainment systems 4	E-14.05 Diagnoses electrical options 3	E-14.06 Diagnoses instrumentation and information displays 4
	E-14.07 Diagnoses electrical accessories 3		
Task E-15 Repairs electrical systems and components	E-15.01 Repairs basic wiring and electrical systems 1	E-15.02 Repairs starting/charging systems and batteries 1,2	E-15.03 Repairs lighting and wiper systems 2
	E-15.04 Repairs entertainment systems 4	E-15.05 Repairs electrical options 3	E-15.06 Repairs instrumentation and information displays 4
	E-15.07 Installs electrical accessories 3	E-15.08 Repairs electrical accessories 2	
Task E-16 Diagnoses heating, ventilation and air conditioning (HVAC) and comfort control systems	E-16.01 Diagnoses air flow control systems 4	E-16.02 Diagnoses refrigerant systems 4	E-16.03 Diagnoses heating systems 4
	E-17.01 Repairs air flow control systems 4	E-17.02 Repairs refrigerant systems 1,4	E-17.03 Repairs heating systems 4

F – DIAGNOSES AND REPAIRS STEERING AND SUSPENSION, BRAKING, CONTROL SYSTEMS, TIRES, HUBS AND WHEEL BEARINGS

Task F-18 Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings	F-18.01 Diagnoses steering, suspension and control systems 1,2	F-18.02 Diagnoses braking and control systems 1,2	F-18.03 Diagnoses tires, wheels, hubs and wheel bearings 1
	F-19.01 Repairs steering, suspension and control systems 1,2	F-19.02 Repairs braking and control systems 1,2	F-19.03 Repairs tires, wheels, hubs and wheel bearings 1

G – DIAGNOSES AND REPAIRS RESTRAINT SYSTEMS, BODY COMPONENTS, ACCESSORIES AND TRIM

Task G-20 Diagnoses restraint systems, body components, accessories and trim	G-20.01 Diagnoses restraint systems 4	G-20.02 Diagnoses wind noises, rattles and water leaks 1	G-20.03 Diagnoses interior and exterior components, accessories and trim 1
	G-20.04 Diagnoses latches, locks and movable glass 1		
Task G-21 Repairs restraint systems, body components, accessories and trim	G-21.01 Repairs restraint systems 4	G-21.02 Repairs wind noises, rattles and water leaks 1	G-21.03 Repairs interior and exterior components, accessories and trim 1
	G-21.04 Repairs latches, locks and movable glass 1		

H – DIAGNOSES AND REPAIRS HYBRID AND ELECTRIC VEHICLES (EV)

Task H-22 Diagnoses hybrid and EV	H-22.01 Implements specific safety protocols for hybrid and EV 1,4	H-22.02 Diagnoses hybrid and EV systems 4
Task H-23 Repairs hybrid and EV	H-23.01 Repairs hybrid vehicle systems 4	H-23.02 Repairs EV systems 4

ELEMENTS OF HARMONIZATION OF APPRENTICESHIP TRAINING

1. Trade name

The official Red Seal name for this trade is Automotive Service Technician.

2. Number of Levels of Apprenticeship

The number of levels of technical training recommended for this trade is 4.

3. Total Training Hours during Apprenticeship Training

The total hours of training, including both on-the-job and in-school training for this trade is 7200.

SEQUENCING OF APPRENTICESHIP TRAINING TOPICS AND RELATED SUBTASKS

These Topic Titles are accompanied by the subtasks and their reference number contained in this Curriculum Outline. The topics in the shaded cells represent those that are covered “in context” with other training.

Level 1	Level 2	Level 3	Level 4
Tools, Equipment, Materials and Documentation	Tools, Equipment, Materials and Documentation	Tools, Equipment, Materials and Documentation	Tools, Equipment, Materials and Documentation
Maintenance Inspection	Maintenance Inspection	Maintenance Inspection	Maintenance Inspection
Vehicle Networking Systems	Vehicle Networking Systems	Vehicle Networking Systems	Vehicle Networking Systems

Level 1	Level 2	Level 3	Level 4
Safety-Related Functions 1.01 Maintains safe work environment 1.02 Uses personal protective equipment (PPE) and safety equipment 17.02 Repairs refrigerant systems 22.01 Implements specific safety protocols for hybrid and electric vehicles (EV)			
Fundamentals of Tools, Equipment, Materials and Documentation 2.01 Uses tools and equipment 2.02 Uses fasteners, tubing, hoses and fittings 2.03 Uses hoisting and lifting equipment 2.04 Uses technical information			
Communication Techniques 3.01 Uses communication techniques			Mentoring Techniques 3.02 Uses mentoring techniques
Tires, Wheels, Hubs and Wheel Bearings 18.03 Diagnoses tires, wheels, hubs and wheel bearings 19.03 Repairs tires, wheels, hubs and wheel bearings			
Body Components, Accessories and Trim 20.02 Diagnoses wind noises, rattles and water leaks 20.03 Diagnoses interior and exterior components, accessories and trim 20.04 Diagnoses latches, locks and movable glass 21.02 Repairs wind noises, rattles and water leaks 21.03 Repairs interior and exterior components, accessories and trim 21.04 Repairs latches, locks and movable glass			

Level 1	Level 2	Level 3	Level 4
Steering, Suspension and Control Systems 18.01 Diagnoses steering, suspension and control systems 19.01 Repairs steering, suspension and control systems	Steering, Suspension and Control Systems 18.01 Diagnoses steering, suspension and control systems 19.01 Repairs steering, suspension and control systems		
Braking and Control Systems 18.02 Diagnoses braking and control systems 19.02 Repairs braking and control systems	Braking and Control Systems 18.02 Diagnoses braking and control systems 19.02 Repairs braking and control systems		
Electrical Systems and Components 14.01 Diagnoses basic wiring and electrical systems 14.02 Diagnoses starting/charging systems and batteries 15.01 Repairs basic wiring and electrical systems 15.02 Repairs starting/charging systems and batteries	Electrical Systems and Components 14.02 Diagnoses starting/charging systems and batteries 14.03 Diagnoses lighting and wiper systems 15.02 Repairs starting/charging systems and batteries 15.03 Repairs lighting and wiper systems 15.08 Repairs instrumentation	Electrical Systems and Components 14.05 Diagnoses electrical options 14.07 Diagnoses electrical accessories 15.05 Repairs electrical options 15.07 Installs electrical accessories	Electrical Systems and Components 14.04 Diagnoses entertainment systems 14.06 Diagnoses instrumentation and information displays 15.04 Repairs entertainment systems 15.06 Repairs instrumentation and information displays
		Vehicle Networking Systems 10.01 Reads diagnostic trouble codes (DTCs) 10.02 Monitors data 10.03 Interprets test results 10.04 Tests system circuitry and components 11.01 Updates component software 11.02 Replaces components 11.03 Verifies vehicle module communications system repair	

Level 1	Level 2	Level 3	Level 4
Driveline Systems 12.01 Diagnoses drive shafts and axles 13.01 Repairs drive shafts and axles	Driveline Systems 12.02 Diagnoses manual transmissions/transaxles 12.04 Diagnoses clutches 12.06 Diagnoses final drive assemblies 13.02 Repairs manual transmissions/transaxles 13.04 Repairs clutches 13.06 Repairs final drive assemblies	Driveline Systems 12.05 Diagnoses transfer cases 13.05 Repairs transfer cases	Driveline Systems 12.03 Diagnoses automatic transmissions/transaxles 12.05 Diagnoses transfer cases 13.03 Repairs automatic transmissions/transaxles 13.05 Repairs transfer cases
	Engine Systems 4.01 Diagnoses cooling systems 4.02 Diagnoses lubricating systems 4.03 Diagnoses engine assembly 4.04 Diagnoses accessory drive systems 5.01 Repairs cooling systems 5.02 Repairs lubricating systems 5.03 Repairs engine assembly 5.04 Repairs accessory drive systems		
		Gasoline Engine Support Systems 6.01 Diagnoses gasoline fuel delivery and injection systems 6.02 Diagnoses gasoline ignition systems 6.03 Diagnoses gasoline intake/exhaust systems 6.04 Diagnoses gasoline emission control systems 7.01 Repairs gasoline fuel delivery and injection systems 7.02 Repairs gasoline ignition systems 7.03 Repairs gasoline intake/exhaust systems 7.04 Repairs gasoline emission control systems	Diesel Engine Support Systems 8.01 Diagnoses diesel fuel delivery and injection systems 8.02 Diagnoses diesel intake/exhaust systems 8.03 Diagnoses diesel emission control systems 9.01 Repairs diesel fuel delivery and injection systems 9.02 Repairs diesel intake/exhaust systems 9.03 Repairs diesel emission control systems

Level 1	Level 2	Level 3	Level 4
			HVAC and Comfort Control Systems 16.01 Diagnoses air flow control systems 16.02 Diagnoses refrigerant systems 16.03 Diagnoses heating systems 17.01 Repairs air flow control systems 17.02 Repairs refrigerant systems 17.03 Repairs heating systems
			Hybrid and Electrical Vehicle (EV) 22.01 Implements specific safety protocols for hybrid and electric vehicles (EV) 22.02 Diagnoses hybrid and electric vehicle (EV) systems 23.01 Repairs hybrid vehicle systems 23.02 Repairs electric vehicles (EV) systems
			Restraint Systems 20.01 Diagnoses restraint systems 21.01 Repairs restraint systems

MAJOR WORK ACTIVITY A

Performs common occupational skills

TASK A-1 Performs safety-related functions

TASK DESCRIPTOR

Proper use of personal protective equipment (PPE) and safe work practices is essential due to the fact that automotive service technicians are using hazardous materials and potentially dangerous equipment.

A-1.01 Maintains safe work environment

Apprenticeship Level	1
Essential Skills	Oral Communication, Document Use, Thinking

RANGE OF VARIABLES

safety regulations include: OH&S, WHMIS/GHS

components of WHMIS/GHS include: safety data sheets (SDS), labels, training

hazardous materials include: supplemental restraint system components, batteries, various automotive fluids and chemicals, various cleaning fluids and chemicals

A-1.02 Uses personal protective equipment (PPE) and safety equipment

Apprenticeship Level	1
Essential Skills	Document Use, Thinking, Reading

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
A-1.02.01L	demonstrate knowledge of PPE , their applications, limitations and procedures for use	identify types of PPE and describe their applications and limitations for use
		describe the care and maintenance of PPE
A-1.02.02L	demonstrate knowledge of safety equipment their applications and procedures for use	identify types of safety equipment and describe their applications
		describe the care and maintenance of safety equipment

RANGE OF VARIABLES

PPE includes: work boots, ear protection, eye protection, face shields, insulating gloves, fire resistant clothing, breathing apparatus

safety equipment includes: jack stands, exhaust ventilation fans, fire extinguishers, lock-out devices, respirators

TASK A-2 Uses tools, equipment and documentation

TASK DESCRIPTOR

Proper use of tools, equipment, materials and documentation is important for safe and effective vehicle repair.

A-2.01 Uses tools and equipment

Apprenticeship Level	1
Essential Skills	Numeracy, Thinking, Document Use

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
A-2.01.01L	demonstrate knowledge of hand and power tools , their applications, maintenance and procedures for use	identify types of hand tools and describe their applications and procedures for use

		describe the procedures used to store and maintain hand tools
		identify types of power tools and describe their applications and procedures for use
		describe the procedures used to store and maintain power tools
		describe safe operating procedures for hand and power tools
A-2.01.02L	demonstrate knowledge of measuring and testing devices , their applications, maintenance and procedures for use	identify types of measuring and testing devices and describe their applications and procedures for use
		identify types of scan tools and digital multimeters (DMM) and describe their applications
		describe the procedures used to store and maintain measuring and testing devices
A-2.01.03L	demonstrate knowledge of shop tools and equipment , their applications, maintenance and procedures for use	identify types of shop tools and equipment and describe their applications and procedures for use
		describe the procedures used to store and maintain shop tools and equipment
A-2.01.04L	demonstrate knowledge of welding, cutting and heating equipment and their applications	identify types of welding, cutting and heating equipment and describe their applications

RANGE OF VARIABLES

power tools include: electric, pneumatic, hydraulic

measuring and testing devices include: micrometers, vernier calipers, pressure gauges, torque wrenches

shop tools and equipment include: brake lathe, tire changing machine, wheel balancer, battery chargers, vices, presses

welding, cutting and heating equipment includes: oxy-acetylene heating and cutting, gas metal arc welding (GMAW), metal inert gas welding (MIG), shielded metal arc welding (SMAW)

A-2.02 Uses fasteners, tubing, hoses and fittings

Apprenticeship Level	1
Essential Skills	Numeracy, Thinking, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.02.01L	demonstrate knowledge of fasteners, tubing, hoses, and fittings, their applications and procedures for use	identify types of fasteners and describe their applications and procedures for use

	identify types of tubing and hoses and describe their applications and procedures for use
	identify types of fittings and flares and describe their applications and procedures for use

A-2.03 Uses hoisting and lifting equipment

Apprenticeship Level	1
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
A-2.03.01L	demonstrate knowledge of vehicle hoisting and lifting equipment, their applications and procedures for use	identify safety considerations pertaining to vehicle hoisting and lifting
		identify the types of vehicle hoisting and lifting equipment and accessories and their applications
		describe procedures for use of vehicle hoisting and lifting equipment
		describe the procedures used to inspect, store and maintain vehicle hoisting and lifting equipment
A-2.03.02L	demonstrate knowledge of shop lifting equipment , their applications and procedures for use	identify safety considerations pertaining to shop lifting equipment
		identify types of shop lifting equipment and their applications
		describe procedures for use of shop lifting equipment
		describe the procedures used to inspect, store and maintain shop lifting equipment

RANGE OF VARIABLES

safety considerations include: OH&S regulations, safe work practices

shop lifting equipment includes: chain falls, overhead cranes, hydraulic jacks, engine hoists, vehicle hoists

A-2.04 Uses technical information

Apprenticeship Level	1
Essential Skills	Document Use, Reading, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
A-2.04.01L	demonstrate knowledge of trade documents and their use	locate and interpret identification codes found on the vehicle and vehicle components
		identify and interpret types of trade documents
A-2.04.02L	demonstrate knowledge of preparing and interpreting trade documents	describe the procedures used to prepare and complete documentation

RANGE OF VARIABLES

documents include: repair orders, estimates, history, preventative maintenance reports and schedules, work orders, schematics and service information, technical service bulletins (TSB), industry standard labour guides, pre-delivery inspection reports

identification codes include: vehicle identification number (VIN), component identification codes, diagnostic indicators

TASK A-3 Uses communication and mentoring techniques

TASK DESCRIPTOR

Learning in the trades is done primarily in the workplace with tradespeople passing on their skills and knowledge to apprentices, as well as sharing knowledge among themselves. Apprenticeship is, and always has been about mentoring. Because of the importance of this to the trade, this task covers the activities related to communication in the workplace and mentoring skills.

