

RED SEAL OCCUPATIONAL STANDARD

Automotive Service Technician



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Red Seal Occupational Standard Automotive Service Technician



Title: Automotive Service Technician

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Foreword

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Red Seal Occupational Standard (RSOS) as the Red Seal standard for the Automotive Service Technician trade.

Background

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to cooperate with provincial and territorial apprenticeship committees and officials in preparing analyzes of a number of skilled occupations. Employment and Social Development Canada (ESDC) funds the Red Seal Program, which, under the guidance of the CCDA, develops a national occupational standard for each of the Red Seal trades.

Standards have the following objectives:

- to describe and group the tasks performed by skilled workers;
- to identify which tasks are performed in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Red Seal Examinations and assessment tools for apprenticeship and certification authorities;
- to develop common tools for apprenticeship on-the-job and technical training in Canada;
- to facilitate the mobility of apprentices and skilled workers in Canada;
- to supply employers, employees, associations, industries, training institutions and governments with occupational standards.

Any questions, comments, or suggestions for changes, corrections, or revisions to this standard or any of its related products may be forwarded to:

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This standard was prepared by the Apprenticeship and Sectoral Initiatives Directorate of ESDC. The coordinating, facilitating and processing of this standard were undertaken by employees of the standards development team of the Trades and Apprenticeship Division and of Ontario, the host jurisdiction for this trade.

Structure of the Occupational Standard

This standard contains the following sections:

Methodology: an overview of the process for development, review, validation and weighting of the standard

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

Skills for Success Summary: an overview of how each of the skills for success (formerly called essential skills) is applied in this trade

Industry Expected Performance: description of the expectations regarding the level of performance of the tasks, including information related to specific codes, regulations and standards that must be observed

Language Requirements: description of the language requirements for working and studying in this trade in Canada

Pie Chart of Red Seal Examination Weightings: a graph which depicts the national percentages of exam questions assigned to the major work activities

Task Matrix and Weightings: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard and the national percentages of exam questions assigned to the major work activities and tasks

Harmonization of Apprenticeship Training: the aspects of apprenticeship training that participating provinces and territories have agreed upon to substantively align apprenticeship systems across Canada

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

Skills:

Performance Criteria: description of the activities that are done as the sub-task is performed

Evidence of Attainment: proof that the activities of the sub-task meet the expected performance of a tradesperson who has reached journeyperson level

Range of Variables: elements and examples (not all inclusive) that provide a more in-depth description of a term used in the performance criteria and evidence of attainment

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 of Variables: elements and examples (not all inclusive) that provide a more in-depth description of a term used in the learning outcomes and learning objectives

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

Appendix B – Tools and Equipment / Outils et équipement: a bilingual non-exhaustive list of tools and equipment used in this trade

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

Methodology

Development of the Standard

A draft standard is developed by a broad group of trade representatives, including tradespeople, instructors and employers at a National Workshop led by a team of facilitators. This draft standard breaks down all the tasks performed in the occupation and describes the knowledge and abilities required for a tradesperson to demonstrate competence in the trade.

Harmonization of Apprenticeship Training

An analysis of all provinces' and territories' apprenticeship programs is performed, and recommendations are made on harmonizing the name of the trade, the hours of training required and the number of levels of training. Provinces and territories consult with their respective industry stakeholders on these elements and revisions are discussed until consensus is reached. Following the development of the workshop draft of the RSOS, participants discuss and come to consensus on the sequence of training topics, as expressed in the new standard. Their sequencing recommendations are reviewed by stakeholders in participating provinces and territories and further discussions are convened to reach consensus and to identify any exceptions.

Online Survey

Stakeholders are asked to review and validate the activities described in the new standard via an online survey. These stakeholders are invited to participate in this consultation through apprenticeship authorities, as well as national stakeholder groups.

Draft Review

The RSOS development team forwards a copy of the standard to provincial and territorial authorities who consult with industry representatives to review it. Their recommendations are assessed and incorporated into the standard.

Validation and Weighting

Participating provinces and territories also consult with industry to validate and weight the document for the purpose of planning the makeup of the Red Seal Interprovincial Examination for the trade. They validate and weight the major work activities (MWA), tasks and sub-tasks, of the standard as follows:

MWA	Each jurisdiction assigns a percentage of questions to each MWA for an examination that would cover the entire trade.
Tasks	Each jurisdiction assigns a percentage of exam questions to each task within a MWA.
Sub-tasks	Each jurisdiction indicates, with a "yes" or "no", whether or not each sub-task is performed by skilled workers within the occupation in its jurisdiction.

The results of this exercise are submitted to the RSOS development team who then analyzes the data and incorporates it into the document. The RSOS provides the individual jurisdictional validation results as well as the national averages of all responses. The national averages for MWA and task weighting guide the Interprovincial Red Seal Examination plan for the trade.

The validation of the RSOS is used to identify common core sub-tasks across Canada for the occupation. If at least 70% of the responding jurisdictions' industry performs a sub-task, it shall be considered common core. Interprovincial Red Seal Examination questions are limited to the common core sub-tasks identified through this validation process.

Definitions for Validation and Weighting

yes	sub-task performed by qualified workers in the occupation in that province or territory
no	sub-task not performed by qualified workers in the occupation in that province or territory
NV	standard <u>N</u> ot <u>V</u> alidated by that province or territory
ND	trade <u>N</u> ot <u>D</u> esignated in a province or territory
Not Common Core (NCC)	sub-task, task or MWA performed less than 70% of responding jurisdictions; these will not be tested by the Interprovincial Red Seal Examination for the trade
National Average %	average percentage of questions assigned to each MWA and task in Interprovincial Red Seal Examination for the trade

Provincial/Territorial Abbreviations

NL	Newfoundland and Labrador
NS	Nova Scotia
PE	Prince Edward Island
NB	New Brunswick
QC	Quebec
ON	Ontario
MB	Manitoba
SK	Saskatchewan
AB	Alberta
BC	British Columbia
NT	Northwest Territories
YT	Yukon Territory
NU	Nunavut

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.

Automotive service technicians possess the full range of knowledge and abilities required to perform preventative maintenance, diagnose faults and repair automotive vehicle, light truck, hybrid vehicle and electric vehicle systems. These systems include engines, vehicle management, steering, braking, tires, wheels, drivetrains, suspension, electrical, advanced driver assistance systems [ADAS], electronics, heating, ventilation and air conditioning (HVAC), restraints, trim and accessories.

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. Safe work practices must be observed.

Some important attributes of automotive service technicians are: good hand-eye coordination, mechanical aptitude, time management skills, logical, analytical and critical thinking and decision-making skills, excellent communication and mentoring 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. Technicians can transfer their skills and knowledge to related occupations such as automotive instructor, industry parts and equipment representative, truck and transport mechanic, agricultural equipment technician or heavy duty equipment technician. Some technicians may open their own garage or automotive specialty shop.

Trends in the Automotive Service Technician Trade

Technology

There are ongoing improvements and new technology in ADAS that are available in most vehicles being manufactured today. These systems can significantly improve vehicle safety by incorporating key driving assistance functions such as forward collision warning, lane departure warning, automatic emergency braking (AEB), and several others. Automotive service technicians need to be knowledgeable of the vehicle-specific sensors used in ADAS and how to recalibrate them when performing maintenance and repairs.

More complex and powerful vehicle management systems are being used in today's vehicles. Technicians need to understand these new systems and how modules communicate to operate the various systems on the vehicle.

Hybrid and EV HVAC systems, depending on the manufacturer, are becoming more advanced in their design and technology. Technicians need to refer to vehicle-specific service information for these new technologies before working on these systems.

Vehicle communication networks integrate multiple systems such as safety, suspension, steering and braking. 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, gasoline direct injection (GDI) and autonomous driving systems.

Health and Safety

Automotive service technicians must be aware and knowledgeable of the safety protocols, procedures, tools and equipment, and specialized personal protective equipment (PPE) required while diagnosing, maintaining and repairing high voltage systems.

Tools and Equipment

Many repair shops have had to invest in costly tools, equipment and safety equipment (e.g., manufacturer-specific special service tools, high voltage battery lifts, testing equipment) for work on new vehicle systems and components such as hybrid and electric vehicles and ADAS.

Oscilloscopes (particularly PC-based scopes) are once again becoming a popular tool to quickly and accurately diagnose vehicle system faults. Modern accessories such as pressure transducers, inductive current probes, and vibration sensors broaden the number of uses for oscilloscopes in automotive applications. These accessories and leads can be used to inspect data bus communication, pinpoint noise, vibration and harshness (NVH) concerns, test various vehicle system sensors, and also non-intrusively verify engine mechanical issues such as cam to crank relationship, relative compression, and in-cylinder compression.

Environmental

Technicians must be conscious of the detrimental effects of hazardous materials (including lithium-ion and nickel-metal hydride batteries) on workers and the environment as well as being informed on the relevant regulations regarding their proper recycling and disposal. Transport of these materials must be done according to Transportation of Dangerous Goods (TDG) legislation.

Skills for Success Summary

Skills for Success are needed in a quickly changing world for work, learning and life. They are foundational for building other skills and important for effective social interaction. Everyone benefits from having these skills as they help individuals get a job, progress at their current job and change jobs. They also help individuals become active members of their community and succeed in learning.

Through extensive research and consultations, the Government of Canada launched the new Skills for Success model renewing the previous Essential Skills framework to better reflect the needs of the current and future labour market.

The summary presented here is based on existing Essential Skills profiles and will be updated to align with the new [Skills for Success model](#) over time.

Reading

Automotive service technicians must read and comprehend a variety of materials including repair information, 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.

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 customers, service managers, apprentices, co-workers, colleagues and suppliers. They may use different means for communication including speaking, listening and interacting using alternative methods of communication.

Numeracy

Automotive service technicians take a variety of measurements using recommended or required diagnostic tools and 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 faults. 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 co-workers and colleagues including apprentices, salespersons, partspersons and management to resolve concerns, situations and faults and for the purposes of mentorship.

Digital Technology

Automotive service technicians use computer-based scanning equipment and hand-held diagnostic tools to access vehicle operational data and perform digital service inspections. Automotive service technicians use online information, resources, technology to access and exchange information with other technicians, service managers, parts technicians, customers, colleagues and manufacturer support specialists.

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.

Roles and Opportunities for Skilled Trades in a Sustainable Future

Climate change affects all of us. Trades play a large role in implementing solutions and adjusting to changes in the world.

Throughout this standard, there may be specific references to tasks, skills and knowledge that clearly show this trade's role in a more sustainable future. Each trade has different roles to play and contributions to make in their own way.