A-3.01 Uses communication techniques

Apprenticeship Level	1
Essential Skills	Oral Communication, Document Use, Working with Others

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
A-3.01.01L	demonstrate knowledge of trade terminology	define terminology used in the trade

A-3.01.02L	demonstrate knowledge of effective communication practices	describe the importance of using effective verbal and non-verbal communication with people in the workplace
A-3.01.03L	demonstrate knowledge of technical resources available	identify sources of information to effectively communicate
A-3.01.04L	demonstrate knowledge of various learning styles	identify communication and learning styles
A-3.01.05L	demonstrate the knowledge and benefits of a productive team environment	identify personal responsibilities and attitudes that contribute to on-the-job success
A-3.01.06L	demonstrate knowledge of policies and procedures regarding harassment and discrimination	identify communication that constitutes harassment and discrimination

RANGE OF VARIABLES

people in the workplace include: other tradespeople, colleagues, apprentices, supervisors, clients, manufacturers

sources of information include: regulations, occupational health and safety requirements, diagrams, schematics, specifications, manufacturer and shop documentation, on-line resources

personal responsibilities and attitudes include: asking questions, working safely, accepting constructive feedback, time management and punctuality, respect for authority, efficient work practice, and good stewardship of materials, tools and property

harassment includes: objectionable conduct, comment or display made either on a one-time or continuous basis that demeans, belittles, or causes personal humiliation or embarrassment to the recipient

discrimination is prohibited based on race, national or ethnic origin, colour, religion, age, sex, sexual orientation, marital status, family status, disability or conviction for which a pardon has been granted or in respect of which a record suspension has been ordered

A-3.02 Uses mentoring techniques

Apprenticeship Level	4
Essential Skills	Working with Others, Oral Communication, Continuous Learning

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
A-3.02.01L	identify, explain and demonstrate strategies for learning skills in the workplace	describe the importance of individual experience
		describe the shared responsibilities for workplace learning
		identify different ways of learning and determine one's own learning preferences and explain how these relate to learning new skills

		describe the importance of different types of skills in the workplace
		describe the importance of essential skills in the workplace
		identify different ways of learning
		identify different learning needs and strategies to meet learning needs
		identify strategies to assist in learning a skill
A-3.02.02L	identify, explain and demonstrate strategies for teaching workplace skills	identify different roles played by a workplace mentor
		describe the steps involved in teaching skills
		explain the importance of identifying the point of a lesson
		identify how to choose the effective time to present a lesson
		explain the importance of linking the lessons
		identify the components of the skill (the context)
		describe considerations in setting up opportunities for skill practice
		explain the importance of providing feedback
		identify techniques for giving effective feedback
		describe a skills assessment
		identify methods of assessing progress
		explain how to adjust a lesson to different situations

RANGE OF VARIABLES

essential skills are: reading, writing, document use, oral communication, numeracy, thinking, working with others, digital technology, continuous learning

learning needs include: learning disabilities, learning preferences, language proficiency

strategies to assist in learning a skill include: understanding the basic principles of instruction, developing coaching skills, being mature and patient, providing feedback

steps involved in teaching skills include: identifying the point of the lesson, linking the lesson, demonstrating the skill, providing practice, giving feedback, assessing skills and progress

MAJOR WORK ACTIVITY B

Diagnoses and repairs engine and engine support systems

TASK B-4 Diagnoses engine systems

TASK DESCRIPTOR

Technicians diagnose engine assemblies including their lubricating, cooling and accessory systems.

B-4.01 Diagnoses cooling systems

Apprenticeship Level	2	
Essential Skills	Document Use, Thinking, Oral Communication	
KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-4.01.01L	demonstrate knowledge of cooling systems, their components and operation	identify types of cooling systems
		identify cooling system components and describe their purpose and operation
		identify types of coolants and chemical additives and describe their characteristics and applications
		identify types of hoses, tubing, belts, gaskets, seals and sealants and describe their applications
		identify types of fan systems and describe their components and operation
		identify related systems and describe their relationship to cooling systems
B-4.01.02L	demonstrate knowledge of the procedures used to diagnose cooling systems	describe the procedures used to diagnose cooling systems

	identify warning systems and indicators and describe their purpose and operation
	identify types of diagnostic tools and equipment and describe their applications and procedures for use

RANGE OF VARIABLES

components include: water pumps, radiators, thermostats, tubes, hoses, belts, tensioners, shrouds

fan systems include: mechanical, electric, hydraulic

related systems include: heating, ventilation and air conditioning (HVAC), coolers and auxiliary coolers, coolant heaters

procedures used to diagnose include: verify concern, perform sensory inspections, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

warning systems and indicators include: lights, gauges, audible alarms

diagnostic tools and equipment include: pressure testers, coolant strength testers, infrared temperature guns, scan tools

B-4.02 Diagnoses lubricating systems

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-4.02.01L	demonstrate knowledge of engine lubricating systems, their components and operation	identify types of engine lubricants and describe their characteristics and applications
		identify types of oil pumps and describe their purpose and operation
		identify types of oil coolers and describe their purpose and operation
		identify types of hoses, tubing, gaskets, seals and sealants and describe their applications
		describe oil flow, filtration and pressure regulation
		identify testing procedures for checking oil contaminations

		identify types of warning systems and indicators and describe their purpose and operation
B-4.02.02L	demonstrate knowledge of the procedures used to diagnose engine lubricating systems	describe the procedures used to diagnose engine lubricating systems

RANGE OF VARIABLES

engine lubricants include: grades and classifications, synthetics, additives

oil pumps include: rotor type, vane type, gear type

oil coolers include: oil-to-air, oil-to-coolant

warning systems and indicators include: lights, gauges, audible alarms

procedures used to diagnose include: verify concern, perform sensory inspections, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

B-4.03 Diagnoses engine assembly

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-4.03.01L	demonstrate knowledge of engine theory	define and explain terminology associated with engines
		explain internal combustion principles
B-4.03.02L	demonstrate knowledge of engine assemblies, their components and operation	identify types of engine classifications
		identify types of engine configurations and describe their construction
		identify types of valve train configurations and valve timing control systems operations and describe their construction
		identify types of fasteners, gaskets, seals and sealants and describe their applications and procedures for use
		identify engine assembly components and describe their design, purpose and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use

		describe engine displacement, compression ratios and horsepower
		identify related components and describe their relationship to engine assembly
B-4.03.03L	demonstrate knowledge of the procedures used to diagnose engine assemblies	identify types and sources of engine assembly problems
		describe the procedures used to diagnose engine assembly problems

RANGE OF VARIABLES

components include: crankshafts, camshafts, bearings, pistons and rings, engine block, cylinder head assemblies, gaskets, variable valve actuators

engine classifications include: fuel (diesel, gasoline, alternate fuels), 2 or 4 stroke, cooling (air, liquid)

engine configurations include: inline, rotary, opposed, V

valve train configurations include: push rod, overhead cam, multi-valve, solenoid operated valve

engine assembly components include: crankshafts, camshafts, bearings, pistons and rings, engine block, cylinder head assemblies, gaskets, variable valve actuators

diagnostic tools and equipment include: pyrometer, laser tools, straight edges, electronic vibration analyzers, stethoscopes

related components include: engine oil coolers, lines, hoses, pulleys

procedures used to diagnose include: verify concern, perform sensory inspections, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

B-4.04 Diagnoses accessory drive systems

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-4.04.01L	demonstrate knowledge of accessory drive systems , their components and operation	identify the types of accessory drive systems , and describe their components and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify related components and describe their relationship to accessory drive systems

B-4.04.02L	demonstrate knowledge of the <i>procedures used to diagnose accessory drive systems</i>	describe the <i>procedures used to diagnose accessory drive systems</i>
		describe the <i>procedures used to diagnose accessory drive system components</i>

RANGE OF VARIABLES

accessory drive systems include: belt tension/tensioners, belts, drives (electric, hydraulic, gear)

diagnostic tools and equipment include: pyrometer, laser tools, straight edges, electronic vibration analyzers, stethoscopes

related components include: water pumps, alternators, AC compressors, power steering pumps

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

TASK B-5 Repairs engine systems

TASK DESCRIPTOR

Engine repair involves servicing and repairs to lubricating, cooling and accessory drive systems as well as engine assemblies.

B-5.01 Repairs cooling systems

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Reading

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-5.01.01L	demonstrate knowledge of cooling systems, their <i>components</i> and operation	identify <i>cooling system components</i> and describe their purpose and operation
		identify types of coolants and chemical additives and describe their characteristics and applications
		identify types of hoses, tubing, belts, gaskets, seals and sealants and describe their applications
		identify types of <i>repair tools and equipment</i> and describe their applications and procedures for use
		identify types of <i>fan systems</i> and describe <i>their components</i> and operation

		identify related systems and describe their relationship to cooling systems
		identify warning systems and indicators and describe their purpose and operation
B-5.01.02L	demonstrate knowledge of the procedures used to repair cooling systems	describe the procedures used to repair cooling systems
		describe the procedures used to remove and reinstall cooling system components
		describe the procedures used to flush and recycle or dispose of coolants according to jurisdictional regulations
		describe procedures used to verify repair

RANGE OF VARIABLES

cooling system components include: radiators, hoses, thermostats, water pumps

repair tools and equipment include: pressure testers, automated refill devices, tension gauges, hand tools, air tools

fan systems and their components include: mechanical, electric

related systems include: HVAC, coolers and auxiliary coolers, coolant heaters

warning systems and indicators include: lights, gauges, audible alarms

B-5.02 Repairs lubricating systems

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-5.02.01L	demonstrate knowledge of engine lubricating systems, their components and operation	identify types of engine lubricants and describe their characteristics and applications
		identify types of oil pumps and drives and describe their purpose and operation
		identify types of oil coolers and describe their purpose and operation
		identify types of hoses, tubing, gaskets, seals and sealants and describe their applications
		describe oil flow, filtration and pressure regulation
		identify requirements related to superchargers and turbochargers

		identify related systems and describe the relationship to lubricating systems
		identify types of warning systems and indicators and describe their purpose and operation
B-5.02.02L	demonstrate knowledge of the procedures used to repair engine lubricating systems	describe the procedures used to repair lubrication systems
		describe procedures used to verify repair

RANGE OF VARIABLES

related systems include: engine assembly, oil coolers

B-5.03 Repairs engine assembly

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-5.03.01L	demonstrate knowledge of engine theory	define and explain terminology associated with engines
		explain internal combustion principles
B-5.03.02L	demonstrate knowledge of engines, their components and operation	identify types of engine classifications
		identify types of engine configurations and describe their construction
		identify types of valve train configurations and describe their construction
		identify types of fasteners, gaskets, seals and sealants and describe their applications and procedures for use
		identify engine components and describe their design, purpose and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe engine displacement and compression ratios
		describe variable valve control systems
B-5.03.03L	demonstrate knowledge of the procedures used to repair engine assembly	identify types and sources of engine assembly problems

	describe the procedures used to remove, repair and reassemble engine assemblies
	describe the procedures used to adjust, repair and/or replace engine assembly components
	describe procedures used to verify repair

RANGE OF VARIABLES

engine classifications include: fuel (diesel, gasoline, alternate fuels)

engine configurations include: inline, rotary, opposed, V

valve train configurations include: push rod, overhead cam, multi-valve, solenoid operated valve

repair tools and equipment include: hand tools, air tools, plastic precision clearance gauges, straight edges, precision measuring tools, torque angle gauge

types and sources of engine assembly problems include: low power, smoke, oil consumption, fluid contamination, rough running, internal/external leaks, noises

B-5.04 Repairs accessory drive systems

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-5.04.01L	demonstrate knowledge of accessory drive systems , their components and operation	identify the types of accessory drive systems and describe their components and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		identify related components and describe their relationship to accessory drive systems
B-5.04.02L	demonstrate knowledge of the procedures used to repair accessory drive systems	describe the procedures used to repair accessory drive systems
		describe the procedures used to repair accessory drive system components
		describe procedures used to verify repair
		describe the procedures used to reinstall and adjust accessory drive systems and their components

RANGE OF VARIABLES

accessory drive systems include: belt tension/tensioners, belts, drives (electric, hydraulic, gear)

repair tools and equipment include: hand tools, air tools, tension relief devices, pullers, belt installers

related components include: water pumps, alternators, AC compressors, power steering pumps

accessory drive system components include: tensioners, belts, pulleys, brackets

TASK B-6 Diagnoses gasoline engine support systems

TASK DESCRIPTOR

Automotive service technicians diagnose gasoline engine support systems. These systems include: fuel delivery, fuel injection, ignition, intake/exhaust and emission control.

B-6.01 Diagnoses gasoline fuel delivery and injection systems

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE

Learning Outcomes

Learning Objectives

B-6.01.01L	demonstrate knowledge of gasoline <i>fuel delivery and injection system</i> , their components and operation	identify <i>safety precautions</i> pertaining to gasoline <i>fuel delivery and injection system</i>
		identify the types of gasoline <i>fuel delivery and injection system</i> and describe their components and operation
		identify types of tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of <i>diagnostic tools and equipment</i> and describe their applications and procedures for use
B-6.01.02L	demonstrate knowledge of the <i>procedures used to diagnose</i> gasoline <i>fuel delivery and injection system</i>	describe the <i>procedures used to diagnose</i> gasoline <i>fuel delivery and injection system</i>

describe the **procedures used to diagnose** gasoline fuel delivery and injection system **components**

RANGE OF VARIABLES

fuel delivery and injection system includes: fuel pumps and supply systems, gasoline direct injection, port injection systems

safety precautions include: high pressure, flammability

diagnostic tools and equipment include: fuel pressure gauges, scan tools, vacuum gauges, DMM, oscilloscope

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

components include: injectors, pumps, lines, filters, control systems

B-6.02 Diagnoses gasoline ignition systems

Apprenticeship Level	3
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Essential Skills	Document Use, Thinking, Digital Technology
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KNOWLEDGE

Learning Outcomes

Learning Objectives

B-6.02.01L	demonstrate knowledge of ignition systems , their components and operation	identify safety considerations pertaining to ignition systems
		identify types of ignition systems and describe their components and operation
		identify the types of ignition circuits and describe their purpose and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify related systems and describe their relationship to ignition systems

B-6.02.02L	demonstrate knowledge of the procedures used to diagnose ignition systems and their components	describe the procedures used to diagnose ignition systems and their components
		identify ignition concerns

RANGE OF VARIABLES

ignition systems include: distributor, distributor-less

safety considerations include: high voltage

ignition system components include: spark plugs, coils, plug wires, modules, control systems

ignition circuits include: primary, secondary, control

diagnostic tools and equipment include: oscilloscopes, scan tools, spark testers

related systems include: fuel systems, exhaust systems, air intake systems

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

ignition concerns include: hesitation, misfire, lag, timing

B-6.03 Diagnoses gasoline intake/exhaust systems

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-6.03.01L	demonstrate knowledge of intake and exhaust systems, their components and operation	identify the types of intake systems and describe their components and operation
		identify safety considerations related to intake/exhaust systems
		identify the exhaust systems and describe their components and operation
		identify types and sources of intake / exhaust system problems
		identify the types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use

		identify related systems and describe their relationship to intake/exhaust systems
B-6.03.02L	demonstrate knowledge of the procedures used to diagnose intake / exhaust systems	describe the procedures used to diagnose intake / exhaust systems

RANGE OF VARIABLES

intake systems include: forced air (turbocharged, supercharged, naturally aspirated [NA])

safety considerations include: high heat, noxious emissions, fuel pressure and volatility

intake/exhaust systems include: forced air (turbocharged, supercharged, NA), single or dual exhaust

diagnostic tools and equipment include: scan tools, vacuum gauges, exhaust back pressure gauges, smoke generators, gas analyzers

related systems include: emissions, lubricating, fuel delivery

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTC s, access service information, conduct tests and measurements, isolate problem and identify root cause

B-6.04 Diagnoses gasoline emission control systems

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-6.04.01L	demonstrate knowledge of emission control systems , their components and operation	identify the types of emission gases and how they are formed
		identify emission control systems and describe their components and operation
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify related systems and describe their relationship to emission control systems

		identify warning systems and indicators
B-6.04.02L	demonstrate knowledge of the procedures used to diagnose emission control systems	describe the procedures used to diagnose emission control systems

RANGE OF VARIABLES

emission control systems include: EGR, EVAP, secondary air injection, exhaust system, PCV, induction system, variable cam-timing (VCT)

emission control system components include: solenoids, EGR valves, hoses, catalytic converters, PCV valve

emission gases include: CO, CO₂, NO_x, HC, O₂

diagnostic tools and equipment include: scan tools, smoke generators, EVAP leak detectors, gas analyzers, DMM

related systems include: exhaust, intake, fuel

warning systems and indicators include: check engine light, driver information centre (DIC)

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

TASK B-7 Repairs gasoline engine support systems

TASK DESCRIPTOR

Automotive service technicians repair gasoline engine support systems. These systems include: fuel delivery, injection, ignition, intake/exhaust and emission control.

B-7.01 Repairs gasoline fuel delivery and injection systems

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-7.01.01L	demonstrate knowledge of gasoline fuel delivery and injection systems , their components and operation	identify safety considerations pertaining to gasoline fuel delivery and injection systems
		identify the types of gasoline fuel delivery and injection systems and describe their components and operation
		identify types of tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of repair tools and equipment and describe their applications and procedures for use

B-7.01.02L	demonstrate knowledge of the procedures used to repair gasoline fuel delivery and injection systems	describe the procedures used to repair gasoline fuel delivery and injection systems
		describe the procedures used to remove and reinstall gasoline fuel delivery and injection systems components
		describe the procedures used to adjust/calibrate repair and/or replace gasoline fuel delivery and injection systems components
		describe procedures used to verify repair

RANGE OF VARIABLES

gasoline fuel delivery and injection systems include: fuel pumps and supply systems, gasoline direct injection, port injection systems

safety considerations include: high pressure, flammability

repair tools and equipment include: fuel pressure gauges, fuel pressure relief devices, fuel transfer and storage equipment, fuel injector cleaning equipment, hand tools, air tools

B-7.02 Repairs gasoline ignition systems

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-7.02.01L	demonstrate knowledge of ignition systems , their components and operation	identify safety considerations pertaining to ignition systems
		identify types of ignition systems and describe their components and operation
		identify the types of ignition circuits and describe their purpose and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		identify warning systems and indicators
B-7.02.02L	demonstrate knowledge of the procedures used to repair ignition systems	describe the procedures used to repair ignition systems
		describe the procedures used to remove and reinstall ignition system components

	describe the procedures used to adjust/calibrate, repair and/or replace ignition system components
	describe procedures used to verify repair

RANGE OF VARIABLES

ignition systems include: distributor, distributor-less

safety considerations include: high voltage, high temperature

ignition circuits include: primary, secondary, control

repair tools and equipment include: scan tools, hand tools, air tools, DMM, gauges, timing light

warning systems and indicators include: check engine light, DIC

ignition system components include: spark plugs, coils, plug wires, modules, sensors

B-7.03 Repairs gasoline intake/exhaust systems

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-7.03.01L	demonstrate knowledge of intake and exhaust systems , their components and operation	identify the types of intake systems and describe their components and operation
		identify the exhaust systems and describe their components and operation
		identify types and sources of intake/exhaust system problems
		identify the types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of repair tools and equipment and describe their applications and procedures for use
B-7.03.02L	demonstrate knowledge of the procedures used to repair intake/exhaust systems	identify related systems and describe their relationship to intake/exhaust systems
		describe procedures used to repair intake/exhaust systems
		describe the procedures used to remove and reinstall intake/exhaust system components

	describe the procedures used to adjust/calibrate, repair and/or replace intake/exhaust system components
	describe the procedures used to perform oil changes and clean supercharger systems and turbocharger systems
	describe procedures used to verify repair

RANGE OF VARIABLES

intake/exhaust systems include: forced air (turbocharged, supercharged, NA), single or dual exhaust, variable intake manifold

intake/exhaust system problems include: leaks, blockages, noise, vibration

repair tools and equipment include: scan tools, hand tools, air tools, torches, welders, vacuum and pressure gauges, timing light

related systems include: emissions, lubricating, fuel delivery

intake/exhaust system components include: intake manifolds, exhaust manifolds and associated piping, mufflers, catalytic converters, turbocharger systems, supercharger systems

B-7.04 Repairs gasoline emission control systems

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-7.04.01L	demonstrate knowledge of emission control systems , their components and operation	identify the types of emission gases and how they are formed
		identify emission control systems and describe their components and operation
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of repair tools and equipment and describe their applications and procedures for use
		identify related systems and describe their relationship to emission control systems
B-7.04.02L	demonstrate knowledge of the procedures used to repair emission control systems	describe procedures used to repair and service emission control systems
		describe the procedures used to remove and reinstall emission control system components

describe the procedures used to adjust, repair and/or replace **emission control system components**

describe procedures used to verify repair

RANGE OF VARIABLES

emission control systems include: EGR, evaporative emission control systems (EVAP), secondary air injection, exhaust system, PCV, induction system, VCT

emission gases include: CO, CO², NO_x, HC, O₂

repair tools and equipment include: hand tools, air tools, cleaning and service tools, scan tools, DMM, reprogramming equipment, gas analyzers

emission control system services include: cleaning EGR valves/passages, replacing PCV valves

emission control system components include: solenoids, EGR valves, hoses, catalytic converters, PCV valves

TASK B-8 Diagnoses diesel engine support systems

TASK DESCRIPTOR

Automotive service technicians diagnose diesel engine support systems. These systems include: fuel delivery, injection, intake/exhaust and emission control.

B-8.01 Diagnoses diesel fuel delivery and injection systems

Apprenticeship Level

4

Essential Skills

Document Use, Thinking, Digital Technology

KNOWLEDGE

Learning Outcomes

Learning Objectives

B-8.01.01L	demonstrate knowledge of diesel fuel delivery and injection systems , their components and operation	identify safety considerations pertaining to diesel fuel delivery and injection systems
		identify the types of diesel fuel delivery and injection systems and describe their components and operation
		identify types of tubing, hoses, gaskets, seals and sealants and describe their applications
		identify the types of starting aids and describe their purpose and operation
B-8.01.02L	demonstrate knowledge of the procedures used to diagnose diesel fuel delivery and injection systems	identify methods to test fuel quality and describe their associated procedures

	identify types of diagnostic tools and equipment and describe their applications and procedures for use
	describe the procedures used to diagnose diesel fuel delivery and injection systems
	describe the procedures used to remove and reinstall diesel fuel delivery and injection system components

RANGE OF VARIABLES

safety considerations include: high pressure fuel, high injection voltage

diesel fuel delivery systems include: lift pumps, fuel filtration, tanks, fuel heater

diesel fuel injection systems include: direct injection, indirect injection, electronic, mechanical, common rail systems, hydraulic

starting aids include: glow plugs intake heaters, timers

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

diagnostic tools and equipment include: fuel pressure gauges, scan tools, vacuum gauges, DMM, graduated cylinders

B-8.02 Diagnoses diesel intake/exhaust systems

Apprenticeship Level	4
Essential Skills	Thinking, Digital Technology, Document Use

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-8.02.01L	demonstrate knowledge of diesel intake/exhaust systems , their components and operation	identify the types of diesel intake systems and describe their components and operation
		identify safety considerations related to diesel intake and exhaust systems
		identify the types of diesel exhaust systems and describe their components and operation
		identify diesel intake systems and describe their components and operation
		identify types and sources of diesel intake/exhaust system problems
		identify the types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications

		identify types of diagnostic tools and equipment and describe their applications and procedures for use
B-8.02.02L	demonstrate knowledge of the procedures used to diagnose diesel intake and exhaust systems	describe the procedures used to diagnose diesel intake and exhaust system components

RANGE OF VARIABLES

diesel intake systems include: turbocharged, supercharged, NA

safety considerations include: extreme temperature, exhaust fumes

diesel intake/exhaust system problems include: leaks, blockages, noise, vibration

diagnostic tools and equipment include: scan tools, vacuum gauges, exhaust back pressure gauges, smoke generators

procedures used to diagnose include: verify concern, performs sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

B-8.03 Diagnoses diesel emission control systems

Apprenticeship Level	4
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-8.03.01L	demonstrate knowledge of diesel emission control systems , their components and operation	identify diesel emissions and how they are formed
		identify safety considerations related to diesel emission control systems
		identify diesel emission control systems and describe their components and operation
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use

		identify warning systems and indicators
B-8.03.02L	demonstrate knowledge of the procedures used to diagnose diesel emission control systems	describe the procedures used to diagnose diesel emission control systems

RANGE OF VARIABLES

diesel emission control systems include: EGR, EVAP, PCV, VCT, SCR, DEF, DOC, DPF

diesel emissions include: CO, CO₂, NO_x, HC, O₂, particulates

safety considerations include: corrosive diesel exhaust fluid, high temperature

diagnostic tools and equipment include: scan tools, vacuum gauges, smoke generators, leak detectors, DMM, opacity meter, refractometer

warning systems and indicators include: check engine light, air filter restriction indicator, water in fuel light

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

TASK B-9 Repairs diesel engine support systems

TASK DESCRIPTOR

Automotive service technician repair diesel engine support systems which include fuel delivery and injection, starting aids, intake/exhaust and emission control systems.

B-9.01 Repairs diesel fuel delivery and injection systems

Apprenticeship Level	4
Essential Skills	Document Use, Numeracy, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-9.01.01L	demonstrate knowledge of diesel fuel delivery and injection systems , their components and operation	identify safety considerations pertaining to diesel fuel delivery and injection systems
		identify the types of diesel fuel delivery and injection systems and describe their components and operation
		identify types of tubing, hoses, gaskets, seals and sealants and describe their applications
		identify the types of starting aids and describe their purpose and operation

		identify related systems and describe their relationship to diesel fuel delivery and injection systems
B-9.01.02L	demonstrate knowledge of the procedures used to repair diesel fuel delivery and injection systems	identify methods to test fuel quality and describe their associated procedures
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to repair diesel fuel delivery and injection systems
		describe the procedures used to remove and reinstall diesel fuel delivery and injection system components
		describe procedures used to verify repair

RANGE OF VARIABLES

diesel fuel delivery and injection systems include: direct injection, indirect injection, electronic, mechanical, common rail systems, hydraulic

safety considerations include: high pressure, high injector voltage, diesel fuel contamination (bacteria)

starting aids include: glow plugs, intake heaters, timers

related systems include: intake/exhaust, emission control

repair tools and equipment include: fuel pressure gauges, fuel pressure relief devices, fuel transfer, storage equipment, scan tools, hand tools, air tools, reprogramming equipment

diesel fuel delivery and injection system components include: fuel filters, tanks, lines, hoses, pumps

B-9.02 Repairs diesel intake/exhaust systems

Apprenticeship Level	4
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-9.02.01L	demonstrate knowledge of diesel intake and exhaust systems , their components and operation	identify the types of diesel intake systems and describe their components and operation
		identify the types of diesel exhaust systems and describe their components and operation
		identify types and sources of diesel intake and exhaust system problems
		identify the types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications

		identify types of repair tools and equipment and describe their applications and procedures for use
B-9.02.02L	demonstrate knowledge of the procedures used to repair diesel intake and exhaust systems	describe the procedures used to repair diesel intake and exhaust systems
		describe the procedures used to remove and reinstall diesel intake and exhaust system components
		describe the procedures used to adjust, repair and/or replace diesel intake and exhaust system components
		describe the procedures used to perform decarbonization of turbocharger systems
		describe procedures used to verify repair

RANGE OF VARIABLES

diesel intake/exhaust system components include: manifolds, mufflers, intercoolers, turbochargers
repair tools and equipment include: scan tools, hand tools, air tools, pyrometers, reprogramming equipment

B-9.03 Repairs diesel emission control systems

Apprenticeship Level	4
Essential Skills	Document Use, Digital Technology, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-9.03.01L	demonstrate knowledge of diesel emission control systems , their components and operation	identify the types of diesel emissions and how they are formed
		identify diesel emission control systems and describe their components and operation
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of repair tools and equipment and describe their applications and procedures for use
B-9.03.02L	demonstrate knowledge of the procedures used to repair diesel emission control systems	describe the procedures used to repair diesel emission control systems

	describe the procedures used to remove and reinstall <i>diesel emission control system components</i>
	describe the procedures used to service, repair and/or replace <i>diesel emission control system components</i>
	describe procedures used to verify repair

RANGE OF VARIABLES

diesel emission control systems include: EGR, PCV, VCT, SCR, DOC, DPF, DEF

diesel emissions include: CO, CO², NO_x, HC, O₂, particulates

repair tools and equipment include: scan tools, hand tools, air tools, vacuum gauges, smoke generators, leak detectors, DMM, reprogramming equipment, opacity meter

diesel emission control system components include: sensors, turbochargers, diesel particulate filters, modules, catalytic converters

MAJOR WORK ACTIVITY C

Diagnoses and repairs vehicle module communications systems

TASK C-10 Diagnoses vehicle networking systems

TASK DESCRIPTOR

Vehicle networking systems allow modules to communicate with each other by sharing input and output information. They also provide vehicle control by monitoring inputs and outputs to modules in order to make decisions based on preset parameters. Vehicle networking systems ensure the efficient operation and communication of component modules such as the engine, transmission, anti-theft system, climate control, body control and brake control. All diagnostic procedures must be performed according to manufacturers' information.