For example:

- Construction tradespeople need to consider the materials they are using, building methods, and improvements to mechanical and electrical installations. There are important changes to codes and standards to help meet the climate change goals and commitments set for 2030 and 2050. Retrofits and new construction of low-energy buildings provide enormous opportunities for workers in this sector. Concepts, such as energy efficiency and regarding buildings as systems are foundational.
- Automotive and mechanical trades are seeing a shift towards the electrification of vehicles and equipment. As a result, new skills and knowledge will be required for tradespeople working in this sector. There are mandates for sales of new light-duty zero-emission vehicles (ZEV) in Canada, with the goal of achieving 100% ZEV sales by 2035. Due to this mandate, the demand for these vehicles is growing quickly among consumers and fleets. With this escalating demand, the need for skilled workers to maintain and repair these vehicles is also increasing.
- In industrial and resource sectors, there is pressure to move towards increased electrification of industrial processes. Many industrial and commercial facilities are also being upgraded to improve energy efficiency in areas such as lighting systems, and new production processes and technologies. There are also opportunities in carbon capture, utilization and storage (CCUS), as well as the production and export of low-carbon hydrogen.
- Trades in the service sector may also need to be aware of responsible sourcing, as well as efficient use of products and materials. New ways of working better are always a part of the job.

There are fast-moving changes in guidelines, codes, regulations and specifications. Many are being implemented for the purpose of energy efficiency and climate change. Those that affect specific trades may be mentioned within the standard. Examples of these guidelines and legislation include:

- The National Energy Code of Canada for Buildings (NECB).
- The Canadian Net-Zero Emissions Accountability Act (CNZEAA).
- programs that encourage sustainable building design and construction such as Leadership in Energy and Environmental Design (LEED) and the Zero Carbon Building (ZCB) standards.

- the Montreal Protocol for phasing out R22 refrigerants.
- energy efficiency programs such as ENERGY STAR.
- principles of the United Nations Declaration for the Rights of Indigenous Peoples pertaining to energy sector development.

Apprentices and tradespeople need to increase their climate literacy and reinforce their own understanding of energy issues and environmental practices. It is important for them to understand why these changes are happening and their effect on trades' work. While individual tradespeople and apprentices may not be able to choose certain elements like; the architectural design of buildings, building material selection, regulatory requirements, use of electric vehicles and technologies, they must understand the impact of using these elements in their work. Impacts include using environmentally friendly products and following requirements related to the disposal and recycling of materials.

In apprenticeship, as well as in ongoing professional development, employers and instructors should encourage learning about these concepts, why they are important, how they are implemented, and the overarching targets they are aiming to achieve.

All in all, it's about doing the work better and building a better world.

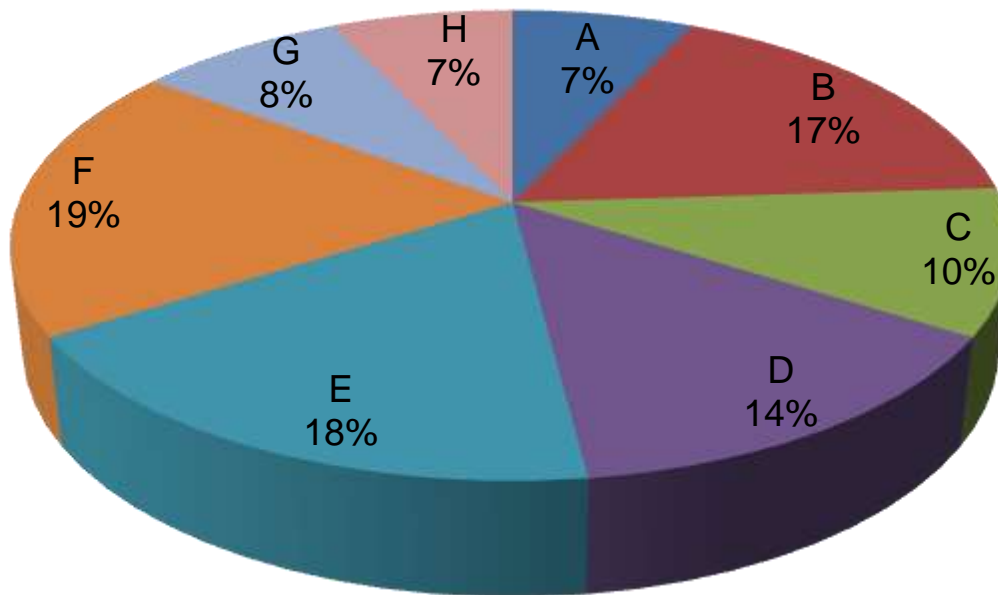
Industry Expected Performance

All tasks must be performed according to the applicable jurisdictional codes and standards. All health and safety standards must be respected and observed. Work should be performed efficiently and to a high quality without material waste or environmental damage. All requirements of employers, manufacturers, clients and quality control policies must be met. At a journeyperson level of performance, all tasks must be done with minimal direction and supervision. As a journeyperson progresses in their career there is an expectation they continue to upgrade their skills and knowledge to maintain pace with industry and promote continuous learning in their trade through mentoring of apprentices.

Language Requirements

It is expected that journeypersons are able to understand and communicate in either English or French, which are Canada's official languages. English or French are the common languages of business as well as languages of instruction in apprenticeship programs.

Pie Chart Of Red Seal Examination Weightings



MWA A	Performs common occupational skills	7%
MWA B	Diagnoses and repairs engine and engine support systems	17%
MWA C	Diagnoses and repairs vehicle module communications systems	10%
MWA D	Diagnoses and repairs driveline systems	14%
MWA E	Diagnoses and repairs electrical and comfort control systems	18%
MWA F	Diagnoses and repairs steering, suspension, braking and control systems, tires, hubs and wheel bearings	19%
MWA G	Diagnoses and repairs restraint systems, body components, accessories and trim	8%
MWA H	Diagnoses and repairs hybrid and electric vehicle (EV) systems	7%

This pie chart represents a breakdown of the interprovincial Red Seal examination. Percentages are based on the collective input from workers from the trade from across Canada. The Task Matrix on the next pages indicates the breakdown of tasks and sub-tasks within each Major Work Activity and the breakdown of questions assigned to the Tasks. The Interprovincial examination for this trade has 125 questions.

Automotive Service Technician

Task Matrix and Weightings

A – Performs common occupational skills

7%

Task A-1 Performs safety-related functions 42%	A-1.01 Maintains safe work environment	A-1.02 Uses personal protective equipment (PPE) and safety equipment	A-1.03 Implements specific safety protocols for hybrid and electric vehicles (EV)
Task A-2 Uses tools, equipment and documentation 50%	A-2.01 Uses tools and equipment	A-2.02 Uses fasteners, tubing, hoses and fittings	A-2.03 Uses hoisting and lifting equipment
Task A-3 Uses communication and mentoring techniques 8%	A-2.04 Uses electronic service tools and systems for diagnostics and programming	A-2.05 Uses documentation and technical information	
	A-3.01 Uses communication techniques	A-3.02 Uses mentoring techniques	

B – Diagnoses and repairs engine and engine support systems

17%

Task B-4 Diagnoses engine systems 19%	B-4.01 Diagnoses cooling systems	B-4.02 Diagnoses lubricating systems	B-4.03 Diagnoses engine assembly
	B-4.04 Diagnoses accessory drive systems		

Task B-5 Repairs engine systems 16%	B-5.01 Repairs cooling systems	B-5.02 Repairs lubricating systems	B-5.03 Repairs engine assembly
	B-5.04 Repairs accessory drive systems		
Task B-6 Diagnoses gasoline engine support systems 21%	B-6.01 Diagnoses gasoline fuel delivery and injection systems	B-6.02 Diagnoses gasoline electronic ignition systems	B-6.03 Diagnoses gasoline intake and exhaust systems
	B-6.04 Diagnoses gasoline emission control systems		
Task B-7 Repairs gasoline engine support systems 18%	B-7.01 Repairs gasoline fuel delivery and injection systems	B-7.02 Repairs gasoline electronic ignition systems	B-7.03 Repairs gasoline intake and exhaust systems
	B-7.04 Repairs gasoline emission control systems		
Task B-8 Diagnoses diesel engine support systems 14%	B-8.01 Diagnoses diesel fuel delivery and injection systems	B-8.02 Diagnoses diesel intake and exhaust systems	B-8.03 Diagnoses diesel emission control systems
Task B-9 Repairs diesel engine support systems 12%	B-9.01 Repairs diesel fuel delivery and injection systems	B-9.02 Repairs diesel intake and exhaust systems	B-9.03 Repairs diesel emission control systems

C – Diagnoses and repairs vehicle module communications systems

10%

Task C-10 Diagnoses vehicle networking systems 62%	C-10.01 Reads diagnostic trouble codes (DTCs)	C-10.02 Monitors data	C-10.03 Tests system circuitry and components
	C-10.04 Interprets test results		
Task C-11 Repairs vehicle networking systems 38%	C-11.01 Updates component software	C-11.02 Replaces components	C-11.03 Repairs system circuitry and components
	C-11.04 Verifies vehicle module communications system repair		

D – Diagnoses and repairs driveline systems

14%

Task D-12 Diagnoses driveline systems 57%	D-12.01 Diagnoses drive shafts and axles	D-12.02 Diagnoses manual transmissions and transaxles	D-12.03 Diagnoses automatic transmissions and transaxles
	D-12.04 Diagnoses clutches	D-12.05 Diagnoses transfer cases	D-12.06 Diagnoses final drive assemblies
Task D-13 Repairs driveline systems 43%	D-13.01 Repairs drive shafts and axles	D-13.02 Repairs manual transmissions and transaxles	D-13.03 Repairs automatic transmissions and transaxles
	D-13.04 Repairs clutches	D-13.05 Repairs transfer cases	D-13.06 Repairs final drive assemblies

E – Diagnoses and repairs electrical and comfort control systems

18%

Task E-14 Diagnoses electrical systems and components 36%	E-14.01 Diagnoses wiring and electrical systems	E-14.02 Diagnoses starting/charging systems and low voltage (12 volt) batteries	E-14.03 Diagnoses lighting and wiper systems
	E-14.04 Diagnoses entertainment systems	E-14.05 Diagnoses electrical options and accessories	E-14.06 Diagnoses instrumentation and information displays
	E-14.07 Diagnoses advanced driver assistance system (ADAS) components		
Task E-15 Repairs electrical systems and components 24%	E-15.01 Repairs wiring and electrical systems	E-15.02 Repairs starting/charging systems and low voltage (12 volt) batteries	E-15.03 Repairs lighting and wiper systems
	E-15.04 Repairs entertainment systems	E-15.05 Repairs electrical options and accessories	E-15.06 Repairs instrumentation and information displays
	E-15.07 Repairs advanced driver assistance system (ADAS) components		
Task E-16 Diagnoses heating, ventilation and air conditioning (HVAC) and comfort control systems 24%	E-16.01 Diagnoses air flow control systems	E-16.02 Diagnoses refrigerant systems	E-16.03 Diagnoses heating systems
Task E-17 Repairs heating, ventilation and air conditioning (HVAC) and comfort control systems 16%	E-17.01 Repairs air flow control systems	E-17.02 Repairs refrigerant systems	E-17.03 Repairs heating systems