C-10.01 Reads diagnostic trouble codes (DTCs)

Apprenticeship Level	3
Essential Skills	Document Use, Digital Technology, Thinking
KNOWLEDGE	
	<div>Learning Outcomes</div> <div>Learning Objectives</div>
C-10.01.01L	<div>demonstrate knowledge of vehicle networking systems, their components and operation</div> <div>explain basic computer operation and its relationship to vehicle networking systems</div>
	<div></div> <div>identify the types of <i>network protocols</i> and describe their purpose</div>
	<div></div> <div>describe the <i>networking of modules and multiplexing</i></div>
	<div></div> <div>identify and interpret DTCs</div>
	<div></div> <div>identify the parameters of inputs and outputs and describe their relationships</div>
	<div></div> <div>identify types of <i>diagnostic tools and equipment</i> used to diagnose network and electronic circuitry and describe their applications and procedures for use</div>

RANGE OF VARIABLES

network protocols include: International Standards Organization (ISO), controller area network (CAN), local interface network (LIN), speed

networking of modules and multiplexing include: wiring designs, wireless

diagnostic tools and equipment include: DMM, oscilloscopes, probes, break out boxes, scan tools

C-10.02 Monitors data

Apprenticeship Level	3
Essential Skills	Digital Technology, Thinking, Document Use

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-10.02.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret data
		identify the parameters of inputs and outputs and describe their relationships

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

data includes: inputs and outputs

C-10.03 Interprets test results

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-10.03.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret data
		identify the parameters of inputs and outputs and describe their relationships

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

C-10.04 Tests system circuitry and components

Apprenticeship Level	3
Essential Skills	Thinking, Digital Technology, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-10.04.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret DTC
		identify the parameters of inputs and outputs and describe their relationships

		identify types of diagnostic tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use
C-10.04.02L	demonstrate knowledge of the procedures used to diagnose vehicle networking system components	describe the procedures used to diagnose vehicle networking systems
C-10.04.03L	demonstrate knowledge of circuits, their components and operation	describe the application of Ohm's law to electrical circuits
		interpret diagnostic flowcharts and schematics
		identify types of wire and describe their characteristics, composition and applications
C-10.04.04L	demonstrate knowledge of the procedures used to diagnose circuits and components	describe the procedures used to diagnose circuits and components

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

diagnostic tools and equipment include: DMM, oscilloscopes, probes, break-out boxes, scan tools, LED circuit testers

procedures used to diagnose include: verify concern, visually inspect, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

electrical circuits include: series circuit, parallel circuit, series-parallel circuits

TASK C-11 Repairs vehicle networking systems

TASK DESCRIPTOR

Vehicle networking systems allow modules to communicate with each other by sharing input and output information. Vehicle networking systems ensure the efficient operation and communication of component modules such as the engine, transmission, anti-theft system, climate control, body control and brake control. All repair tasks must be performed according to manufacturers' information.

C-11.01 Updates component software

Apprenticeship Level	3	
Essential Skills	Digital Technology, Document Use, Thinking	
KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-11.01.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships
		identify types of repair tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use
C-11.01.02L	demonstrate knowledge of the procedures used to repair vehicle networking system components	describe the procedures used to repair vehicle networking systems
C-11.01.03L	demonstrate knowledge of reprogramming software	identify methods used to access/transfer and reprogram software and describe their associated procedures

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

repair tools and equipment include: DMM, oscilloscopes, probes, break-out boxes, scan tools, hand tools, air tools, SAE J2534 compliant tools, laptops, computers

methods used to access/transfer and reprogram software include: CD/DVD, USB, Internet, scan tool, PROM

C-11.02 Replaces components

Apprenticeship Level	3
Essential Skills	Digital Technology, Thinking, Document Use

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-11.02.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships
		identify types of tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use
C-11.02.02L	demonstrate knowledge of the procedures used to repair vehicle networking system components	describe the procedures used to repair and/or replace vehicle networking system components
C-11.02.03L	demonstrate knowledge of reprogramming software	identify methods used to access/transfer and reprogram software and describe their associated procedures

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

tools and equipment include: hand tools, air tools and specialized tools (DMM, oscilloscopes, probes, break out boxes, scan tools, J2534 compliant tools)

methods used to access/transfer and reprogram software include: CD/DVD, USB, Internet, scan tool

C-11.03 Verifies vehicle module communications system repair

Apprenticeship Level

3

Essential Skills

Digital Technology, Thinking, Document Use

KNOWLEDGE

Learning Outcomes

Learning Objectives

C-11.03.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships
C-11.03.02L	demonstrate knowledge of the procedures used to repair vehicle networking system components	identify types of diagnostic tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use
		describe the procedures used to repair and/or replace vehicle networking system components
C-11.03.03L	demonstrate knowledge of reprogramming software	identify methods used to access/transfer and reprogram software and describe their associated procedures

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

diagnostic tools and equipment include: DMM, oscilloscopes, probes, break-out boxes, scan tools, J2534 compliant tools

methods used to access/transfer and reprogram software include: CD/DVD, USB, Internet, scan tool, PROM

MAJOR WORK ACTIVITY D

Diagnoses and repairs driveline systems

TASK D-12 Diagnoses driveline systems

TASK DESCRIPTOR

Driveline systems provide a means of transmitting energy from the engines/motors to the drive wheels in complex and innovative methods. All diagnostic tasks must be performed according to manufacturers' information.

D-12.01 Diagnoses drive shafts and axles

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-12.01.01L	demonstrate knowledge of drive shafts and axles, their components and operation	identify types of drive shafts and describe their composition
		identify safety considerations pertaining to drive shafts and axles
		identify types of drive shaft components and describe their purpose and operation
		identify types of axles and describe their components and operation
		describe axle disconnects, locking hubs and their purpose
		describe the importance of multiple piece drive shaft phasing, indexing and angles
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications

D-12.01.02L	demonstrate knowledge of the procedures used to diagnose drive shafts and axles	identify diagnostic tools and equipment and describe their applications and procedures for use
		describe the procedures used to diagnose drive shafts and axle systems

RANGE OF VARIABLES

types of drive shafts include: 1 piece, 2 piece

composition includes: steel, aluminum

safety considerations include: exposed rotating parts, pinch points

drive shaft components include: slip yokes and flanges, flex joints, single cardan joints, double cardan joints, CV, support bearing, viscous coupling

axles include: half shafts, floating, semi-floating

diagnostic tools include: electronic vibration analyzers, inclinometers, dial indicators, hand tools, scan tools

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, measure driveline angles, isolate problem and identify root cause

D-12.02 Diagnoses manual transmissions/transaxles

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-12.02.01L	demonstrate knowledge of manual transmissions/transaxles, their components and operation	identify types of manual transmissions/transaxles and describe their components and operation
		identify safety considerations pertaining to manual transmissions/transaxles
		explain manual transmissions/transaxles power flow
		describe gear ratios, their purpose and calculation
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use

		identify types of engine and driveline mounts, their construction and application
D-12.02.02L	demonstrate knowledge of the <i>procedures used to diagnose</i> manual transmissions/transaxles	describe the <i>procedures used to diagnose</i> manual transmissions/transaxles

RANGE OF VARIABLES

safety considerations include: exposed rotating parts, pinch points, lifting and support procedures

diagnostic tools and equipment include: chassis ears, stethoscopes, hand tools, scan tools

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

D-12.03 Diagnoses automatic transmissions/transaxles

Apprenticeship Level	4
Essential Skills	Digital Technology, Reading, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-12.03.01L	demonstrate knowledge of <i>automatic transmissions/transaxles</i> , their components and operation	identify types of <i>automatic transmissions/transaxles</i> and describe their components and operation
		identify <i>safety considerations</i> pertaining to <i>automatic transmissions/transaxles</i>
		identify types of <i>alternate automatic transmissions/transaxle designs</i>
		explain <i>hydraulic principles</i> related to automatic transmissions and transaxles
		explain automatic transmission/transaxle power flow
		interpret electric and hydraulic schematics
		describe gear ratios, their purpose and calculation
		identify types of lubricants, fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of <i>diagnostic tools and equipment</i> and describe their applications and procedures for use

		identify warning systems and indicators
D-12.03.02L	demonstrate knowledge of the procedures used to diagnose automatic transmissions and transaxles	describe the procedures used to diagnose automatic transmissions and transaxles

RANGE OF VARIABLES

automatic transmissions and transaxles include: electrically controlled, hydraulically controlled

safety considerations include: exposed rotating parts, pinch points, lifting and support procedures

alternate automatic transmissions and transaxle designs include: continually/constantly variable transmission (CVT), dual clutch transmission (DCT)

hydraulic principles include: Pascal's law, fluid dynamics

diagnostic tools and equipment include: pressure gauges, scan tools, reprogramming equipment, hand tools

warning systems and indicators include: DIC, instrument panel cluster (IPC), check engine light, TCM light

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

D-12.04 Diagnoses clutches

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
12.04.01L	demonstrate knowledge of clutches, their components and operation	identify types of clutches and describe their components and operation
		identify safety considerations pertaining to clutch systems
		identify mechanical and hydraulic clutch actuating systems and describe their components and operation
		identify types of fluids, fasteners, tubing, hoses and seals and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		describe clutch system power flow

		identify related systems and describe their relationship to clutch systems
12.04.02L	demonstrate knowledge of the procedures used to diagnose clutches	describe the procedures used to diagnose clutches

RANGE OF VARIABLES

safety considerations include: airborne contaminants, pinch points, exposed rotating components, lifting and support procedures

related systems include: engine, manual transmission, drive shafts and axles

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

D-12.05 Diagnoses transfer cases

Apprenticeship Level	3
Essential Skills	Digital Technology, Reading, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-12.05.01L	demonstrate knowledge of transfer cases, their components and operation	identify types of transfer cases and describe their components and operation
		identify types of AWD systems, their components and operation
		identify safety considerations pertaining to transfer cases
		identify related systems and describe their relationship to transfer cases
		identify types of control systems and describe their components and operation
		describe transfer case power flow
		describe gear ratios, their purpose and calculations
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications

		identify types of diagnostic tools and equipment and describe their applications and procedures for use
D-12.05.02L	demonstrate knowledge of the procedures used to diagnose	describe the procedures used to diagnose

RANGE OF VARIABLES

safety considerations include: exposed rotating parts, pinch points, lifting and support procedures

related systems include: transmissions, drivelines, mounts

control systems include: vacuum, mechanical, electronic

diagnostic tools and equipment include: scan tools, hand tools

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

D-12.06 Diagnoses final drive assemblies

Apprenticeship Level	2
Essential Skills	Digital Technology, Reading, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-12.06.01L	demonstrate knowledge of final drive assemblies, their components and applications	identify final drive assembly components and their application
		identify safety considerations pertaining to final drive assembly
		identify diagnostic tools and equipment pertaining to final drive assembly
		identify related systems and describe their relationship to final drive assembly
		describe final drive assembly power flow
D-12.06.02L	demonstrate knowledge of procedures to diagnose final drive assembly	describe procedures used to diagnose final drive assembly
		identify tests used to diagnose final drive assembly

RANGE OF VARIABLES

safety considerations include: exposed rotating parts, pinch points, lifting and support procedures

diagnostic tools and equipment include: hand tools, scan tools, measuring tools, chassis ears

related systems include: transmissions, drivelines, mounts

procedures to diagnose final drive assembly include: road test, sensory inspection, bearing inspection, gear tooth patterns

TASK D-13 Repairs driveline systems

TASK DESCRIPTOR

Driveline systems provide a means of transmitting energy from the engines/motors to the drive wheels in complex and innovative methods. This includes CV joints, drive shaft and steady bearings, differentials, transmissions, transfer cases and clutches. All repairs must be performed according to manufacturers' information.

D-13.01 Repairs drive shafts and axles

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Numeracy
KNOWLEDGE	

describe the procedures used to adjust, repair and/or replace drive shafts and **axles** and their related components

describe procedures used to verify repair

RANGE OF VARIABLES

drive shaft components include: slip yokes and flanges, flex joints, single cardan joints, double cardan joints, CV, support bearings, viscous coupling

safety considerations include: exposed rotating parts, pinch points, lifting and support procedures

axles include: half shafts, floating, semi-floating

repair tools and equipment include: measuring tools (dial indicators, inclinometer), pullers, presses, hand tools, air tools

D-13.02 Repairs manual transmissions/transaxles

Apprenticeship Level

2

Essential Skills

Thinking, Document Use, Numeracy

KNOWLEDGE

Learning Outcomes

Learning Objectives

D-13.02.01L	demonstrate knowledge of manual transmissions and transaxles, their components and operation	identify types of manual transmissions and transaxles and describe their components and operation
		identify safety considerations pertaining to manual transmissions/transaxles
		describe manual transmission and transaxle power flow
		describe gear ratios, their purpose and perform calculations
D-13.02.02L	demonstrate knowledge of the procedures used to repair manual transmissions and transaxles	identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to remove and reinstall manual transmissions and transaxles
		describe the procedures used to adjust, repair and/or replace manual transmissions and transaxles and their related components
		describe the procedures used to replace engine and driveline mounts

describe procedures used to verify repair

RANGE OF VARIABLES

safety considerations include: exposed rotating parts, pinch points, lifting and support procedures

repair tools and equipment include: measuring tools, presses, pullers, hand tools, air tools, lifting and support equipment

D-13.03 Repairs automatic transmissions/transaxles

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-13.03.01L	demonstrate knowledge of automatic transmissions and transaxles , their components and operation	identify types of automatic transmissions and transaxles and describe their components and operation
		identify safety considerations pertaining to automatic transmissions/transaxles
		identify types of alternate automatic transmissions and transaxle designs
		explain hydraulic principles related to automatic transmissions and transaxles
		describe automatic transmission and transaxle power flow
		interpret electric and hydraulic schematics
		describe gear ratios, their purpose and perform calculations
D-13.03.02L	demonstrate knowledge of the procedures used to repair automatic transmissions and transaxles	identify types of repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to remove and reinstall automatic transmissions and transaxles
		describe the procedures used to adjust, repair and/or replace automatic transmissions and transaxles and their related components

	describe the procedures used to replace engine and driveline mounts
	describe procedures used to verify repair

RANGE OF VARIABLES

automatic transmissions and transaxles include: electrically controlled and hydraulically controlled

safety considerations include: exposed rotating parts, pinch points, lifting and support procedures

alternate automatic transmissions and transaxle designs include: continually/constantly variable transmission (CVT), dual clutch transmission (DCT)

hydraulic principles include: Pascal's law, fluid dynamics

repair tools and equipment include: scan tools, reprogramming equipment, pressure gauges, measuring tools, presses, pullers, hand tools, air tools, lifting and support equipment

D-13.04 Repairs clutches

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-13.04.01L	demonstrate knowledge of clutches , their components and operation	identify types of clutches and describe their components and operation
		identify safety considerations pertaining to clutch systems
		identify types of flywheels and describe their components and operation
		identify mechanical and hydraulic clutch actuating systems and describe their components and operation
		identify types of fluids, fasteners, tubing, hoses and seals, and describe their applications
D-13.04.02L	demonstrate knowledge of the procedures used to repair clutches	identify types of repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to remove and reinstall clutches

	describe the procedures used to adjust, repair and/or replace clutches and flywheels and their related components
	describe procedures used to verify repair

RANGE OF VARIABLES

clutches include: single and multi-disc systems

safety considerations include: airborne contaminants, pinch points, exposed rotating components, lifting and support procedures

repair tools and equipment include: measuring tools, pullers, hand tools, air tools, lifting and support equipment

D-13.05 Repairs transfer cases

Apprenticeship Level	3
Essential Skills	Digital Technology, Reading, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-13.05.01L	demonstrate knowledge of transfer cases , their components and operation	identify types of transfer cases and describe their components and operation
		identify types of AWD systems, their components and operation
		identify safety considerations pertaining to transfer cases
		identify related systems and describe their relationship to transfer cases
		identify types of control systems and describe their components and operation
		describe transfer case power flow
		describe gear ratios, their purpose and calculations
D-13.05.02L	demonstrate knowledge of the procedures used to repair transfer cases	identify types of repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to remove and reinstall transfer cases

	describe the procedures used to adjust, repair and/or replace transfer cases and their related components
	describe procedures used to verify repair

RANGE OF VARIABLES

transfer cases include: part-time, full-time, automatic

safety considerations include: pinch points, exposed rotating components, lifting and support procedures

related systems include: transmissions, drivelines, mounts

control systems include: vacuum, mechanical, electronic

repair tools and equipment include: scan tools, reprogramming equipment, measuring tools, presses, pullers, hand tools, air tools, lifting and support equipment

D-13.06 Repairs final drive assemblies

Apprenticeship Level	2
Essential Skills	Numeracy, Reading, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D13.06.01L	demonstrate knowledge of final drive assemblies , their components and applications	identify final drive assembly components and their application
		identify safety considerations pertaining to final drive assemblies
		identify diagnostic tools pertaining to final drive assemblies
		identify repair tools and equipment pertaining to final drive assemblies
D13.06.02L	demonstrate knowledge of procedures to repair final drive assemblies	describe final drive assembly power flow
		describe procedures used to repair final drive assemblies
		describe the procedures used to remove and reinstall final drive assemblies

describe the procedures used to adjust,
repair and/or replace **final drive
assemblies** and their related components

describe procedures used to verify repair

RANGE OF VARIABLES

final drive assemblies include: all-wheel drive, integral, removable, locking, limited slip and torque distribution

safety considerations include: exposed rotating parts, pinch points, lifting and support procedures

repair tools and equipment include: hand tools, air tools, scan tools, measuring tools, presses, pullers, lifting and support equipment, tooth contact pattern

MAJOR WORK ACTIVITY E

Diagnoses and repairs electrical and comfort control systems

TASK E-14 Diagnoses electrical systems and components

TASK DESCRIPTOR

Electrical systems include electrical accessories, options, information and entertainment systems. For the purpose of this RSOS, work on information and entertainment systems are described separately. In many cases in industry these are combined and are referred to as infotainment systems. Diagnoses have to be performed according to manufacturers' information. Incorrect processes can result in personal injury and component failure.

E-14.01 Diagnoses basic wiring and electrical systems

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-14.01.01L	demonstrate knowledge of basic electrical and electronic principles	explain basic electrical theory
		explain basic computer operation
		identify types of electrical components and describe their purpose and operation
E-14.01.02L	demonstrate knowledge of electrical circuits , their components and operation	describe the application of Ohm's law to electrical circuits
		identify types of wire and describe their characteristics, composition and applications
		describe relationship of basic wiring and electronic systems to the vehicle networking system
E-14.01.03L	demonstrate knowledge of the procedures used to diagnose electrical circuits and components	interpret diagnostic flowcharts and schematics

	identify types of diagnostic tools and equipment used to test electrical circuits and components and describe their applications and procedures for use
	describe the procedures used to diagnose electrical circuits and components

RANGE OF VARIABLES

basic electrical and electronic principles include: conventional theory, electron theory, Ohm's Law, Watt's Law, magnetism, induced voltages

basic computer operation includes: inputs and outputs

electrical components purpose and operation include: circuit protection, control devices, load devices

electrical circuits include: series circuit, parallel circuit, series-parallel circuits

diagnostic tools and equipment include: DMM, scan tools, circuit testers

procedures used to diagnose include: verify concerns, perform inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

E-14.02 Diagnoses starting/charging systems and batteries

Apprenticeship Level	1,2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-14.02.01L	demonstrate knowledge of starting/charging systems, and batteries, their components and operation	identify types of starting/charging systems and batteries, and describe their components and operation
		identify safety considerations pertaining to starting/charging systems and batteries
		identify control systems and describe their components and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		describe relationship of starting/charging systems and batteries to the vehicle networking system
		identify warning indicators
E-14.02.02L	demonstrate knowledge of the procedures used to diagnose starting/charging systems and batteries	describe the procedures used to diagnose starting/charging systems and batteries

RANGE OF VARIABLES

components include: generator, starter motor, battery, fusible link

safety considerations include: battery explosions, corrosive materials, high voltage

control systems include: anti-theft/immobilizer, safety interlock devices

diagnostic tools and equipment include: battery load tester, DMMs, circuit testers and scan tools, battery capacitance tester, oscilloscopes

warning indicators include: IPC, DIC

procedures used to diagnose include: verify concerns, perform inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

E-14.03 Diagnoses lighting and wiper systems

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-14.03.01L	demonstrate knowledge of lighting and wiper systems , their components and operation	identify safety considerations pertaining to lighting and wiper systems
		identify jurisdictional requirements pertaining to lighting and wiper systems
		identify types of lighting and wiper systems and describe their components and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		describe relationship of lighting and wiper systems to the vehicle networking system
E-14.03.02L	demonstrate knowledge of the procedures to diagnose lighting and wiper systems	describe the procedures used to diagnose lighting and wiper systems

RANGE OF VARIABLES

lighting and wiper systems include: electrically controlled, electronically controlled

components include: wiper linkages/transmissions, motors, modules, switches, lamps

safety considerations include: lamps (high intensity discharge (HID)), pinch points

diagnostic tools and equipment include: DMMs, scan tools, circuit testers, oscilloscopes

procedures used to diagnose include: verify concerns, perform inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

E-14.04 Diagnoses entertainment systems

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-14.04.01L	demonstrate knowledge of entertainment systems , their components and operation	identify safety considerations pertaining to entertainment systems identify types of entertainment systems and describe their components and operation identify types of diagnostic tools and equipment and describe their applications and procedures for use identify the relationship of the entertainment system to the vehicle networking system
E-14.04.02L	demonstrate knowledge of the procedures used to diagnose entertainment systems	describe the procedures used to diagnose entertainment systems

RANGE OF VARIABLES

safety considerations include: accidental restraint system deployment

entertainment systems include: audio, video, wireless/handsfree

diagnostic tools and equipment include: DMMs, scan tools, circuit testers

procedures used to diagnose include: verify concerns, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

E-14.05 Diagnoses electrical options

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-14.05.01L	demonstrate knowledge of basic electrical and electronic principles	explain basic electrical theory
		explain basic computer operation
		describe the application of Ohm's law to electrical circuits
E-14.05.02L	demonstrate knowledge of circuits, their components and operation	interpret diagnostic flowcharts and schematics
		identify types of wire and describe their characteristics, composition and applications
		identify safety considerations pertaining to electrical options
		identify electrical accessories and describe their components and operation
		identify types of diagnostic tools and equipment used to test electrical options and describe their applications and procedures for use
E-14.05.03L	demonstrate knowledge of the procedures used to diagnose electrical accessories	describe relationship of vehicle options to the vehicle networking system
		describe the procedures used to diagnose electrical accessories

RANGE OF VARIABLES

basic electrical and electronic principles include: conventional theory, electron theory, Ohm's Law, Watt's Law, magnetism, induced voltages

basic computer operation includes: inputs, outputs

electrical circuits include: series circuit, parallel circuit, series-parallel circuits

safety considerations include: accidental restraint system deployment

electrical accessories include: power options (windows, mirrors, seats, door locks), theft deterrents, remote starter, seat heaters

diagnostic tools and equipment include: DMMs, scan tools, circuit testers

procedures used to diagnose include: verify concerns, perform inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

E-14.06 Diagnoses instrumentation and information displays

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-14.06.01L	demonstrate knowledge of instrumentation and information displays, their components and operation	identify safety considerations pertaining to instrumentation and information displays
		identify jurisdictional requirements pertaining to instrumentation and information displays
		identify types of instrumentation systems and describe their components and operation
		identify types of information displays and describe their purpose and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
E-14.06.02L	demonstrate knowledge of the procedures used to diagnose instrumentation and information displays	describe relationship of instrumentation and information displays to the vehicle networking system
		describe the procedures used to diagnose instrumentation and information displays

RANGE OF VARIABLES

safety considerations include: accidental restraint system deployment

jurisdictional requirements pertaining to instrumentation and information displays include: odometer servicing

instrumentation systems include: gauges, warning indicators

diagnostic tools and equipment include: DMMs, scan tools, circuit testers

procedures used to diagnose include: verify concerns, perform inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

E-14.07 Diagnoses electrical accessories

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-14.07.01L	demonstrate knowledge of electrical accessories , their components and operation	identify safety considerations pertaining to electrical accessories
		identify types of electrical accessories and describe their components and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		describe relationship of electrical accessories to the vehicle networking system
E-14.07.02L	demonstrate knowledge of the procedures used to diagnose electrical accessories	describe the procedures used to diagnose electrical accessories

RANGE OF VARIABLES

safety considerations include: accidental restraint system deployment

electrical accessories include: theft deterrents, audio/video, remote starter

diagnostic tools and equipment include: DMMs, circuit testers

procedures used to diagnose include: verify concerns, perform sensory inspection, retrieve DTCs, access service, information, conduct tests and measurements, isolate problem, identify root cause

TASK E-15 Repairs electrical systems and components

TASK DESCRIPTOR

Electrical systems include electrical accessories, options and information entertainment systems. For the purpose of this RSOS, work on information and entertainment systems are described separately. In many cases in industry these are combined and are referred to as infotainment systems. Repairs have to be performed according to manufacturers' information. Incorrect processes can result in personal injury and component failure.

E-15.01 Repairs basic wiring and electrical systems

Apprenticeship Level	1																					
Essential Skills	Thinking, Document Use, Digital Technology																					
KNOWLEDGE																						
	<table><tr><th>Learning Outcomes</th><th>Learning Objectives</th></tr><tr><td rowspan="3">E-15.01.01L</td><td>demonstrate knowledge of basic electrical and electronic principles</td><td>explain basic electrical theory</td></tr><tr><td></td><td>explain basic computer operation</td></tr><tr><td></td><td>identify types of electrical components and describe their purpose and operation</td></tr><tr><td rowspan="2">E-15.01.02L</td><td>demonstrate knowledge of electrical circuits, their components and operation</td><td>describe the application of Ohm's law to electrical circuits</td></tr><tr><td></td><td>identify types of wire and describe their characteristics, composition and applications</td></tr><tr><td rowspan="3">E-15.01.03L</td><td>demonstrate knowledge of the procedures used to repair electrical circuits and components</td><td>interpret diagnostic flowcharts and schematics</td></tr><tr><td></td><td>identify types of repair tools and equipment used to repair electrical circuits and components and describe their applications and procedures for use</td></tr><tr><td></td><td>identify methods of wire repair and describe their associated procedures</td></tr></table>	Learning Outcomes	Learning Objectives	E-15.01.01L	demonstrate knowledge of basic electrical and electronic principles	explain basic electrical theory		explain basic computer operation		identify types of electrical components and describe their purpose and operation	E-15.01.02L	demonstrate knowledge of electrical circuits , their components and operation	describe the application of Ohm's law to electrical circuits		identify types of wire and describe their characteristics, composition and applications	E-15.01.03L	demonstrate knowledge of the procedures used to repair electrical circuits and components	interpret diagnostic flowcharts and schematics		identify types of repair tools and equipment used to repair electrical circuits and components and describe their applications and procedures for use		identify methods of wire repair and describe their associated procedures
Learning Outcomes	Learning Objectives																					
E-15.01.01L	demonstrate knowledge of basic electrical and electronic principles	explain basic electrical theory																				
		explain basic computer operation																				
		identify types of electrical components and describe their purpose and operation																				
E-15.01.02L	demonstrate knowledge of electrical circuits , their components and operation	describe the application of Ohm's law to electrical circuits																				
		identify types of wire and describe their characteristics, composition and applications																				
E-15.01.03L	demonstrate knowledge of the procedures used to repair electrical circuits and components	interpret diagnostic flowcharts and schematics																				
		identify types of repair tools and equipment used to repair electrical circuits and components and describe their applications and procedures for use																				
		identify methods of wire repair and describe their associated procedures																				

	describe the procedures used to repair and/or replace electrical circuits and components
	describe procedures used to verify repair

RANGE OF VARIABLES

basic electrical and electronic principles include: conventional theory, electron theory, Ohm's Law, Watt's Law, magnetism, induced voltages

basic computer operation includes: inputs and outputs

electrical components purpose and operation include: circuit protection, control devices, load devices

electrical circuits include: series circuit, parallel circuit and series-parallel circuits

repair tools and equipment include: hand tools, air tools, soldering equipment

methods include: splicing, terminal replacement, soldering, crimping

E-15.02 Repairs starting/charging systems and batteries

Apprenticeship Level	1,2
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-15.02.01L	demonstrate knowledge of starting/charging systems and batteries, their components and operation	identify types of starting/charging systems and batteries and describe their components and operation
		identify safety considerations
		identify types of control systems and describe their components and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe relationship of starting/charging systems and batteries to the vehicle networking system
E-15.02.02L	demonstrate knowledge of the procedures to repair starting/charging system components and batteries	describe the procedures used to adjust, repair and/or replace starting/charging system components and batteries
		describe procedures used to verify repair

RANGE OF VARIABLES

safety considerations include: battery explosions, corrosive materials, high voltage

control systems include: anti-theft/immobilizer, safety interlock devices

repair tools and equipment include: scan tools, hand tools, air tools, DMMs, specialized tools

E-15.03 Repairs lighting and wiper systems

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-15.03.01L	demonstrate knowledge of lighting and wiper systems , their components and operation	identify safety considerations pertaining to lighting and wiper systems
		identify jurisdictional requirements pertaining to lighting and wiper systems
		identify types of lighting and wiper systems and describe their components and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe relationship of lighting and wiper systems to the vehicle networking system
E-15.03.02L	demonstrate knowledge of the procedures to repair lighting and wiper systems	describe the procedures used to adjust, repair and/or replace lighting and wiper system components
		describe procedures used to verify repair

RANGE OF VARIABLES

safety considerations include: HID, pinch points, lamps

lighting and wiper systems include: electrically controlled, electronically controlled

repair tools and equipment include: hand tools, scan tools, air tools, reprogramming equipment, specialized tools, DMMs

lighting components include: light bulbs, switches, modules

wiper components include: switches, linkages/transmissions, controls, wiper motors