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

19%

Task F-18 Diagnoses steering, suspension, braking and control systems, tires, wheels, hubs and wheel bearings 56%	F-18.01 Diagnoses steering, suspension and control systems	F-18.02 Diagnoses braking and control systems	F-18.03 Diagnoses tires, wheels, hubs and wheel bearings
	F-18.04 Diagnoses advanced driver assistance system (ADAS) components related to steering, suspension and braking systems		
Task F-19 Repairs steering, suspension, braking and control systems, tires, wheels, hubs and wheel bearings 44%	F-19.01 Repairs steering, suspension and control systems	F-19.02 Repairs braking and control systems	F-19.03 Repairs tires, wheels, hubs and wheel bearings
	F-19.04 Repairs advanced driver assistance system (ADAS) components related to steering, suspension and braking systems		

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

8%

Task G-20 Diagnoses restraint systems, body components, accessories and trim 59%	G-20.01 Diagnoses restraint systems	G-20.02 Diagnoses wind noises, rattles and water leaks	G-20.03 Diagnoses interior and exterior components, accessories and trim
	G-20.04 Diagnoses latches, locks and movable glass		
Task G-21 Repairs restraint systems, body components, accessories and trim 41%	G-21.01 Repairs restraint systems	G-21.02 Repairs wind noises, rattles and water leaks	G-21.03 Repairs interior and exterior components, accessories and trim
	G-21.04 Repairs latches, locks and movable glass		

H – Diagnoses and repairs hybrid and electric vehicle (EV) systems

7%

Task H-22 Diagnoses hybrid and electric vehicle (EV) systems 58%	H-22.01 Diagnoses hybrid vehicle systems	H-22.02 Diagnoses electric vehicle (EV) systems	H-22.03 Diagnoses high voltage batteries
	H-22.04 Diagnoses hybrid and electric vehicle (EV) HVAC systems		
Task H-23 Repairs hybrid and electric vehicle (EV) systems 42%	H-23.01 Repairs hybrid vehicle systems	H-23.02 Repairs electric vehicle (EV) systems	H-23.03 Services high voltage batteries
	H-23.04 Repairs hybrid and electric vehicle (EV) HVAC systems		

Harmonization of Apprenticeship Training

Provincial and territorial apprenticeship authorities are each responsible for their respective apprenticeship programs. In the spirit of continual improvement, and to facilitate mobility among apprentices in Canada, participating authorities have agreed to work towards harmonizing certain aspects of their programs where possible. After consulting with their stakeholders in the trade, they have reached consensus on the following elements. Note that implementation of these elements may vary from jurisdiction to jurisdiction, depending on their own circumstances. For more information on the implementation in any province and territory, please contact that jurisdiction’s apprenticeship authority.

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 four (4).

3. Total Training Hours

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

4. Sequencing Topics and Related Sub-tasks

The topic titles in the table below are placed in a column for each apprenticeship level for technical training. Each topic is accompanied by the sub-tasks and their reference number. The topics in the grey shaded cells represent those that are covered “in context” with other training in the subsequent years.

Level 1	Level 2	Level 3	Level 4
	Context	Context	Context
	Tools, Equipment and Documentation	Tools, Equipment and Documentation	Tools, Equipment and Documentation
			Vehicle Networking Systems (Diagnoses)
			Vehicle Networking Systems (Repairs)

Safety-Related Functions
1.01 Maintains safe work environment
1.02 Uses personal protective equipment (PPE) and safety equipment
1.03 Implements specific safety protocols for hybrid and electric vehicles (EV)

Tools, Equipment 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 electronic service tools and systems for diagnostics and programming
- 2.05 Uses documentation and technical information

Communication Techniques

- 3.01 Uses communication techniques

Mentoring Techniques

- 3.02 Uses mentoring techniques

Engine Systems¹ (Diagnoses)

- 4.01 Diagnoses cooling systems
- 4.02 Diagnoses lubricating systems
- 4.03 Diagnoses engine assembly
- 4.04 Diagnoses accessory drive systems

Engine Systems (Repairs)

- 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 (Diagnoses)

- 6.01 Diagnoses gasoline fuel delivery and injection systems
- 6.02 Diagnoses gasoline electronic ignition systems
- 6.03 Diagnoses gasoline intake and exhaust systems
- 6.04 Diagnoses gasoline emission control systems

¹ New Brunswick may provide additional training to exceed requirements by more training on engine assembly in Level 3.

Gasoline Engine Support Systems (Repairs)

- 7.01 Repairs gasoline fuel delivery and injection systems
- 7.02 Repairs gasoline electronic ignition systems
- 7.03 Repairs gasoline intake and exhaust systems
- 7.04 Repairs gasoline emission control systems

Diesel Engine Support Systems (Diagnoses)

- 8.01 Diagnoses diesel fuel delivery and injection systems
- 8.02 Diagnoses diesel intake and exhaust systems
- 8.03 Diagnoses diesel emission control systems

Diesel Engine Support Systems (Repairs)

- 9.01 Repairs diesel fuel delivery and injection systems
- 9.02 Repairs diesel intake and exhaust systems
- 9.03 Repairs diesel emission control systems

Vehicle Networking Systems (Diagnoses)

- 10.01 Reads diagnostic trouble codes (DTCs)
- 10.02 Monitors data
- 10.03 Tests system circuitry and components
- 10.04 Interprets test results

Vehicle Networking Systems (Repairs)

- 11.01 Updates component software
- 11.02 Replaces components
- 11.03 Repairs system circuitry and components
- 11.04 Verifies vehicle module communications system repair

Driveline Systems (Diagnoses)

- 12.01 Diagnoses drive shafts and axles

Driveline Systems (Diagnoses)

- 12.02 Diagnoses manual transmissions and transaxles
- 12.04 Diagnoses clutches
- 12.06 Diagnoses final drive assemblies

Driveline Systems (Diagnoses)

- 12.03 Diagnoses automatic transmissions and transaxles
- 12.05 (AWD) Diagnoses transfer cases

<p>Driveline Systems (Repairs)</p> <p>13.01 Repairs drive shafts and axles</p>	<p>Driveline Systems (Repairs)</p> <p>13.02 Repairs manual transmissions and transaxles 13.04 Repairs clutches 13.06 Repairs final drive assemblies</p>	<p>Driveline Systems (Repairs)</p> <p>13.03 Repairs automatic transmissions and transaxles 13.05 (AWD) Repairs transfer cases</p>	
<p>Electrical Systems and Components (Diagnoses)</p> <p>14.01 Diagnoses wiring and electrical systems 14.02 Diagnoses starting/charging systems and low voltage (12 volt) batteries</p>	<p>Electrical Systems and Components (Diagnoses)</p> <p>14.02 Diagnoses starting/charging systems and low voltage (12 volt) batteries 14.03 Diagnoses lighting and wiper systems</p>	<p>Electrical Systems and Components (Diagnoses)</p> <p>14.05 Diagnoses electrical options and accessories 14.07 Diagnoses advanced driver assistance system (ADAS) components</p>	<p>Electrical Systems and Components (Diagnoses)</p> <p>14.04 Diagnoses entertainment systems 14.06 Diagnoses instrumentation and information displays</p>
<p>Electrical Systems and Components (Repairs)</p> <p>15.01 Repairs wiring and electrical systems 15.02 Repairs starting/charging systems and low voltage (12 volt) batteries</p>	<p>Electrical Systems and Components (Repairs)</p> <p>15.01 Repairs wiring and electrical systems 15.02 Repairs starting/charging systems and low voltage (12 volt) batteries 15.03 Repairs lighting and wiper systems</p>	<p>Electrical Systems and Components (Repairs)</p> <p>15.05 Repairs electrical options and accessories 15.07 Repairs advanced driver assistance system (ADAS) components</p>	<p>Electrical Systems and Components (Repairs)</p> <p>15.04 Repairs entertainment systems 15.06 Repairs instrumentation and information displays</p>
			<p>HVAC and Comfort Control Systems (Diagnoses)²</p> <p>16.01 Diagnoses air flow control systems 16.02 Diagnoses refrigerant systems 16.03 Diagnoses heating systems</p>
			<p>HVAC and Comfort Control Systems (Repairs)</p> <p>17.01 Repairs air flow control systems 17.02 Repairs refrigerant systems 17.03 Repairs heating systems</p>
<p>Steering, Suspension, Braking, Control Systems, Tires, Wheels, Hubs and Wheel Bearings (Diagnoses)</p> <p>18.01 Diagnoses steering, suspension and control systems 18.02 Diagnoses braking and control systems 18.03 Diagnoses tires, wheels, hubs and wheel bearings</p>	<p>Steering, Suspension, Braking, Control Systems, Tires, Wheels, Hubs and Wheel Bearings (Diagnoses)</p> <p>18.01 Diagnoses steering, suspension and control systems 18.02 Diagnoses braking and control systems</p>	<p>Steering, Suspension, Braking, Control Systems, Tires, Wheels, Hubs and Wheel Bearings (Diagnoses)</p> <p>18.04 Diagnoses advanced driver assistance system (ADAS) components related to steering, suspension and braking systems</p>	

² Jurisdictions may need to deliver refrigerant evacuation and recharge elsewhere in the program to meet regulatory or licensing issues.

Steering, Suspension, Braking, Control Systems, Tires, Wheels, Hubs and Wheel Bearings (Repairs)

19.01 Repairs steering, suspension and control systems
 19.02 Repairs braking and control systems
 19.03 Repairs tires, wheels, hubs and wheel bearings

Steering, Suspension, Braking, Control Systems, Tires, Wheels, Hubs and Wheel Bearings (Repairs)

19.01 Repairs steering, suspension and control systems
 19.02 Repairs braking and control systems

Steering, Suspension, Braking, Control Systems, Tires, Wheels, Hubs and Wheel Bearings (Repairs)

19.04 Repairs advanced driver assistance system (ADAS) components related to steering, suspension and braking systems

Restraint Systems, Body Components, Accessories and Trim (Diagnoses)³

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

Restraint Systems, Body Components, Accessories and Trim (Diagnoses)

20.01 Diagnoses restraint systems

Restraint Systems, Body Components, Accessories and Trim (Repairs)⁴

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

Restraint Systems, Body Components, Accessories and Trim (Repairs)

21.01 Repairs restraint systems

Hybrid and EV Systems (Diagnoses)

22.01 Diagnoses hybrid vehicle systems
 22.02 Diagnoses electric vehicle (EV) systems
 22.03 Diagnoses high voltage batteries
 22.04 Diagnoses hybrid and electric vehicle (EV) HVAC systems

³ Some components of this topic are covered by the Alberta Auto Body Technician program.

⁴ Some components of this topic are covered by the Alberta Auto Body Technician program.

Hybrid and EV Systems (Repairs)

23.01 Repairs hybrid vehicle systems

23.02 Repairs electric vehicle (EV) systems

23.03 Services high voltage batteries

23.04 Repairs hybrid and electric vehicle (EV) HVAC systems

Major Work Activity A

Performs common occupational skills

Task A-1 Performs safety-related functions

Task Descriptor

Automotive service technicians create and maintain a safe work environment to ensure safety of equipment and personnel. They must wear personal protective equipment (PPE), use safety equipment, and follow manufacturers' service information when performing certain tasks.

Automotive service technicians are increasingly working on electric motors, inverters, converters, high voltage batteries and associated support systems in hybrid and electric vehicles (EV). Safety is of paramount importance due to the risk of electrocution when working with high voltages.

A-1.01 Maintains safe work environment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
A-1.01.01P	recognize potential worksite hazards and hazardous materials	worksite hazards and hazardous materials are identified according to safety regulations
A-1.01.02P	apply jurisdictional safety regulations	jurisdictional safety regulations are located, identified and applied
A-1.01.03P	handle, remove, recycle and dispose of hazardous materials	hazardous materials are handled, removed, recycled and disposed of according to jurisdictional regulations and manufacturers' service information
A-1.01.04P	perform sensory inspection of vehicles	vehicles are inspected prior to test drive to ensure safe operation
A-1.01.05P	maintain clean and clutter-free work area	work area is kept clean and clutter-free according to jurisdictional regulations and workplace policies

A-1.01.06P	adhere to manufacturers' safety guidelines	manufacturers' safety guidelines are followed when working on a vehicle or using equipment
A-1.01.07P	remove, repair or replace defective equipment	defective equipment is removed, repaired or replaced according to manufacturers' service information
A-1.01.08P	report hazards and safety concerns to supervisor	supervisor is notified of all hazards and safety concerns

Range of Variables

worksite hazards include: spills; noise level; poor air quality; obstructions; defective equipment; flammable, reactive, toxic and explosive materials

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

safety regulations include: Occupational Health and Safety (OH&S), Workplace Hazardous Materials Information System (WHMIS)/Globally Harmonized System (GHS)

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

hazards include: personal, environmental, shop/facility (fire, explosion, gases), vehicle (restraint systems, high voltage systems, high pressure fuel systems)

Knowledge		
	Learning Outcomes	Learning Objectives
A-1.01.01L	demonstrate knowledge of safe work practices	describe safe work practices to maintain a safe work environment
		describe procedures to handle, store, recycle and dispose of hazardous materials
A-1.01.02L	demonstrate knowledge of training and certification requirements related to workplace safety	identify training and certification requirements related to workplace safety
A-1.01.03L	demonstrate knowledge of regulatory requirements pertaining to safety	identify and describe jurisdictional safety regulations to maintain a safe work environment
		identify components of Workplace Hazardous Materials Information System (WHMIS)/Globally Harmonized System (GHS)
		identify and describe jurisdictional requirements for handling, recycling and disposing of hazardous materials

Range of Variables

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

training and certification requirements include: WHMIS/GHS, first aid, refrigerant-handling training

safety regulations include: Occupational Health and Safety (OH&S), Workplace Hazardous Materials Information System (WHMIS)/Globally Harmonized System (GHS)

components of components of Workplace Hazardous Materials Information System (WHMIS)/Globally Harmonized System (GHS) include: safety data sheets (SDS), labels, training

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

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
A-1.02.01P	select PPE and safety equipment required for specific tasks	PPE and safety equipment are selected and used according to location, environment, application, jurisdictional regulations and manufacturers' service information
A-1.02.02P	recognize workplace hazards that require use of PPE and safety equipment	workplace hazards that require use of PPE and safety equipment are determined according to task
A-1.02.03P	inspect and maintain PPE and safety equipment	PPE and safety equipment are inspected and maintained according to jurisdictional regulations and manufacturers' service information
A-1.02.04P	operate safety equipment	safety equipment is operated according to jurisdictional regulations and manufacturers' service information
A-1.02.05P	identify, remove and replace defective PPE	defective PPE is identified, removed or replaced according to manufacturers' service information
A-1.02.06P	identify, remove, service or replace defective safety equipment	defective safety equipment is identified, removed or replaced according to manufacturers' service information
A-1.02.07P	report defective PPE and safety equipment to supervisor	supervisor is notified of defective PPE and safety equipment according to jurisdictional regulations

Range of Variables

PPE includes: work boots, ear protection, eye protection, face shields, insulated clothing, fire-resistant clothing, respirators

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

jurisdictional regulations include: WHMIS/GHS, OH&S

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

workplace hazards include: personal, environmental, shop/facility (fire, explosion, gases), vehicle (restraint systems, high voltage systems, high pressure fuel systems)

Knowledge		
	Learning Outcomes	Learning Objectives
A-1.02.01L	demonstrate knowledge of PPE and safety equipment , their characteristics, applications, limitations and procedures for use	identify types of PPE and safety equipment , and describe their characteristics, applications, limitations and procedures for use
		describe handling, storage and maintenance of PPE and safety equipment
A-1.02.02L	demonstrate knowledge of training and certification requirements for PPE and safety equipment	identify training and certification requirements pertaining to PPE and safety equipment
A-1.02.03L	demonstrate knowledge of regulatory requirements pertaining to PPE and safety equipment	identify safety manuals, standards and jurisdictional regulations pertaining to PPE and safety equipment

Range of Variables

PPE includes: work boots, ear protection, eye protection, face shields, insulated clothing, fire-resistant clothing, respirators

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

jurisdictional regulations include: WHMIS/GHS, OH&S

A-1.03**Implements specific safety protocols for hybrid and electric vehicles (EV)**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
A-1.03.01P	select and use <i>PPE and safety equipment specific to hybrid and EV systems</i>	<i>PPE and safety equipment specific to hybrid and EV systems</i> is selected and used according to <i>standards and regulations</i> , and <i>manufacturers' service information</i>
A-1.03.02P	complete safety preparation before starting work on hybrid and EV systems	safety preparations are completed before starting work on hybrid and EV systems according to <i>standards and regulations</i> , and <i>manufacturers' service information</i>
A-1.03.03P	recognize <i>safety hazards specific to working on hybrid vehicles and EVs</i>	<i>safety hazards specific to working on hybrid vehicles and EVs</i> are identified
A-1.03.04P	ensure that <i>safety protocols for hybrid and EV systems</i> have been implemented	<i>safety protocols for hybrid and EV systems</i> have been implemented according to <i>standards and regulations</i> , and <i>manufacturers' service information</i>

Range of Variables

PPE and safety equipment specific to hybrid and EV systems include: insulated clothing (e.g. gloves, arc flash suit, helmets, aprons), pylons, high voltage specific tools, safety hook, lock-out, tag-out, glasses, facemask

standards and regulations include: CSA (e.g., z462), jurisdictional regulations

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

safety hazards specific to working on hybrid vehicles and EVs include: fire, electrocution, burns, arc flash

safety protocols for hybrid and EV systems include: safe work procedures for high voltage, manufacturers' safety procedures, maintenance facility requirements, vehicle shut down procedures, high voltage disconnecting procedures, lifting procedures

Knowledge

Learning Outcomes	Learning Objectives
A-1.03.01L	demonstrate knowledge of <i>PPE and safety equipment specific to hybrid and EV systems</i> , their characteristics, applications and procedures for use
	identify types of <i>PPE and safety equipment specific to hybrid and EV systems</i> , and describe their characteristics, applications and procedures for use
A-1.03.02L	demonstrate knowledge of <i>safety protocols for hybrid and EV systems</i>
	identify safety protocols pertaining to hybrid and EV systems
	identify <i>safety hazards specific to working on hybrid vehicles and EVs</i> and safe work practices
A-1.03.03L	demonstrate knowledge of regulatory requirements pertaining to hybrid and EV systems
	identify and interpret <i>standards and regulations</i> pertaining to hybrid and EV systems

Range of Variables

PPE and safety equipment specific to hybrid and EV systems include: insulated clothing (e.g. gloves, arc flash suit, helmets, aprons), pylons, high voltage specific tools, safety hook, lock-out, tag-out, glasses, facemask

standards and regulations include: CSA (e.g., z462), jurisdictional regulations

Task A-2 Uses tools, equipment and documentation

Task Descriptor

Automotive service technicians use tools and equipment to perform all tasks in their trade in a safe and efficient manner. They maintain these tools and equipment to ensure longevity and safe operation.

They reference different sources of documentation to prepare job action plans, and diagnose and repair systems.

A-2.01 Uses tools and equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
A-2.01.01P	organize and store personal tools and equipment	personal tools and equipment are organized and stored so that they can be accessed efficiently
A-2.01.02P	organize and store shop tools and equipment	shop tools and equipment are organized and stored according to shop standards and safety regulations
A-2.01.03P	inspect tools and equipment regularly	tools and equipment are inspected regularly to recognize worn, damaged, defective or expired tools and equipment according to safety regulations and manufacturers' service information
A-2.01.04P	clean, lubricate and maintain tools and equipment	tools and equipment are cleaned, lubricated and maintained according to manufacturers' service information
A-2.01.05P	identify, remove, repair or replace defective equipment	defective equipment is identified and communicated to management, and removed, repaired or replaced according to manufacturers' service information
A-2.01.06P	calibrate measuring and testing devices	measuring and testing devices' settings are calibrated to manufacturers' service information
A-2.01.07P	operate shop tools and equipment	shop tools and equipment are operated according to manufacturers' service information

Range of Variables

shop tools and equipment include: brake lathe, tire changing machine, wheel balancer, battery chargers, vices, presses, parts washers, oil bins, welding, cutting and heating equipment, inductive heating equipment

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

Knowledge		
	Learning Outcomes	Learning Objectives
A-2.01.01L	demonstrate knowledge of hand and power tools , their characteristics, applications, maintenance and procedures for use	identify types of hand tools and describe their characteristics, applications and procedures for use
		describe procedures used to store and maintain hand tools
		identify types of power tools and describe their characteristics, applications and procedures for use
		describe 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 characteristics, applications, maintenance and procedures for use	identify types of measuring and testing devices and describe their characteristics, applications and procedures for use
		describe procedures used to store and maintain measuring and testing devices
A-2.01.03L	demonstrate knowledge of shop tools and equipment , their characteristics, applications, maintenance and procedures for use	identify types of shop tools and equipment and describe their characteristics, applications and procedures for use
		describe procedures used to store and maintain shop tools and equipment
A-2.01.04L	demonstrate knowledge of welding, cutting and heating equipment , their characteristics, applications, maintenance and procedures for use	identify types of welding, cutting and heating equipment , and describe their characteristics, applications and procedures for use

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, parts washers, oil bins, welding, cutting and heating equipment, inductive heating equipment