E-15.04 Repairs entertainment systems

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-15.04.01L	demonstrate knowledge of entertainment systems, their components and operation	identify types of repair tools and equipment and describe their applications and procedures for use describe relationship of entertainment systems to the vehicle networking system
E-15.04.02L	demonstrate knowledge of the procedures used to repair entertainment systems	describe the procedures used to adjust, repair and/or replace entertainment systems describe procedures used to verify repair

RANGE OF VARIABLES

repair tools and equipment include: scan tools, hand tools, air tools, specialized tools, DMMs

E-15.05 Repairs electrical options

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-15.05.01L	demonstrate knowledge of basic electrical and electronic principles	explain basic electrical theory explain basic computer operation describe the application of Ohm's law to electrical circuits
E-15.05.02L	demonstrate knowledge of circuits, their components and operation	interpret diagnostic flowcharts and schematics identify types of wire and describe their characteristics, composition and applications identify safety considerations pertaining to electrical accessories identify types of electrical accessories and describe their components and operation

		identify types of repair tools and equipment used to test electrical options and describe their applications and procedures for use
		describe relationship of electrical accessories to the vehicle networking system
E-15.05.03L	demonstrate knowledge of the procedures used to repair electrical accessories	describe the procedures used to adjust, calibrate, repair and/or replace electrical accessories
		describe procedures used to verify repair

RANGE OF VARIABLES

basic electrical and electronic principles include: conventional theory, electron theory, Ohm's Law, Watt's Law, magnetism, induced voltages

basic computer operation includes: inputs, outputs

electrical circuits include: series circuit, parallel circuit, series-parallel circuits

electrical accessories include: power options, theft deterrents, audio/video, remote starter

repair tools and equipment include: scan tools, hand tools, air tools, reprogramming equipment, DMMs

E-15.06 Repairs instrumentation and information displays

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-15.06.01L	demonstrate knowledge of instrumentation and information displays, their components and operation	identify safety considerations pertaining to instrumentation and information displays
		identify jurisdictional requirements pertaining to instrumentation and information displays
		identify types of instrumentation systems and describe their components and operation
		identify types of information displays and describe their purpose and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe relationship of instrumentation and information displays to the vehicle networking system

E-15.06.02L	demonstrate knowledge of the procedures used to repair instrumentation and information displays	describe the procedures used to adjust, calibrate, repair and/or replace instrumentation and information displays
		describe procedures used to verify repair

RANGE OF VARIABLES

safety considerations include: accidental deployment of restraint systems

jurisdictional requirements pertaining to instrumentation and information displays include: odometer servicing

instrumentation systems include: gauges, warning indicators, digital, analog

information displays include: back-up camera, navigation systems, DIC

repair tools and equipment include: hand tools, air tools, scan tools, reprogramming equipment, DMMs

E-15.07 Installs electrical accessories

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-15.07.01L	demonstrate knowledge of electrical accessories , their components and operation	identify safety considerations pertaining to electrical accessories
		identify types of electrical accessories and describe their components and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe relationship of electrical accessories to the vehicle networking system
E-15.07.02L	demonstrate knowledge of the procedures used to install electrical accessories	describe the procedures used to install electrical accessories
		describe procedures used to verify installation

RANGE OF VARIABLES

electrical accessories include: theft deterrents, audio/video, remote starter, keyless technology

safety considerations include: accidental deployment of restraint systems

repair tools and equipment include: hand tools, air tools, scan tools, reprogramming equipment, DMMs

E-15.08 Repairs electrical accessories

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-15.08.01L	demonstrate knowledge of electrical accessories , their components and operation	identify safety considerations pertaining to electrical accessories
		identify types of electrical accessories and describe their components and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe relationship of electrical accessories to the vehicle networking system
E-15.08.02L	demonstrate knowledge of the procedures used to repair electrical accessories	describe the procedures used to adjust, calibrate, repair and/or replace electrical accessories
		describe procedures used to verify repair

RANGE OF VARIABLES

electrical accessories include: theft deterrents, audio/video, remote starter

safety considerations include: accidental deployment of restraint systems

repair tools and equipment include: scan tools, hand tools, air tools, reprogramming equipment, DMMs

TASK E-16 Diagnoses heating, ventilation and air conditioning (HVAC) and comfort control systems

TASK DESCRIPTOR

Automotive service technicians diagnose HVAC systems. These systems are responsible for heating and cooling the passenger cabins for occupants' comfort. Diagnostics have to be performed according to manufacturers' information and jurisdictional regulations. Incorrect processes can result in personal injury, component failure and environmental damage.

E-16.01 Diagnoses air flow control systems

Apprenticeship Level	4																
Essential Skills	Document Use, Thinking, Digital Technology																
KNOWLEDGE																	
	<table><tr><th>Learning Outcomes</th><th>Learning Objectives</th></tr><tr><td>E-16.01.01L</td><td>demonstrate knowledge of air flow control systems, their components and operation</td></tr><tr><td></td><td>identify air flow control systems, their components and operation</td></tr><tr><td></td><td>identify safety considerations pertaining to air flow control systems</td></tr><tr><td></td><td>identify types of specialized tools and equipment and describe their applications and procedures for use</td></tr><tr><td></td><td>identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications</td></tr><tr><td>E-16.01.02L</td><td>demonstrate knowledge of the procedures used to diagnose air flow control systems</td></tr><tr><td></td><td>describe the procedures used to diagnose air flow control systems</td></tr></table>	Learning Outcomes	Learning Objectives	E-16.01.01L	demonstrate knowledge of air flow control systems, their components and operation		identify air flow control systems, their components and operation		identify safety considerations pertaining to air flow control systems		identify types of specialized tools and equipment and describe their applications and procedures for use		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications	E-16.01.02L	demonstrate knowledge of the procedures used to diagnose air flow control systems		describe the procedures used to diagnose air flow control systems
Learning Outcomes	Learning Objectives																
E-16.01.01L	demonstrate knowledge of air flow control systems, their components and operation																
	identify air flow control systems, their components and operation																
	identify safety considerations pertaining to air flow control systems																
	identify types of specialized tools and equipment and describe their applications and procedures for use																
	identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications																
E-16.01.02L	demonstrate knowledge of the procedures used to diagnose air flow control systems																
	describe the procedures used to diagnose air flow control systems																

RANGE OF VARIABLES

components include: cabin filter, blower motors, actuators, ventilation systems, duct work, control units, connectors, blend door motors, resistors

safety considerations include: airborne contaminants, mould spores, pinch points

procedures used to diagnose include: verify concerns, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

E-16.02 Diagnoses refrigerant systems

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-16.02.01L	demonstrate knowledge of refrigerant systems, their components and operation	identify safety considerations pertaining to refrigerant systems
		identify refrigerant system components , their components and operation
		identify types of refrigerants and lubricants and describe their applications and procedures for use
		identify jurisdictional requirements pertaining to handling, storage, use and disposal of refrigerants and lubricants
		explain the principles of the refrigeration cycle
		describe the procedures used to identify, recover, recycle, evacuate and recharge refrigerant systems
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify related systems and describe their relationship to refrigerant systems
E-16.02.02L	demonstrate knowledge of the procedures used to diagnose refrigerant systems	describe refrigerant systems specific to hybrid and electric vehicles
		describe the procedures used to diagnose refrigerant systems

RANGE OF VARIABLES

safety considerations include: handling of refrigerant, risk of personal injury, rotating components, pinch points

refrigerant system components include: orifice tube, thermal expansion valve, hoses, tubing, A/C compressors

jurisdictional requirements include: handling and disposal, storing and recycling, heating, HRAI licensing and certification

diagnostic tools and equipment include: refrigerant leak detectors, refrigerant identifiers, DMMs, circuit testers, AC machines, detection equipment, scan tools

related systems include: engine cooling system, accessory drives, HVAC system, vehicle management system

procedures used to diagnose include: verify concerns, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem and identify root cause

E-16.03 Diagnoses heating systems

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-16.03.01L	demonstrate knowledge of heating systems, their components and operation	identify types of heating systems and describe their components and operation
		identify safety considerations pertaining to heating systems
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify related systems and describe their relationship to heating systems
E-16.03.02L	demonstrate knowledge of the procedures used to diagnose heating systems	describe the procedures used to diagnose heating systems

RANGE OF VARIABLES

components include: cabin filters, blower motors, actuators, heater core, thermostats, fans **safety**

considerations include: airborne contaminants, mould spores, pinch points

diagnostic tools and equipment include: DMMs, scan tools, infrared thermometers, circuit testers, black lights, inspection cameras

related systems include: AC systems, engine cooling system, vehicle management system, air flow

procedures used to diagnose include: verify concerns, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

TASK E-17 Repairs heating, ventilation and air conditioning (HVAC) and comfort control systems

TASK DESCRIPTOR

Automotive service technicians repair HVAC systems. These systems are responsible for heating and cooling the passenger cabins for occupants' comfort. Repairs have to be performed according to manufacturers' information and jurisdictional regulations. Incorrect processes can result in personal injury, component failure and environmental damage.

E-17.01 Repairs air flow control systems

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Digital Technology
KNOWLEDGE	
	<div>Learning Outcomes</div> <div>Learning Objectives</div>
E-17.01.01L	<div>demonstrate knowledge of air flow control systems, their components and operation</div> <div>identify air flow control systems, their components and operation</div>
	<div></div> <div>identify safety considerations pertaining to air flow control systems</div>
	<div></div> <div>identify types of repair tools and equipment and describe their applications and procedures for use</div>
	<div></div> <div>identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications</div>
E-17.01.02L	<div>demonstrate knowledge of the procedures used to repair air flow control systems</div> <div>describe the procedures used to repair air flow control systems</div>
	<div></div> <div>describe the procedures used to remove and reinstall air flow control system components</div>
	<div></div> <div>describe procedures used to verify repair</div>

RANGE OF VARIABLES

components include: cabin filter, blower motors, actuators, ventilation systems, duct work, control units, connectors, blend door motors, resistors

safety considerations include: airborne contaminants, mould spores, pinch points

repair tools and equipment include: hand tools, air tools, scan tools, specialized tools

E-17.02 Repairs refrigerant systems

Apprenticeship Level	1,4
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-17.02.01L	demonstrate knowledge of refrigerant systems, their components and operation	identify safety considerations pertaining to refrigerant systems
		identify refrigerant systems, their components and operation
		identify types of refrigerants and lubricants and describe their applications and procedures for use
		identify jurisdictional requirements pertaining to refrigerants and lubricants
		explain the principles of the refrigeration cycle
		describe the procedures used to identify, recover, recycle, evacuate and recharge refrigerant systems
		identify types of repair tools and equipment and describe their applications and procedures for use
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		describe refrigerant systems specific to hybrid and electric vehicles
E-17.02.02L	demonstrate knowledge of the procedures used to repair refrigerant systems	describe the procedures used to repair refrigerant systems
		describe the procedures used to remove and reinstall refrigerant system components
		describe procedures used to verify repair

RANGE OF VARIABLES

safety considerations include: handling of refrigerant, risk of personal injury, rotating components, pinch points, high voltage compressors (for hybrid and EV)

jurisdictional requirements include: handling and disposal, storing and recycling, HRAI licensing and certification

repair tools and equipment include: hand tools, air tools, scan tools, specialized tools, AC machine

components include: switches, wiring, expansion valves, compressors, evaporators, condensers, lines and seals

E-17.03 Repairs heating systems

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
Learning Outcomes		Learning Objectives
E-17.03.01L	demonstrate knowledge of heating systems, their components and operation	identify types of heating systems and describe their components and operation
		identify safety considerations pertaining to heating systems
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of repair tools and equipment and describe their applications and procedures for use
E-17.03.02L	demonstrate knowledge of the procedures used to repair heating systems	describe the procedures used to repair heating systems
		describe the procedures used to remove and reinstall heating system components
		describe the procedures used to fill and bleed heating systems
		describe procedures used to verify repair

RANGE OF VARIABLES

components include: heater core, heater hoses, thermostat, coolant flow valve, gaskets

safety considerations include: airborne contaminants, mould spores, pinch points, burns, personal injury

repair tools and equipment include: hand tools, air tools, scan tools, vacuum fill tools, DMMs

MAJOR WORK ACTIVITY F

Diagnoses and repairs steering and suspension, braking, control systems, tires, hubs and wheel bearings

TASK F-18 Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings

TASK DESCRIPTOR

Steering systems transmit inputs from the driver to the wheel assembly actuated through various mechanical and electrical inputs and outputs. The steering system is designed for precise directional control of the vehicle.

Suspension systems are used to support and cushion the vehicle, absorbing road surface irregularities and smoothing the vehicle ride. The suspension is designed for controlled movement over irregular surfaces.

Braking systems slow or stop the vehicle in a safe and controlled manner by using hydraulic or electronic controls. The vehicle braking systems are operated by the power unit that supplies hydraulic or electric inputs and outputs to various components such as calipers, wheel cylinders and actuators.

Control systems such as antilock braking systems (ABS), adaptive cruise control (ACC), traction control systems (TCS) and dynamic stability control (DSC) are incorporated into many of today's vehicles.

Tires, wheels, hubs and wheel bearings are diagnosed by automotive service technicians in order to ensure the safe and correct operation of the vehicle such as wheel balance and wheel alignment.