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

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
A-2.02.01P	select fasteners	fasteners are selected by size, grade, thread pitch and type according to application and manufacturers' service information
A-2.02.02P	remove and install fasteners	fasteners are removed and installed according to grade, manufacturers' torque specifications and procedures
A-2.02.03P	extract broken or damaged fasteners	broken or damaged fasteners are removed
A-2.02.04P	restore damaged threads	damaged threads are restored to usable condition
A-2.02.05P	select tubing, hoses and fittings	tubing, hoses and fittings are selected according to application and manufacturers' service information
A-2.02.06P	flare tubing	tubing is flared according to standards, application and manufacturers' service information

Range of Variables

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

torque specifications include: tensile strength, torque-to-yield (single-use), angles

Knowledge

	Learning Outcomes	Learning Objectives
A-2.02.01L	demonstrate knowledge of fasteners, tubing, hoses and fittings, their characteristics, applications and procedures for use	identify types of fasteners and describe their characteristics, applications and procedures for use
		identify types of tubing and hoses and describe their characteristics, applications and procedures for use
		identify types of fittings and flares , and describe their characteristics, applications and procedures for use
A-2.02.02L	demonstrate knowledge of procedures to use fasteners, tubing, hoses and fittings	describe procedures to use fasteners, tubing, hoses and fittings

Range of Variables

flares include: single, double (imperial), International Standards Organization (ISO) (metric)

A-2.03 Uses hoisting and lifting equipment

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
A-2.03.01P	determine vehicle or item lifting points and required adapters and extensions	vehicle or item lifting points and required adapters and extensions are used and determined according to manufacturers' service information
A-2.03.02P	determine type and capacity of hoisting and lifting equipment required for vehicle or item to be lifted	type and capacity of hoisting and lifting equipment is selected according to type of vehicle or item to be lifted
A-2.03.03P	operate vehicle hoists	vehicle hoists are operated according to manufacturers' recommendations and safe operating procedures
A-2.03.04P	operate shop lifting equipment	shop lifting equipment is operated according to manufacturers' safe operating procedures

A-2.03.05P	inspect hoisting and lifting equipment	hoisting and lifting equipment is inspected according to manufacturers' service information and jurisdictional regulations
A-2.03.06P	remove from service or replace defective hoisting and lifting equipment	defective hoisting and lifting equipment is removed from service or replaced according to jurisdictional regulations

Range of Variables

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

shop lifting equipment includes: chain falls, overhead cranes, hydraulic jacks/transmission jacks, engine hoists, battery tables/lifts

Knowledge		
	Learning Outcomes	Learning Objectives
A-2.03.01L	demonstrate knowledge of vehicle hoists, their components, characteristics, applications and maintenance	identify types of vehicle hoists and accessories, and describe their characteristics and applications
		describe procedures used to inspect, store and maintain vehicle hoists and accessories
A-2.03.02L	demonstrate knowledge of procedures used to operate vehicle hoists and accessories	describe procedures used to operate vehicle hoists and accessories
		identify hazards and describe safe work practices pertaining to vehicle hoists and accessories
A-2.03.03L	demonstrate knowledge of shop lifting equipment , their characteristics, applications and procedures for use	identify types of shop lifting equipment and describe their characteristics and applications
		describe procedures used to inspect, store and maintain shop lifting equipment
A-2.03.04L	demonstrate knowledge of procedures used to operate shop lifting equipment	describe procedures used to operate shop lifting equipment
		identify hazards and describe safe work practices pertaining to shop lifting equipment

Range of Variables

hazards include: ceiling heights, overhead wires, uneven surfaces

safe work practices include: supervision of lifts, securing work area, communication

shop lifting equipment includes: chain falls, overhead cranes, hydraulic jacks/transmission jacks, engine hoists, battery tables/lifts

A-2.04 Uses electronic service tools and systems for diagnostics and programming

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
A-2.04.01P	use software applications	software applications are used according to manufacturers' service information
A-2.04.02P	verify software application version, download from manufacturer, and upload correct calibration to control module	software application version is verified, downloaded from manufacturer, and correct calibration is uploaded to control module
A-2.04.03P	select and use electronic service tools	electronic service tools are selected and used according to task and manufacturers' service information
A-2.04.04P	download and document reports from equipment control module, and forward to original equipment manufacturer (OEM) or advisors	reports from equipment control module are downloaded and documented, and forwarded to OEM or advisors
A-2.04.05P	monitor data and parameters	data and parameters are monitored for operational status according to manufacturers' service information
A-2.04.06P	adjust parameters	parameters are adjusted according to customer request and manufacturers' service information
A-2.04.07P	interpret diagnostic results and reports	diagnostic results and reports are interpreted to determine failure and required repair

Range of Variables

software applications include: OEM diagnostic and operating software, online technical support, remote monitoring systems

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

electronic service tools include: laptops, smart phones, tablets, on-board diagnostic II (OBDII) adaptors, scanners

data includes: temperatures, speeds, pressures, switch states, state of charge, fuel trims, altitude changes, rotational speeds, system status, positions, voltages

parameters include: speeds, temperatures, pressures, volumes

Knowledge		
	Learning Outcomes	Learning Objectives
A-2.04.01L	demonstrate knowledge of using electronic service tools for diagnostics and programming	describe software applications used in diagnostics and programming
		identify types of electronic service tools used in diagnostics and programming, and describe their characteristics, applications and procedures for use
		describe manufacturers' programming and monitoring procedures
		describe data and parameters of diagnostic results and reports

Range of Variables

electronic service tools include: laptops, smart phones, tablets, on-board diagnostic II (OBDII) adaptors, scanners

software applications include: OEM diagnostic and operating software, online technical support, remote monitoring systems

data includes: temperatures, speeds, pressures, switch states, state of charge, fuel trims, altitude changes, rotational speeds, system status, positions, voltages

parameters include: speeds, temperatures, pressures, volumes

A-2.05 Uses documentation and technical information

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
A-2.05.01P	access technical diagnostic and repair information	technical diagnostic and repair information is accessed
A-2.05.02P	locate and interpret identification codes	identification codes found on vehicles and vehicle components are located and interpreted
A-2.05.03P	locate and reference most recent technical information	most recent technical information is located and referenced for diagnostic, servicing and repair procedures
A-2.05.04P	interpret and apply technical information to task	technical information is interpreted and applied to task
A-2.05.05P	document service history	service history is documented according to company policies and procedures, manufacturers' requirements and jurisdictional regulations
A-2.05.06P	create documents	documents are created according to company policies
A-2.05.07P	complete safety-related documents	safety-related documents are completed according to jurisdictional regulations, and company policies and procedures
A-2.05.08P	document work-related information	work-related information is documented according to company policies and procedures, and manufacturers' requirements

Range of Variables

identification codes include: vehicle identification number (VIN), component identification codes, diagnostic indicators, safety placards and decals, information labels, part numbers, serial numbers

technical information includes: online service and parts information, troubleshooting trees, flow charts, schematics, technical drawings, specifications, test results, parameters, technical service bulletins (TSB), warranty bulletins, service records, preventative maintenance records

service history includes: motor vehicle inspections, warranty records, preventative maintenance documents, failure analysis using photographs

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

safety-related documents include: accident reports, injury reports, safety inspection reports, safety warning labels and symbols, workplace hazard reports including hazard analysis

work-related information includes: technician hours worked, odometer reading, VIN, parts used, service descriptions, scan data

Knowledge

	Learning Outcomes	Learning Objectives
A-2.05.01L	demonstrate knowledge of trade-related documents , their characteristics and applications	identify and interpret types of trade-related documents and describe their characteristics and applications
		identify trade-related identification codes and technical information
		identify work-related information to be recorded
A-2.05.02L	demonstrate knowledge of preparing, completing and using trade-related documents	describe procedures used to prepare, complete and use trade-related documents
		document vehicle service history
		describe procedures used to prepare safety-related documents

Range of Variables

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

identification codes include: vehicle identification number (VIN), component identification codes, diagnostic indicators, safety placards and decals, information labels, part numbers, serial numbers

technical information includes: online service and parts information, troubleshooting trees, flow charts, schematics, technical drawings, specifications, test results, parameters, technical service bulletins (TSB), warranty bulletins, service records, preventative maintenance records

work-related information includes: technician hours worked, odometer reading, VIN, parts used, service descriptions, scan data

service history includes: motor vehicle inspections, warranty records, preventative maintenance documents, failure analysis using photographs

safety-related documents include: accident reports, injury reports, safety inspection reports, safety warning labels and symbols, workplace hazard reports including hazard analysis

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 – learning workplace skills and passing them on. 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

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	no	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
A-3.01.01P	demonstrate communication practices with individuals or in a group	instructions and messages are interpreted by all parties involved in communication
A-3.01.02P	listen using active listening practices	active listening practices are utilized
A-3.01.03P	recognize alternative communication skills and accommodations for them that may be used in the workplace	alternative communication skills and accommodations for them are recognized
A-3.01.04P	speak clearly using correct industry terminology to ensure understanding	understanding of message is confirmed by both parties
A-3.01.05P	receive and respond to instructions	response to instructions indicates understanding
A-3.01.06P	receive and respond to feedback on work completed or performed	response to feedback indicates understanding and corrective measures are taken
A-3.01.07P	explain and provide feedback	explanation and feedback are provided and task is carried out as directed
A-3.01.08P	use questions to improve communication	questions enhance understanding, on-the-job training and goal setting
A-3.01.09P	participate in safety and information meetings	meetings are attended, information is relayed to workforce, and is applied
A-3.01.10P	send and receive electronic messages	electronic messages are sent and received using professionalism, plain language and clear expressions according to company policy

Range of Variables

active listening includes: understanding, interpreting, reflecting, responding, paraphrasing

alternative communication skills include: sign language, written communication, body/facial expression

electronic messages include: email, text messages

Knowledge		
	Learning Outcomes	Learning Objectives
A-3.01.01L	demonstrate knowledge of trade terminology	define terminology used in trade
A-3.01.02L	demonstrate knowledge of effective communication practices	describe importance of using effective verbal and non-verbal communication with people in the workplace
		identify sources of information to effectively communicate
		identify communication and learning styles
		describe effective listening and speaking skills
		demonstrate awareness of alternative communication skills that may be present in workplace
		describe how to receive and give instructions effectively
		identify personal responsibilities and attitudes that contribute to on-the-job success
		identify value of equity, diversity and inclusion in workplace
		identify communication that constitutes bullying, harassment and discrimination
		identify communication styles appropriate to different systems and applications of electronic messages

Range of Variables

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

sources of information include: regulations, codes, occupational health and safety requirements, jurisdictional requirements, prints, drawings, specifications, company and client documentation

learning styles include: visual, auditory, reading, writing, kinesthetic

alternative communication skills include: sign language, written communication, body/facial expression

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

harassment: as defined by the Canadian and jurisdictional Human Rights Commissions

discrimination: as defined by the Canadian Human Rights Act and jurisdictional human rights laws

electronic messages include: email, text messages

A-3.02 Uses mentoring techniques

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	no	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
A-3.02.01P	identify and communicate learning objective and point of lesson	apprentice or learner can explain objective and point of lesson
A-3.02.02P	link lesson to other lessons and project	lesson order and unplanned learning opportunities are defined
A-3.02.03P	demonstrate performance of a skill to an apprentice or learner	steps required to demonstrate a skill are performed
A-3.02.04P	set up conditions required for apprentice or learner to practice a skill	practice conditions are set up so that skill can be practiced safely by apprentice or learner
A-3.02.05P	assess apprentice or learner's ability to perform tasks with increasing independence	performance of apprentice or learner improves with practice to a point where task can be done with little supervision
A-3.02.06P	give supportive and corrective feedback	apprentice or learner adopts best practice after having been given supportive or corrective feedback
A-3.02.07P	support apprentices or learners in pursuing technical training opportunities	technical training is completed within timeframe prescribed by apprenticeship authority
A-3.02.08P	support anti- harassment and anti- discrimination practices, guidelines and policies in workplace	workplace is harassment and discrimination -free
A-3.02.09P	assess apprentice or learner suitability to trade during probationary period	apprentice or learner is given constructive feedback that helps them identify their own strengths and weaknesses and suitability for the trade

Range of Variables

steps required to demonstrate a skill include: understanding who, what, where, when, why, and how; explaining; showing; giving encouragement; following up to ensure skill is performed correctly

practice conditions means: guided, limited independence, full independence

harassment: as defined by the Canadian and jurisdictional Human Rights Commissions

discrimination: as defined by the Canadian Human Rights Act and jurisdictional human rights laws

Knowledge

Learning Outcomes		Learning Objectives
A-3.02.01L	demonstrate knowledge of strategies for learning skills in workplace	describe importance of individual experience
		describe shared responsibilities for workplace learning
		determine one's own learning preferences and explain how these relate to learning new skills
		describe importance of different types of skills in workplace
		describe importance of skills for success (essential skills) in workplace
		identify different learning styles
		identify different learning needs and strategies to meet them
		identify strategies to assist in learning a skill
A-3.02.02L	demonstrate knowledge of strategies for teaching workplace skills	identify different roles played by workplace mentor
		describe teaching skills
		explain importance of identifying point of lesson
		identify how to choose a good time to present lesson
		explain importance of linking lessons
		identify context for learning skills
		describe considerations in setting up opportunities for skill practice
		explain importance of providing feedback
		identify techniques for giving effective feedback
		describe a skills assessment
		identify methods of assessing progress
		explain how to adjust lesson to different situations

Range of Variables

skills for success (essential skills) are: adaptability, collaboration, communication, creativity and innovation, digital, numeracy, problem solving, reading, writing

learning styles include: visual, auditory, reading, writing, kinesthetic

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

teaching skills include: identifying point of lesson, linking lesson, demonstrating 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

Automotive service technicians diagnose engine systems according to manufacturers' service information. Accurate diagnosis is important to effectively perform repairs on the engine, which may include replacement or rebuilding of components.

B-4.01 Diagnoses cooling systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
B-4.01.01P	verify concern	concern is verified to determine diagnostic strategy
B-4.01.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-4.01.03P	inspect components	components are inspected for wear, damage and defects
B-4.01.04P	analyze coolant	coolant is analyzed for concentration, chemistry and contamination using procedures according to manufacturers' service information
B-4.01.05P	identify restrictions in air and coolant flow	restrictions in air and coolant flow are identified through system operation tests
B-4.01.06P	check and identify electronically-controlled system faults	electronically-controlled system faults are identified according to manufacturers' service information

B-4.01.07P	check and identify mechanical system faults	mechanical system faults are identified according to manufacturers' service information
B-4.01.08P	pressure test cooling system and components	cooling system and components are pressure tested to locate leaks and faults
B-4.01.09P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

tools and equipment include: pressure testers, coolant testers, infrared temperature guns, scan tools
manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

electronically-controlled system faults include: blown fuses, defective motors, circuit failures, sensors out of range, relay failure, control module failure

mechanical system faults include: mechanical fan, fan clutch and belt tension malfunctions, incorrect routing

Knowledge		
	Learning Outcomes	Learning Objectives
B-4.01.01L	demonstrate knowledge of cooling systems, their components , characteristics, applications and operation	identify types of cooling systems and their components , and describe their characteristics and applications
		describe operating principles of cooling systems and their components
		identify types of coolants and chemical additives, and describe their characteristics and applications
		identify types of fan systems and their components, and describe their characteristics, applications and operation
		identify related systems and describe their relationship to cooling systems

B-4.01.02L	demonstrate knowledge of procedures used to diagnose cooling systems and their components	identify tools and equipment used to diagnose cooling systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to cooling systems and their components
		describe procedures used to diagnose cooling systems and their components
		identify warning indicators and describe their characteristics, applications and operation
		identify materials that can be reconditioned, reused or recycled
B-4.01.03L	demonstrate knowledge of regulatory requirements pertaining to cooling systems	identify jurisdictional standards and regulations pertaining to cooling systems

Range of Variables

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

fan systems include: mechanical, electric, hydraulic

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

procedures used to diagnose include: verify concern, perform inspection, retrieve diagnostic trouble codes (DTC), access service information, conduct tests and measurements, isolate fault and identify root cause

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

hazards include: high temperature, high pressure, toxicity

warning indicators include: warning messages, warning lights, audible signals

jurisdictional standards include: provincial, territorial, federal

B-4.02 Diagnoses lubricating systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-4.02.01P	verify concern	concern is verified to determine diagnostic strategy
B-4.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-4.02.03P	inspect components	components are inspected for wear, damage, defects and blockages

B-4.02.04P	inspect engine oil	engine oil is inspected to identify contamination and oil levels
B-4.02.05P	identify system faults	system faults are identified according to manufacturers' service information
B-4.02.06P	perform oil pressure tests	oil pressure tests are performed, recorded and compared to manufacturers' service information
B-4.02.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

tools and equipment include: pressure gauges, scan tools, black light and dye penetrant

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: pumps and drives, coolers, lines, hoses, filters, chains, tensioners, seals, sealants, gaskets

system faults include: leaks, low and high pressures, pump drive malfunctions

Knowledge

	Learning Outcomes	Learning Objectives
B-4.02.01L	demonstrate knowledge of engine lubricating systems, their components , characteristics, applications and operation	identify types of engine lubricating systems and their components , and describe their characteristics and applications
		describe operating principles of engine lubricating systems and their components
		identify types of engine lubricants and describe their characteristics and applications
		identify types of oil pumps and describe their characteristics, applications and operation
		identify types of oil coolers and describe their characteristics and applications
		describe oil flow, filtration and pressure regulation
		identify warning indicators and describe their characteristics, applications and operation

B-4.02.02L	demonstrate knowledge of procedures used to diagnose engine lubricating systems and their components	identify tools and equipment used to diagnose engine lubricating systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to engine lubricating systems and their components
		describe procedures used to diagnose engine lubricating systems and their components
		identify testing procedures for checking oil contaminations
		describe procedures to remove, replace, recycle and dispose of oil
		identify materials that can be reconditioned, reused or recycled
B-4.02.03L	demonstrate knowledge of regulatory requirements pertaining to engine lubricating systems	identify standards and regulations pertaining to engine lubricating systems and materials

Range of Variables

components include: pumps and drives, coolers, lines, hoses, filters, chains, tensioners, seals, sealants, gaskets

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 indicators include: warning messages, warning lights, audible signals

tools and equipment include: pressure gauges, scan tools, black light and dye penetrant

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

B-4.03 Diagnoses engine assembly

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-4.03.01P	verify concerns	concerns are verified to determine diagnostic strategy
B-4.03.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-4.03.03P	perform tests	tests are performed according to manufacturers' service information

B-4.03.04P	inspect engine assemblies, and their components	engine assemblies and their components are inspected for wear, damage and defects
B-4.03.05P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

concerns include: noise, vibration and harshness (NVH), oil consumption, lack of power, fluid leaks

tools and equipment include: scan tools, compression testers, measuring tools, stethoscopes, electronic vibration analyzers, pyrometer, laser tools, straight edges, leak down testers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

tests include: cylinder leak-down, compression, vacuum

components include: crankshafts, camshafts, bearings, pistons and rings, engine block, cylinder head assemblies, gaskets, seals, sealants, timing belt or chain, gears, tensioners, pulleys, variable valve timing (VVT) actuator

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 , characteristics, applications and operation	identify engine assemblies and their components , and describe their characteristics and applications
		describe operating principles of engine assemblies and their components
		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
		describe engine displacement, compression ratios and horsepower
		identify related components and describe their relationship to engine assembly

B-4.03.03L	demonstrate knowledge of procedures used to diagnose engine assemblies and their components	identify tools and equipment used to diagnose engine assemblies and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to engine assemblies and their components
		describe procedures used to diagnose engine assemblies and their components
		identify types and sources of engine assembly faults
		identify materials that can be reconditioned, reused or recycled

Range of Variables

components include: crankshafts, camshafts, bearings, pistons and rings, engine block, cylinder head assemblies, gaskets, seals, sealants, timing belt or chain, gears, tensioners, pulleys, variable valve timing (VVT) actuator

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

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

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

tools and equipment include: scan tools, compression testers, measuring tools, stethoscopes, electronic vibration analyzers, pyrometer, laser tools, straight edges, leak down testers

hazards include: slips and falls, high temperature, toxicity, sharp edges, rotating parts

B-4.04 Diagnoses accessory drive systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-4.04.01P	verify concern	concern is verified to determine diagnostic strategy
B-4.04.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-4.04.03P	check and inspect accessory drive pulley alignment	accessory drive pulleys are inspected for alignment according to manufacturers' service information
B-4.04.04P	identify type of drive pulley system	drive pulley system is identified

B-4.04.05P	identify cause of noise and vibration	cause of noise and vibration is identified using tools and equipment
B-4.04.06P	measure belt tension	belt tension is measured according to manufacturers' service information
B-4.04.07P	inspect accessory drive systems, and their components	accessory drive systems and their components are inspected for wear, tension and noise according to manufacturers' service information
B-4.04.08P	inspect accessory brackets	accessory brackets are inspected for damage and wear
B-4.04.09P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

tools and equipment include: pyrometer, laser tools, straight edges, electronic vibration analyzers, stethoscopes, belt tension gauges

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

drive pulley system includes: serpentine, stretch-to-fit, cog

components include: tensioners, pulleys, belts

Knowledge		
	Learning Outcomes	Learning Objectives
B-4.04.01L	demonstrate knowledge of accessory drive systems, their components , characteristics, applications and operation	identify types of accessory drive systems and their components , and describe their characteristics and applications
		describe operating principles of accessory drive systems and their components
		identify related components and describe their relationship to accessory drive systems
B-4.04.02L	demonstrate knowledge of procedures used to diagnose accessory drive systems and their components	identify tools and equipment used to diagnose accessory drive systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to accessory drive systems and their components
		describe procedures used to diagnose accessory drive systems and their components
		identify materials that can be recycled

Range of Variables

components include: tensioners, pulleys, belts

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

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

tools and equipment include: pyrometer, laser tools, straight edges, electronic vibration analyzers, stethoscopes, belt tension gauges

hazards include: rotating components, pinch points, loose clothing

Task B-5 Repairs engine systems

Task Descriptor

Automotive service technicians repair engine systems according to manufacturers' service information to ensure proper operation and protection of the engine and its components.