F-18.01 Diagnoses steering, suspension and control systems

Apprenticeship Level	1,2
Essential Skills	Thinking, Reading, Document Use

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
F-18.01.01L	demonstrate knowledge of suspension systems , their components and operation	identify types of suspension systems and describe their components and operation
		identify types of springs and describe their purpose and operation
		identify types of dampers and describe their components and operation
		describe suspension geometry

F-18.01.02L	demonstrate knowledge of the procedures used to diagnose suspension systems	describe the procedures used to diagnose suspension systems
F-18.01.03L	demonstrate knowledge of steering systems , their components and operation	identify safety considerations pertaining to steering systems
		identify types of steering columns and describe their components and operation
		identify types of steering systems and describe their components and operation
		identify related systems and describe their relationship to steering systems
		identify types of steering assist systems and describe their components and operation
		identify types of power steering pumps and describe their components and operation
		identify types of fluids and lubricants, fasteners, tubing, hoses, gaskets and seals and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		describe the procedures used to disarm passive restraints
		describe steering geometry
F-18.01.04L	demonstrate knowledge of the procedures used to diagnose steering systems	describe the procedures used to diagnose steering systems
F-18.01.05L	demonstrate knowledge of electronically controlled suspension systems, their components and operation	identify types of electronically controlled suspension systems
		identify types of electronically controlled suspension system components
		describe the procedures used to diagnose electronically controlled suspension systems
F-18.01.06L	demonstrate knowledge of the procedures used to diagnose and perform wheel alignments	describe the procedures used to diagnose and perform wheel alignments

RANGE OF VARIABLES

suspension systems include: MacPherson strut, leaf spring, independent, monobeam, electronic suspension systems

springs include: coil, leaf, torsion bar, air

dampers include: struts, shocks

procedures used to diagnose include: verify concern, perform sensory inspection, access service information, conduct tests and measurements, isolate problem, identify root cause

steering systems include: rack-and-pinion, recirculating ball (steering box)

safety considerations include: accidental deployment of passive restraints (air bags, clock springs), collapsible columns, loaded components

steering columns include: tilt, telescopic

steering system components include: tie rods, idler arms, pitman arms, center links

related systems include: lane departures, active park assist

steering assist systems include: electric, hydraulic, variable

power steering pumps include: hydraulic, gear, vane

diagnostic tools and equipment include: scan tools, pressure gauges, dial indicators, alignment machine

F-18.02 Diagnoses braking and control systems

Apprenticeship Level	1,2
Essential Skills	Document Use, Numeracy, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
F-18.02.01L	demonstrate knowledge of braking systems, their components and operation	identify safety considerations pertaining to braking systems
		explain hydraulic principles related to braking systems
		identify types of braking systems and describe their components and operation
		identify types of braking systems in hybrid and EVs
		identify types of power assists and describe their components and operation
		identify types of control systems and describe their components and operation
		identify types of brake fluids and describe their applications and procedures for use
		identify types of fittings, flaring, tubing and hoses and describe their applications and procedures for use
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify types of trailer brakes and controls and describe their components and operation

F-18.02.02L	demonstrate knowledge of the procedures used to diagnose braking systems	describe the procedures used to diagnose braking systems
F-18.02.03L	demonstrate knowledge of the procedures used to diagnose control systems	describe the procedures used to diagnose control systems

RANGE OF VARIABLES

safety considerations include: hydraulic pressure, airborne contaminants

braking system components include: discs, drums, pads, calipers, shoes, lines, cylinders, metering valves or blocks, proportioning valves, pressure limiting systems, actuators

power assists include: vacuum, hydraulic, electric

control systems include: TCS, ABS, stability control

diagnostic tools and equipment include: scan tools, pressure gauges, measuring tools

procedures used to diagnose include: verify concerns, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

F-18.03 Diagnoses tires, wheels, hubs and wheel bearings

Apprenticeship Level	1
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
F-18.03.01L	demonstrate knowledge of tires, wheels, hubs, bearings, their components and operation	identify safety considerations pertaining to tires, wheels, hubs and wheel bearings, their components and operation
		identify types of tires and describe their construction
		interpret tire codes and sidewall markings
		describe the importance of tire pressure and rotation
		identify types of wheels and describe their components and construction
		identify types of hubs and bearing assemblies and describe their components and operation
		identify types of tire pressure monitoring systems and describe their applications
		identify types of lubricants and describe their applications and procedures for use

		describe the relationship between the steering, suspension and wheel assemblies
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
F-18.03.02L	demonstrate knowledge of the procedures used to diagnose tires, wheels, bearings and hubs	describe the procedures used to diagnose tires, wheels, bearings and hubs

RANGE OF VARIABLES

safety considerations include: tire inflation procedure, mounting, pinch points, lifting and support procedures

types of tires include: snow, run flats, radials, bias, passenger, light truck

types of wheels include: steel alloy

wheel construction includes: offset, drop zone, deep flange, hub surface

hubs include: pressed in, integral, tapered roller

types of tire pressure monitoring systems include: passive, active

diagnostic tools and equipment include: measuring tools, pressure gauges, chassis ears, stethoscopes, vibration analyzers, TPMS equipment

procedures used to diagnose include: verify concern, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

TASK F-19 Repairs steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings

TASK DESCRIPTOR

Steering, suspension, braking and control systems, tires, wheels, hubs and wheel bearings work together to allow the driver to control the vehicle. Repairs must be performed according to manufacturers' information. Incorrect processes can result in personal injury and component failure.

F-19.01 Repairs steering, suspension and control systems

Apprenticeship Level	1,2
Essential Skills	Document Use, Numeracy, Thinking
KNOWLEDGE	
	<div>Learning Outcomes</div> <div>Learning Objectives</div>
F-19.01.01L	<div>demonstrate knowledge of suspension systems, their components and operation</div> <div>identify types of suspension systems and describe their components and operation</div>
	<div></div> <div>identify safety considerations pertaining to suspension systems</div>
	<div></div> <div>identify types of springs and describe their purpose and operation</div>
	<div></div> <div>identify types of dampers and describe their components and operation</div>
F-19.01.02L	<div>demonstrate knowledge of the procedures used to repair suspension systems</div> <div>describe the procedures used to repair suspension systems</div>
	<div></div> <div>describe the procedures used to remove and reinstall suspension system components</div>
	<div></div> <div>describe the procedures used to adjust, repair and/or replace suspension system components</div>
F-19.01.03L	<div>demonstrate knowledge of the procedures used to repair steering systems</div> <div>describe the procedures used to remove and reinstall steering system components</div>
	<div></div> <div>describe the procedures used to adjust, repair and/or replace steering system components</div>
	<div></div> <div>identify related systems and describe their relationship to steering systems</div>
F-19.01.04L	<div>demonstrate knowledge of the procedures used to repair wheel alignment and electronically-controlled suspension systems</div> <div>describe the procedures used to remove and reinstall electronically-controlled suspension systems components</div>

	describe the procedures used to adjust, repair and/or replace electronically-controlled suspension systems components
	describe the procedures to perform wheel alignment
	describe the procedures to reset steering sensors
	describe procedures used to verify repair

RANGE OF VARIABLES

suspension systems include: MacPherson strut, leaf spring, independent, monobeam, electronic suspension systems

safety considerations include: accidental deployment of passive restraints (air bags, clock springs), collapsible columns, loaded components (ball joints, first struts)

suspension system components include: springs, dampers, control arms, ball joints

steering systems include: rack-and-pinion, recirculating ball (steering box)

steering system components include: tie rods, idler arms, pitman arms, center links, columns, rack-and-pinion steering box, modules

related systems include: lane departures, active park assist

F-19.02 Repairs braking and control systems

Apprenticeship Level	1,2
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
F-19.02.01L	demonstrate knowledge of braking systems , their components and operation	explain hydraulic principles related to braking systems
		identify safety considerations pertaining to braking system repairs
		identify types of braking systems and describe their components and operation
		identify types of power assists and describe their components and operation
		identify types of control systems and describe their components and operation
		identify types of brake fluids and describe their applications and procedures for use
		identify types of fittings, flaring, tubing and hoses and describe their applications and procedures for use

		identify types of repair tools and equipment and describe their applications and procedures for use
		identify types of trailer brakes and controls and describe their components and operation
		identify types of braking systems in hybrid and EVs
F-19.02.02L	demonstrate knowledge of the procedures used to repair braking systems	describe the procedures used to repair braking systems
		describe the procedures used to flush and bleed hydraulic and anti-lock brakes
		describe the procedures used to measure and machine components
		describe the procedures used to adjust, repair and replace braking system components
		describe procedures used to verify repair
F-19.02.03L	demonstrate knowledge of the procedures used to repair control systems	describe procedures used to repair control systems

RANGE OF VARIABLES

braking systems include: hydraulic, electric, park brake

braking system components include: discs, drums, pads, calipers, shoes, lines, cylinders

safety considerations include: hydraulic pressure, airborne contaminants

power assists include: vacuum, hydraulic, electric

control systems include: TCS, ABS, stability control

repair tools and equipment include: hand tools, air tools, scan tools, pressure gauges, measuring tools, lathe, reprogramming equipment

F-19.03 Repairs tires, wheels, hubs and wheel bearings

Apprenticeship Level	1
Essential Skills	Document Use, Digital Technology, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
F-19.03.01L	demonstrate knowledge of tires, wheels, hubs, wheel bearings, their components and operation	identify types of tires and describe their construction
		identify safety considerations pertaining to tires, wheels, hubs and wheel bearings repair
		interpret tire codes and sidewall markings

		describe the importance of tire rotation, balance and pressure
		identify types of wheels and describe their components and operation
		identify types of hubs and bearing assemblies and describe their components and operation
		identify types of tire pressure monitoring systems and describe their applications
		identify types of lubricants and describe their applications and procedures for use
		describe the relationship between the steering, suspension and wheel assemblies
		identify types of repair tools and equipment and describe their applications and procedures for use
F-19.03.02L	demonstrate knowledge of the procedures used to repair tires, wheels, hubs and wheel bearings	describe the procedures used to repair tires, wheels, hubs and wheel bearings
		describe the procedures used to remove and reinstall tires, wheels, hubs and wheel bearings
		describe the procedures used to repair and replace tires, wheels, hubs and wheel bearings
		describe procedures used to verify repair

RANGE OF VARIABLES

types of tires include: snow, run flats, radials, bias, passenger, light truck

safety considerations include: tire inflation procedure, mounting, pinch points, lifting and support procedures, noise levels

types of wheels include: steel alloy

types of tire pressure monitoring systems include: passive, active

repair tools and equipment include: hand tools, air tools, scan tools, wheel balancers, tire changing machines, tire pressure monitoring tools, presses, pullers, tire inflation cage

procedures include: dismounting and mounting, puncture repair, cleaning, resealing, servicing bearings, balancing

MAJOR WORK ACTIVITY G

Diagnoses and repairs restraint systems, body components, accessories and trim

TASK G-20 Diagnoses restraint systems, body components, accessories and trim

TASK DESCRIPTOR

Restraint systems are designed to provide additional protection for the occupants of the vehicle.

Body components, accessories and trim are designed to enhance structural integrity, vehicle appearance and function. They secure the occupant and storage compartments of a vehicle as well as enhance vehicle safety.

Diagnoses must be performed according to manufacturers' information. Incorrect processes can result in personal injury and component failure.

G-20.01 Diagnoses restraint systems

Apprenticeship Level	4
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
G-20.01.01L	demonstrate knowledge of restraint systems , their components and operation	identify types of restraint systems and describe their operation
		identify restraint system components and describe their purpose and operation
		identify jurisdictional requirements pertaining to restraint systems
		identify safety considerations related to restraint systems
		identify types of restraint system monitoring and warning systems and describe their purpose

G-20.01.02L	demonstrate knowledge of the <i>procedures used to diagnose</i> restraint systems	describe the <i>procedures used to diagnose</i> restraint systems
		identify types of <i>diagnostic tools and equipment</i> and describe their applications and procedures for use

RANGE OF VARIABLES

restraint systems include: active and passive

restraint system components include: seatbelts, steering column (collapsible and pyrotechnic), OCS, various airbags, pre-tensioner systems, crash sensor, control modules, clock spring, buckles, retractors, seat belt track, seat track frame, seat belt covers

safety considerations include: handling, disposal, storage, manufacturers' protocols

restraint system monitoring and warning systems include: warning indicators (chimes, lights)

procedures used to diagnose include: verify concern, visually inspect, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

diagnostic tools and equipment include: scan tools, hand tools, simulators, test leads, DMMs

G-20.02 Diagnoses wind noises, rattles and water leaks

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
G-20.02.01L	demonstrate knowledge of wind noises, rattles and water leaks and their causes	identify the sources of wind noises, rattles and water leaks and their causes
		explain the principles of basic aerodynamics related to body design
G-20.02.02L	demonstrate knowledge of the <i>procedures used to diagnose</i> wind noises, rattles and water leaks	describe the <i>procedures used to diagnose</i> wind noises, rattles and water leaks
		identify types of seals, adhesives, sealing materials and fasteners and describe their applications and procedures for use
		identify <i>diagnostic tools and equipment</i> and describe their applications and procedures for use

RANGE OF VARIABLES

procedures used to diagnose include: verify concern, perform sensory inspection, access service information, conduct tests and measurements, isolate problem, identify root cause

diagnostic tools and equipment include: chassis ears, water hose, stethoscope

G-20.03 Diagnoses interior and exterior components, accessories and trim

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Reading

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
G-20.03.01L	demonstrate knowledge of <i>interior and exterior components, accessories</i> and trim and their applications	identify <i>safety considerations</i> related to <i>interior and exterior components, accessories</i> and trim
		identify <i>interior and exterior components</i> , accessories and trim and describe their purpose and operation
		identify <i>flaws</i> related to <i>interior and exterior components</i> , accessories and trim
G-20.03.02L	demonstrate knowledge of the <i>procedures used to diagnose interior and exterior components</i> , accessories and trim	describe the <i>procedures used to diagnose interior and exterior components</i> , accessories and trim
		identify <i>diagnostic tools and equipment</i> and describe their applications and procedures for use

RANGE OF VARIABLES

interior and exterior components include: doors, seats, dashes, bumpers, mirrors

accessories include: bug shields, visors, spoilers, roof racks, bike racks, running boards

safety considerations include: restraint components (seatbelts, OCS, various airbags, pre-tensioner systems, crash sensors, control modules)

flaws include: fit, finish, form, function

procedures used to diagnose include: verify concern, perform sensory inspection, access service information, conduct tests and measurements, isolate problem, identify root cause

diagnostic tools and equipment include: hand tools, trim tools, hinge tools

G-20.04 Diagnoses latches, locks and movable glass

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Reading

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
G-20.04.01L	demonstrate knowledge of latches, locks and movable glass and their application	identify types of latches, locks and movable glass and their application

		distinguish between electrical and mechanical components
		identify safety considerations related to latches, locks and movable glass
G-20.04.02L	demonstrate knowledge of procedures used to diagnose latches, locks and movable glass	identify procedures used to diagnose latches, locks and movable glass
		identify diagnostic tools and equipment used to diagnose latches, locks and movable glass and describe their application and procedures for use

RANGE OF VARIABLES

components include: electrical (sensors, switches), mechanical (rods, fasteners, latches, hinges)

safety considerations include: pinch points, handling of glass

procedures used to diagnose include: verify concerns, perform sensory inspection, retrieve DTCs, access service information, conduct tests and measurements, isolate problem, identify root cause

diagnostic tools and equipment include: trim panel tools, hand tools

TASK G-21 Repairs restraint systems, body components, accessories and trim

TASK DESCRIPTOR

Form, fit, function, finish and safety are key considerations in the repair of restraint systems, body components, accessories and trim. Repairs must be performed according to manufacturers' information. Incorrect processes can result in personal injury and component failure.