B-5.01 Repairs cooling systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-5.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-5.01.02P	select and use components for repair	components are selected and used according to repair requirements and manufacturers' service information
B-5.01.03P	remove, service and replace cooling system components	cooling system components are removed, serviced and replaced according to requirements
B-5.01.04P	identify types and characteristics of coolants	types and characteristics of coolants are identified to avoid mixing incompatible types and to ensure required concentrations

B-5.01.05P	drain, flush, refill and bleed coolant system	coolant system is drained, flushed, refilled and bled according to manufacturers' service information
B-5.01.06P	recycle and dispose of coolant	coolant is recycled and disposed of according to jurisdictional regulations
B-5.01.07P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: radiators, thermostats, water pumps, hoses, tubing, belts, seals, gaskets, sealants, fastening devices

Knowledge		
	Learning Outcomes	Learning Objectives
B-5.01.01L	demonstrate knowledge of cooling system components , their characteristics, applications and operation	identify cooling system components and describe their characteristics and applications
		describe operating principles of cooling system components
		identify types of coolants and chemical additives, and describe their characteristics and applications
		identify types of fan systems and their components , and describe their characteristics, applications and operation
		identify related systems and describe their relationship to cooling systems
		identify warning indicators and describe their characteristics, applications and operation
B-5.01.02L	demonstrate knowledge of procedures used to repair cooling system components	identify tools and equipment used to repair cooling system components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to cooling systems
		describe procedures used to repair cooling systems
		describe procedures used to remove and reinstall cooling system components

		describe procedures used to flush and recycle or dispose of coolants
		describe procedures to remove, replace, recycle and dispose of cooling system coolant
		describe service intervals according to type of coolant
		describe procedures used to verify repair
B-5.01.03L	demonstrate knowledge of regulatory requirements pertaining cooling systems	identify and interpret standards and regulations pertaining to cooling systems

Range of Variables

components include: radiators, thermostats, water pumps, hoses, tubing, belts, seals, gaskets, sealants, fastening devices

fan systems and their components include: mechanical, electrical, hydraulic

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

warning indicators include: warning messages, warning lights, audible signals

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

hazards include: high pressure, high temperature, toxicity

B-5.02 Repairs lubricating systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-5.02.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-5.02.02P	select and use components for repair	components are selected and used according to repair requirements and manufacturers' service information
B-5.02.03P	remove, replace or service lubricating system components	lubricating system components are removed, replaced or serviced according to manufacturers' service information
B-5.02.04P	identify and select engine oil	engine oil is identified and selected according to manufacturers' service information
B-5.02.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information

B-5.02.06P	perform priming and pre-lubrication of oil pressure system	priming and pre-lubrication of oil pressure system is performed according to manufacturers' service information
B-5.02.07P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: scan tools, oil pressure gauges, measuring tools, pre-lubricator, priming tools, hand tools, air tools, power tools

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: pumps and drives, coolers, lines, hoses, filters, chains, tensioners, seals, sealants, gaskets, fastening devices

maintenance procedures include: changing oil and filter, resetting maintenance reminder

Knowledge

	Learning Outcomes	Learning Objectives
B-5.02.01L	demonstrate knowledge of engine lubricating systems, their components , characteristics, applications and operation	identify types of engine lubricants and describe their characteristics and applications
		describe operating principles of engine lubricating systems and their components
		identify types of oil pumps and drives and describe their purpose and operation
		identify types of oil coolers and describe their purpose and operation
		describe oil flow, filtration and pressure regulation
		identify requirements related to superchargers and turbochargers
		identify related systems and describe relationship to lubricating systems
		identify warning indicators and describe their characteristics, applications and operation

B-5.02.02L	demonstrate knowledge of procedures used to repair engine lubricating systems	identify tools and equipment used to repair engine lubricating systems, and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to lubricating systems
		describe procedures used to repair engine lubricating systems
		describe maintenance procedures
		describe procedures used to verify repair
		identify materials that can be recycled
B-5.02.03L	demonstrate knowledge of regulatory requirements pertaining to engine lubricating systems	identify standards and regulations pertaining to engine lubricating systems and materials

Range of Variables

components include: pumps and drives, coolers, lines, hoses, filters, chains, tensioners, seals, sealants, gaskets, fastening devices

related systems include: engine assembly, oil coolers

warning indicators include: warning messages, warning lights, audible signals

tools and equipment include: scan tools, oil pressure gauges, measuring tools, pre-lubricator, priming tools, hand tools, air tools, power tools

hazards include: slip and fall, toxicity

maintenance procedures include: changing oil and filter, resetting maintenance reminder

B-5.03 Repairs engine assembly

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-5.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-5.03.02P	select and use components for repair	components are selected and used according to repair requirements and manufacturers' service information
B-5.03.03P	remove and reinstall engine assembly	engine assembly is removed and reinstalled according to manufacturers' service information

B-5.03.04P	remove, disassemble and inspect engine components	engine components are removed and disassembled according to manufacturers' service information , inspected for damage, measured for wear and compared to manufacturers' service information
B-5.03.05P	replace or service engine components	engine components are replaced or serviced according to manufacturers' service information
B-5.03.06P	reassemble engine components , and perform measurements and adjustments	engine components are reassembled, and measurements and adjustments are performed according to manufacturers' service information
B-5.03.07P	perform mechanical engine timing procedures	mechanical engine timing procedures are performed according to manufacturers' service information
B-5.03.08P	perform pre-lubrication and priming procedures	pre-lubrication and priming procedures are performed according to manufacturers' service information
B-5.03.09P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-5.03.10P	verify repair	repair is verified by system re-test and road test according to manufacturers' service information

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: crankshafts, camshafts, bearings, pistons and rings, engine block, cylinder head assemblies, VVT actuators, seals, sealants, gaskets, fastening devices, timing mechanism

maintenance procedures include: oil change, maintenance reminder

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 engine assemblies, their components , characteristics, applications 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

		describe operating principles of engine assemblies and their components
		identify engine components and describe their design, purpose and operation
		describe engine displacement and compression ratios
		describe variable valve timing control systems
B-5.03.03L	demonstrate knowledge of the procedures used to repair engine assemblies and their components	identify tools and equipment used to repair engine assemblies and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to engine assemblies
		identify types and sources of engine assembly faults
		describe procedures used to remove, repair and reassemble engine assemblies and their components
		describe procedures used to adjust, repair and replace engine assembly components
		describe maintenance procedures
		describe procedures used to verify repair
		identify materials that can be reconditioned, reused or recycled

Range of Variables

components include: crankshafts, camshafts, bearings, pistons and rings, engine block, cylinder head assemblies, VVT actuators, seals, sealants, gaskets, fastening devices, timing mechanism

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

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

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

hazards include: slips and falls, high temperature, high pressure, toxicity, rotating parts

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

maintenance procedures include: oil change, maintenance reminder

B-5.04 Repairs accessory drive systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-5.04.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-5.04.02P	select and use components for repair	components are selected and used according to repair requirements and manufacturers' service information
B-5.04.03P	remove, service and replace accessory drive system components	accessory drive system components are removed, serviced and replaced according to requirements
B-5.04.04P	adjust accessory drive system components	accessory drive system components are adjusted according to manufacturers' service information
B-5.04.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-5.04.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: tensioners, belts, pulleys, brackets, gaskets, sealants, fastening devices

maintenance procedures include: belt inspection, tensioner inspection

Knowledge

	Learning Outcomes	Learning Objectives
B-5.04.01L	demonstrate knowledge of accessory drive systems, and their components , characteristics, applications and operation	identify types of accessory drive systems, and their components , and describe their characteristics and applications
		describe operating principles of accessory drive systems, and their components
		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, and their components	identify tools and equipment used to repair accessory drive systems, and their components and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to accessory drive systems
		describe procedures used to repair accessory drive systems, and their components
		describe procedures used to reinstall and adjust accessory drive systems, and their components
		describe maintenance procedures
		describe procedures used to verify repair

Range of Variables

components include: tensioners, belts, pulleys, brackets, gaskets, sealants, fastening devices

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

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

hazards include: rotating components, pinch points, loose clothing, high pressure liquids and gases

maintenance procedures include: belt inspection, tensioner inspection

Task B-6 Diagnoses gasoline engine support systems

Task Descriptor

Automotive service technicians diagnose gasoline engine support systems according to manufacturers' service information to ensure proper engine efficiency and operation.

B-6.01 Diagnoses gasoline fuel delivery and injection systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-6.01.01P	verify concern	concern is verified to determine diagnostic strategy
B-6.01.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-6.01.03P	identify type of gasoline fuel delivery and injection systems	gasoline fuel delivery and injection systems are identified
B-6.01.04P	inspect and test fuel properties for contaminants	fuel properties are inspected and tested for contaminants
B-6.01.05P	inspect gasoline fuel delivery and injection systems, and their components	gasoline fuel delivery and injection systems, and their components are inspected for wear, damage and defects
B-6.01.06P	perform tests	tests are performed according to manufacturers' service information
B-6.01.07P	identify faults	faults are identified
B-6.01.08P	record, interpret and analyze test results	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

tools and equipment include: fuel pressure gauges, scan tools, vacuum gauges, digital multimeters (DMMs), oscilloscopes

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

fuel properties include: quality, colour, odour, ethanol content

components include: injectors, pumps, lines, filters, control systems, tubing, hoses, gaskets, seals

tests include: pressure, volume, fuel injector flow, injector balance

faults include: engine misfires, lack of power

Knowledge		
Learning Outcomes	Learning Objectives	
B-6.01.01L	demonstrate knowledge of gasoline fuel delivery and injection systems , their components , characteristics, applications and operation	identify types of gasoline fuel delivery and injection systems and their components , and describe their characteristics and applications describe operating principles of gasoline fuel delivery and injection systems and their components
B-6.01.02L	demonstrate knowledge of the procedures used to diagnose gasoline fuel delivery and injection systems and their components	identify tools and equipment used to diagnose gasoline fuel delivery and injection systems and their components , and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to gasoline fuel delivery and injection systems describe procedures used to diagnose gasoline fuel delivery and injection systems and their components describe procedures used to remove and reinstall gasoline fuel delivery and injection systems and their components identify materials that can be recycled
B-6.01.03L	demonstrate knowledge of regulatory requirements pertaining to gasoline fuel delivery and injection systems	identify codes, standards and regulations pertaining to gasoline fuel delivery and injection systems

Range of Variables

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

components include: injectors, pumps, lines, filters, control systems, tubing, hoses, gaskets, seals