G-21.01 Repairs restraint systems

Apprenticeship Level	4
Essential Skills	Document Use, Thinking, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
G-21.01.01L	demonstrate knowledge of restraint systems , their components and applications	identify types of restraint systems and describe their purpose and operation
		identify restraint system components and describe their purpose and operation
		identify safety considerations related to restraint systems and their components

		identify <i>jurisdictional requirements</i> pertaining to <i>restraint systems</i>
		identify types of restraint system monitoring and warning systems and describe their purpose
G-21.01.02L	demonstrate knowledge of the procedures used to repair <i>restraint systems</i>	describe the procedures used to repair <i>restraint systems</i>
		identify types of <i>repair tools and equipment</i> and describe their applications and procedures for use
		describe the procedures used to remove, repair, replace, adjust and reinstall electrical or <i>restraint system mechanical components</i>
		describe the procedures used to recycle or dispose of <i>restraint systems components</i> according to jurisdictional regulations
		describe proper care, handling and storage procedures of <i>restraint system components</i>
		identify procedures used to verify repair

RANGE OF VARIABLES

restraint systems include: active and passive

restraint system components include: seatbelts, pyrotechnic steering column, OCS, various airbags, pre-tensioner systems, crash sensor, control modules, clock spring, pyrotechnic devices

safety considerations include: handling, disposal, storage, manufacturers' protocols and safety procedures

jurisdictional requirements include: disposal, repair, motor vehicle inspection

repair tools and equipment include: scan tools, hand tools, air tools, repair kit, simulators, test leads, DMM

restraint systems' mechanical components include: buckles, retractors, seat belt track, seat track frame, seat belt covers

G-21.02 Repairs wind noises, rattles and water leaks

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Digital Technology

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
G-21.02.01L	demonstrate knowledge of wind noises, rattles and water leaks	identify types and <i>sources of wind noises, rattles and water leaks</i>
		explain the principles of basic aerodynamics related to body design
		identify types of <i>repair materials</i> and describe their applications and procedures for use
G-21.02.02L	demonstrate knowledge of the procedures used to repair wind noises, rattles and water leaks	identify types of <i>body components</i> and <i>accessories</i>
		describe the procedures used to repair wind noises, rattles and water leaks according to task being performed
		identify <i>repair tools and equipment</i> and describe their applications and procedures for use to repair wind noises, rattles and water leaks
		identify procedures used to verify repair

RANGE OF VARIABLES

sources of wind noises, rattles and water leaks include: missing sealant and adhesives, loose fasteners, panel misalignment, incorrect clearances, exterior accessories

repair materials include: lubricants, sealants, adhesives, fastening devices, tapes, insulators

body components include: interior (doors, seats, dashes), exterior (bumpers, mirrors, mounts)

accessories include: bug shields, visors, spoilers, roof racks, bike racks, running boards

repair tools and equipment include: trim tools, hand tools, air tools, scan tools

G-21.03 Repairs interior and exterior components, accessories and trim

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Reading

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
G-21.03.01L	demonstrate knowledge of interior and exterior components, accessories and trim and their applications	identify interior and exterior components , accessories and trim and describe their purpose and operation identify safety considerations related to interior and exterior components, accessories and trim
G-21.03.02L	demonstrate knowledge of the procedures used to repair interior and exterior components , trim and accessories	describe the procedures used to repair interior and exterior components, accessories and trim identify types of repair materials and describe their applications and procedures for use identify repair tools and equipment and describe their applications and procedures for use describe the procedures used to adjust, repair or replace interior and exterior components , accessories and trim identify procedures used to verify repair

RANGE OF VARIABLES

interior and exterior components include: doors, seats, dashes, bumpers, mirrors

accessories include: bug shields, visors, spoilers, roof racks, bike racks, running boards

repair materials include: adhesives, gaskets, seals and sealants, fastening devices, cleaners

repair tools and equipment include: trim tools, hand tools, air tools, scan tools

G-21.04 Repairs latches, locks and movable glass

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Reading

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
G-21.04.01L	demonstrate knowledge of latches, locks and movable glass and their applications	identify types of latches, locks and movable glass and their purpose and operation
		identify safety considerations related to latches, locks and movable glass
		identify warning systems
G-21.04.02L	demonstrate knowledge of procedures used to repair latches, locks and movable glass	identify procedures used to repair latches, locks and movable glass
		identify repair tools and equipment used to repair latches, locks and movable glass and describe their application and procedures for use
		identify procedures used to verify repair

RANGE OF VARIABLES

safety considerations include: pinch points, handling of glass

warning systems include: chimes, bells, lights

repair tools and equipment include: trim tools, hand tools, air tools

MAJOR WORK ACTIVITY H

Diagnoses and repairs hybrid and electric vehicles (EV)

TASK H-22 Diagnoses hybrid and electric vehicles (EV)

TASK DESCRIPTOR

Automotive Service Technicians diagnose electric motors, inverters, converters, high-voltage batteries and associated support systems in hybrid and EV. Safety is of paramount importance due to the risk of electrocution when working with high voltages.

H-22.01 Implements specific safety protocols for hybrid and electric vehicles (EV)

Apprenticeship Level	1,4	
Essential Skills	Thinking, Document Use, Reading	
	KNOWLEDGE	
	Learning Outcomes	Learning Objectives
H-22.01.01L	demonstrate knowledge of <i>safety protocols for hybrid and EV systems</i>	identify <i>safety protocols pertaining to hybrid and EV systems</i>

RANGE OF VARIABLES

safety protocols for hybrid and EV systems include: safe work procedures for high voltage, manufacturers' safety procedures

H-22.02 Diagnoses hybrid and electric vehicle (EV) systems

Apprenticeship Level	4	
Essential Skills	Thinking, Reading, Digital Technology	
	KNOWLEDGE	
	Learning Outcomes	Learning Objectives
H-22.02.01L	demonstrate knowledge of operations of hybrid and EV systems	identify the function of hybrid and EV systems
H-22.02.02L	demonstrate knowledge of diagnosing hybrid and EV systems	identify methods for diagnosing hybrid and EV systems

TASK H-23 Repairs hybrid and electric vehicles (EV)

TASK DESCRIPTOR

Automotive Service Technicians repair and service electric motors, inverters, converters, high-voltage batteries and associated support systems in hybrid and EV.

H-23.01 Repairs hybrid vehicle systems

Apprenticeship Level	4	
Essential Skills	Thinking, Digital Technology, Reading	
	KNOWLEDGE	
	Learning Outcomes	Learning Objectives
H-23.01.01L	demonstrates knowledge of repairing hybrid vehicle systems	identify methods for repair of hybrid vehicle systems

H-23.02 Repairs electric vehicle (EV) systems

Apprenticeship Level	4	
Essential Skills	Thinking, Digital Technology, Reading	
	KNOWLEDGE	
	Learning Outcomes	Learning Objectives
H-23.02.01L	demonstrates knowledge of repairing EV systems	identify methods for repairing EV systems

APPENDIX A

ACRONYMS

ABS	antilock braking systems
ACC	adaptive cruise control
AVR	alternator voltage regulator
AWD	all-wheel drive
BCM	body control module
CAN	controller area network
CMB	collision monitoring braking systems
CVT	constantly variable transmission
DCT	dual clutch transmission
DIC	driver information centre
DEF	diesel exhaust fluid
DLC	data link connection
DOC	diesel oxidation catalyst
DPF	diesel particulate filter
DSC	dynamic stability control
DTC	diagnostic trouble codes
DVOM	digital volt ohm meter
EGR	exhaust gas recirculation
EV	electric vehicles
EVAP	evaporative emission control systems
GDI	gasoline direct injection
GHS	Globally Harmonized System
GMAW	gas metal arc welding
HID	high intensity discharge
HRAI	heating, refrigeration and air conditioning institute of Canada
HVAC	heating, ventilation and air conditioning
IPC	instrument panel cluster
ISO	International Standards Organization
LIN	local interface network
MIG	metal inert gas welding
NA	naturally aspirated
NVH	noise, vibration and harshness
OCS	occupant classification system
OEM	original equipment manufacturer
OH&S	Occupational Health and Safety
PCM	powertrain control module

PCV	positive crankcase ventilation
PPE	personal protective equipment
SAE	Society of Automotive Engineers
SCR	Selective Catalyst Reduction
SDS	safety data sheets
SMAW	shielded metal arc welding
TCM	transmission control module
TCS	traction control systems
TPMS	tire pressure monitoring system
TSB	technical service bulletins
VCT	variable cam-timing
VIN	vehicle identification number
WHMIS	Workplace Hazardous Materials Information System

APPENDIX B

TOOLS AND EQUIPMENT

Standard Tool Kit

air die grinder	inspection mirror
air hammer/chisel	jumper lead
air ratchet	locking pliers
antifreeze tester	magnetic pick-up tool
axle boot clamp tools	mechanic's pick set
battery post service and reshape tool	metal files
belt tension release tool	micrometer – SAE and metric
blow gun	digital multimeter (DMM)
bolt and nut extractor set (easy-outs)	nut driver set – SAE and metric
brake service tools (adjusters, spring removal and installation tools, caliper tools)	pliers – slip joint, needle nose, multipurpose adjustable, side cutter, snap ring, inside pliers
caulking gun	pry bars
compression testers	pullers – gear, pulley, battery terminal and steering wheel
creeper	punches and chisels
crowfoot wrenches	ratchet and sockets – SAE and metric, swivel, spark plug, extensions and adapters
dial indicator set	refractometer
drill and bits	rivet gun
drill gauge	scraper (gasket and carbon)
feeler gauges – SAE and metric	screwdriver set
fender covers	seal drivers and extractors
filter wrenches	soldering tools
flare nut wrenches – SAE and metric	spark plug gapper
flaring tool (SAE, metric and ISO)	spark tester
flashlights	standard test leads and probes
fuel injector noid lights	stethoscope
fuel/transmission/air conditioning line disconnect set	straight edge
hacksaw	stud extractor
hammers – ball peen, dead blow, rubber mallet, softface	tap and die set – SAE, metric and pipe thread
hex keys and sockets – SAE and metric	tape and ruler
impact driver and bits	terminal remover tools
impact wrench and impact socket set – SAE and metric	test lamp

Standard Tool Kit (continued)

thermometer

thread files

timing light

tin snips – centre, left and right cut

tire pressure gauge

torque angle meter/indicator

torque limited sockets (torque sticks)

torque wrenches – various sizes and ranges

torx bits and sockets

tread depth gauge (for tires and brakes)

trouble light

tube bending tool

tube cutters

upholstery tools – trim panel tools, hog ring pliers

utility knife

vacuum pump

vacuum/pressure gauge

vernier caliper – SAE and metric

wire brush

wire stripper/crimping tool

wrench set – SAE and metric/various designs

Shop Tools and Equipment

acetylene torches

air compressor – hoses, inline filter and water separators

air conditioning flushing equipment

air conditioning leak detection and inspection equipment

air conditioning recovery/recycle/recharge station

air conditioning service and repair tools

airbag removal tools

airbag simulators

anti-static devices

ball joint press and adapters

battery chargers/boosting equipment

battery, alternator and starter tester (AVR)

battery power supply

bearing remover

belt tension gauge

bench grinders

bench vises

black light

borescope

brake cylinder hone

brake drum gauge

brake lathe

brake pressure tester

brake rotor gauge

brake system bleeder

CAT-IV meter (for hybrid vehicles)

camshaft bearing tools (removal and installation)

chassis ears

clutch alignment tools

clutch installers and removers

compression leak-down tester

computer – laptop, PC

coolant drain pans

cooling system pressure tester

cooling system recovery and flushing station

core plug/expansion plug installation tool

cylinder ridge reamer

drill press

electrical short detector

engine and transmission supports

engine cylinder hone

engine hanging supports; engine hoisting equipment

engine stand – portable

EVAP test equipment (smoke generator)

exhaust fan, ventilation hoses

exhaust pipe bender

Shop Tools and Equipment (continued)

floor jack	shop vacuum
fuel injector flushing kit	slide hammer
fuel quality tester	specialized tools for air conditioning systems
fuel recovery and storage station	specialized tools for engines and transmission
funnels	spreaders
gear puller set	spring compressors – coil spring and strut spring
grease gun – oil dispensing system, fluid suction pump	tire changing machine
hydraulic press	tire pressure monitoring systems (TPMS)
hydraulic transmission jack	tire repair equipment
insulated tools (for hybrid vehicles)	transmission fixtures
jack stands and supports	transmission flushing equipment
leak detection tank (tires)	transmission pressure test kit
lock pick set – lock out tools	vacuum fill tools
manometer	valve grinding equipment
oil drain barrels and disposal system	valve spring compressor
opacity meter	vehicle hoist
oscilloscope	vehicle service information system
parts washers/steam cleaners and blaster	water hose
piston ring compressor	welding equipment – TIG, GMAW, GTAW, MIG welder and oxy-fuel
piston ring installer	wheel alignment equipment
power steering pressure tester	wheel balancer
pressure washer	wheel chocks
propane enrichment tools	wheel ramps

Measuring Tools and Equipment

air conditioning pressure gauge	inclinometer
ammeter	infrared temperature gun
AVR (alternator voltage regulator)	micrometer – SAE and metric
back pressure gauge	oil pressure gauge set – engine/transmission
ball joint dial indicator set	opacity meter
battery load tester	plastic precision clearance gauge
coolant system pressure tester	power steering pressure tester
cylinder bore gauges – small bore gauge, telescoping gauge	pyrometer
electronic vibration analyzer	refractometer
fuel pressure gauges	refractor
headlight aiming equipment	scan tools
hole gauge	spring scale

Safety and Personal Protective Equipment

body protection – shop apron/heat resistant arm protectors

CSA approved safety foot wear

eye protection – face shield/goggles/safety glasses/welding goggles

eye wash station

fire extinguisher

first aid kits and station

hand protection – chemical/heat resistant, abrasion/leather, disposable latex gloves, gloves (for hybrid vehicles and EV)

hearing protection – ear muffs, ear plugs

respiratory protection – dust and particle masks, chemical filtered mask

safety hook (for hybrid and electric vehicles)

safety pylons (for hybrid and electric vehicles)

APPENDIX C

GLOSSARY

ammeter	instrument used to measure electrical current flow in a circuit
AVR	alternator voltage regulator; refers to a device that is used to test generators/alternators for electrical output, voltage and amperage
CAN	controller area network; a protocol for communication between electronic/computer modules
DMM	a digital electronic measuring instrument that combines several functions in one unit
accessories	features that are not originally equipped by the manufacturer
options	features that are originally equipped at time of manufacture
inclinometer	device used to measure the incline of an object, measured in degrees
J2534 standard	is an interface standard designed by SAE (Society of Automotive Engineers) for vehicle electronics reprogramming
jounce	the motion of a wheel that compresses its suspension. Full jounce refers to a wheel that is at the upper limits of its travel. Jounce is the opposite of rebound
manometer	a graduated tube containing water which measures pressure/vacuum in units of water column
micrometer	a precision measuring device for small distances
OBD	on board diagnostics are part of a vehicle's engine management software used to monitor system performance
Ohm's Law	the relationship between current, resistance and voltage in any electrical circuit
opacity meter (smoke)	an instrument that measure the optical properties of diesel exhaust
Pascal's Law	fluid pressure exerted in a sealed vessel is equal and undiminished in all directions
pneumatic	operated by compressed air
pyrometer	instrument used to measure temperatures
sensory inspection	using one or more senses to perform an inspection
refractor	test instrument used to measure the strength of antifreeze or specific gravity of electrolyte in a cell of a lead/acid battery
sirometer	test instrument used to measure RPM of an engine or frequency of a vibration with great accuracy
UART	universal asynchronous receive transmit; a protocol for communication between computer modules
Watt's Law	the relationship of power to current, voltage and resistance in any electrical circuit