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

tools and equipment include: fuel pressure gauges, scan tools, vacuum gauges, digital multimeters (DMMs), oscilloscopes

hazards include: high pressure, flammability

B-6.02 Diagnoses gasoline electronic ignition systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-6.02.01P	verify concern	concern is verified to determine diagnostic strategy
B-6.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-6.02.03P	inspect gasoline electronic ignition systems and their components	gasoline electronic ignition systems and their components are inspected for wear and damage
B-6.02.04P	perform tests	tests are performed according to manufacturers' service information
B-6.02.05P	record, interpret and analyze test results	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

gasoline electronic ignition systems include: coil-on-plug, coil near plug, waste spark

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

tests include: coil, primary and secondary circuits, road

Knowledge

	Learning Outcomes	Learning Objectives
B-6.02.01L	demonstrate knowledge of gasoline electronic ignition systems , their components , characteristics, applications and operation	identify types of gasoline electronic ignition systems and their components , and describe their characteristics and applications describe operating principles of gasoline electronic ignition systems and their components identify types of ignition circuits and describe their purpose and operation identify related systems and describe their relationship to gasoline electronic ignition systems
B-6.02.02L	demonstrate knowledge of the procedures used to diagnose gasoline electronic ignition systems and their components	identify tools and equipment used to diagnose gasoline electronic ignition systems and their components , and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to gasoline electronic ignition systems describe procedures used to diagnose gasoline electronic ignition systems and their components identify gasoline electronic ignition concerns

Range of Variables

gasoline electronic ignition systems include: coil-on-plug, coil near plug, waste spark

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

ignition circuits include: primary, secondary, control

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

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

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

hazards include: high voltage, flammability

gasoline electronic ignition concerns include: hesitation, misfire, lag, no start

B-6.03**Diagnoses gasoline intake and exhaust systems**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-6.03.01P	verify concern	concern is verified to determine diagnostic strategy
B-6.03.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-6.03.03P	inspect gasoline intake and exhaust systems	gasoline intake and exhaust systems are inspected for function, leaks, restrictions and variable intake manifold operation
B-6.03.04P	perform tests	tests are performed according to manufacturers' service information
B-6.03.05P	inspect gasoline intake and exhaust systems and their components	gasoline intake and exhaust systems and their components are inspected for restrictions, wear, damage and defects
B-6.03.06P	take measurements on turbocharger systems and supercharger systems	measurements are taken on turbocharger systems and supercharger systems according to manufacturers' service information
B-6.03.07P	record, interpret and analyze test results	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

gasoline intake and exhaust systems include: forced air (turbocharged, supercharged), naturally aspirated (NA), single or dual exhaust, variable intake manifold

tests include: exhaust back pressure, leak, intake restriction

components include: intake manifolds and associated piping, exhaust manifolds and associated piping, mufflers, catalytic converters, turbocharger systems, supercharger systems, fasteners, tubing, hoses, gaskets, seals, sealants

measurements include: end play, boost

Knowledge

	Learning Outcomes	Learning Objectives
B-6.03.01L	demonstrate knowledge of gasoline intake and exhaust systems , their components , characteristics, applications and operation	identify types of gasoline intake and exhaust systems and their components , and describe their characteristics and applications
		describe operating principles of gasoline intake and exhaust systems and their components
		identify related systems and describe their relationship to gasoline intake and exhaust systems
B-6.03.02L	demonstrate knowledge of procedures used to diagnose gasoline intake and exhaust systems and their components	identify tools and equipment used to diagnose gasoline intake and exhaust systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to gasoline intake and exhaust systems and their components
		describe procedures used to diagnose gasoline intake and exhaust systems and their components
		identify materials that can be recycled

Range of Variables

gasoline intake and exhaust systems include: forced air (turbocharged, supercharged), naturally aspirated (NA), single or dual exhaust, variable intake manifold

components include: intake manifolds and associated piping, exhaust manifolds and associated piping, mufflers, catalytic converters, turbocharger systems, supercharger systems, fasteners, tubing, hoses, gaskets, seals, sealants

related systems include: emissions, lubricating, fuel delivery

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

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

hazards include: high temperature, noxious emissions, fuel pressure and flammability

B-6.04**Diagnoses gasoline emission control systems**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-6.04.01P	verify concern	concern is verified to determine diagnostic strategy
B-6.04.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-6.04.03P	access DTCs and data from on-board diagnostics (OBD) system	DTCs and data from OBD system are accessed
B-6.04.04P	inspect gasoline emission control systems and their components	gasoline emission control systems and their components are inspected for wear, damage and defects
B-6.04.05P	identify types of gasoline emission control systems and their components	types of gasoline emission control systems and their components are identified to determine type of tests required
B-6.04.06P	perform tests	tests are performed according to manufacturers' service information
B-6.04.07P	record, interpret and analyze test results	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

tools and equipment include: scan tools, smoke generators, evaporative emission control system (EVAP) leak detectors, gas analyzers, DMMs, oscilloscopes

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

gasoline emission control systems include: exhaust gas recirculation (EGR), EVAP, secondary air injection, exhaust system, positive crankcase ventilation (PCV), induction system, variable cam-timing (VCT)

components include: solenoids, EGR valves, hoses, catalytic converters, PCV valves, canisters, air pumps, fasteners, tubing, hoses, gaskets, seals, sealants

tests include: leak detection, exhaust gas analysis, actuator test, flow test

Knowledge

	Learning Outcomes	Learning Objectives
B-6.04.01L	demonstrate knowledge of gasoline emission control systems , their components , characteristics, applications and operation	identify types of gasoline emission control systems and their components , and describe their characteristics and applications describe operating principles of gasoline emission control systems and their components identify types of emission gases and how they are formed identify related systems and describe their relationship to gasoline emission control systems identify warning indicators and describe their characteristics, applications and operation
B-6.04.02L	demonstrate knowledge of procedures used to diagnose gasoline emission control systems and their components	identify tools and equipment used to diagnose gasoline emission control systems and their components , and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to gasoline emission control systems and their components describe procedures used to diagnose gasoline emission control systems and their components identify materials that can be recycled
B-6.04.03L	demonstrate knowledge of regulatory requirements pertaining to gasoline emission control systems	identify standards and regulations pertaining to gasoline emission control systems

Range of Variables

gasoline emission control systems include: exhaust gas recirculation (EGR), EVAP, secondary air injection, exhaust system, positive crankcase ventilation (PCV), induction system, variable cam-timing (VCT)

components include: solenoids, EGR valves, hoses, catalytic converters, PCV valves, canisters, air pumps, fasteners, tubing, hoses, gaskets, seals, sealants

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

related systems include: exhaust, intake, fuel

warning indicators include: warning messages, warning lights, audible signals

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

tools and equipment include: scan tools, smoke generators, evaporative emission control system (EVAP) leak detectors, gas analyzers, DMMs, oscilloscopes

hazards include: high temperature, noxious gas

Task B-7 Repairs gasoline engine support systems

Task Descriptor

Automotive service technicians repair and maintain gasoline engine support systems according to manufacturers' service information.

B-7.01 Repairs gasoline fuel delivery and injection systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-7.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-7.01.02P	select and use components for repair	components are selected and used according to repair requirements and manufacturers' service information
B-7.01.03P	depressurize gasoline fuel delivery and injection systems	gasoline fuel delivery and injection systems are depressurized according to manufacturers' service information to remove and disassemble system
B-7.01.04P	remove, service and replace gasoline fuel delivery and injection systems and their components	gasoline fuel delivery and injection systems and their components are removed, serviced and replaced according to manufacturers' service information
B-7.01.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-7.01.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: fuel filters, injectors, tanks, lines, hoses and pumps, regulators, gaskets, seals, fastening devices

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

maintenance procedures include: fuel injector flushes, contaminants removal, filter replacement

Knowledge		
	Learning Outcomes	Learning Objectives
B-7.01.01L	demonstrate knowledge of gasoline fuel delivery and injection systems , their components , characteristics, applications and operation	identify types of gasoline fuel delivery and injection systems and their components , and describe their characteristics and applications
		describe operating principles of gasoline fuel delivery and injection systems and their components
B-7.01.02L	demonstrate knowledge of procedures used to repair gasoline fuel delivery and injection systems and their components	identify tools and equipment used to repair gasoline fuel delivery and injection systems , and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to gasoline fuel delivery and injection systems
		describe procedures used to remove and reinstall gasoline fuel delivery and injection system components
		describe procedures used to adjust, calibrate, repair and replace gasoline fuel delivery and injection system components
		describe maintenance procedures
B-7.01.03L	demonstrate knowledge of regulatory requirements pertaining to gasoline fuel delivery and injection systems	describe procedures used to verify repair
		identify codes, standards and regulations pertaining to gasoline fuel delivery and injection systems

Range of Variables

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

components include: fuel filters, injectors, tanks, lines, hoses and pumps, regulators, gaskets, seals, fastening devices

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

hazards include: high pressure, flammability

maintenance procedures include: fuel injector flushes, contaminants removal, filter replacement

B-7.02 Repairs gasoline electronic ignition systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-7.02.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-7.02.02P	select and use components for repair	components are selected and used according to repair requirements and manufacturers' service information
B-7.02.03P	remove, replace or service gasoline ignition system components	gasoline ignition system components are removed, replaced or serviced according to manufacturers' service information
B-7.02.04P	measure and adjust clearances	clearances are measured and adjusted according to manufacturers' service information
B-7.02.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-7.02.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: scan tools, hand tools, air tools, power tools, DMMs, oscilloscopes, gauges, spark testers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: spark plugs, coils, plug wires, modules, sensors, fastening devices

gasoline ignition systems include: coil-on-plug, coil-near-plug, waste spark

clearances include: spark plug gap, sensor clearances

maintenance procedures include: spark plug change intervals, ignition cable replacement

Knowledge		
Learning Outcomes	Learning Objectives	
B-7.02.01L	demonstrate knowledge of gasoline ignition systems , their components , characteristics, applications and operation	identify types of gasoline ignition systems and their components , and describe their characteristics and applications
		describe operating principles of gasoline ignition systems and their components
		identify types of ignition circuits and describe their purpose and operation
		identify warning indicators and describe their characteristics, applications and operation
B-7.02.02L	demonstrate knowledge of procedures used to repair gasoline ignition systems and their components	identify tools and equipment used to repair gasoline ignition systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to gasoline ignition systems
		describe procedures used to repair gasoline ignition systems
		describe procedures used to remove and reinstall gasoline ignition system components
		describe procedures used to adjust, calibrate, repair and replace gasoline ignition system components
		describe maintenance procedures
		describe procedures used to verify repair

Range of Variables

gasoline ignition systems include: coil-on-plug, coil-near-plug, waste spark

components include: spark plugs, coils, plug wires, modules, sensors, fastening devices

ignition circuits include: primary, secondary, control

warning indicators include: warning messages, warning lights, audible signals

tools and equipment include: scan tools, hand tools, air tools, power tools, DMMs, oscilloscopes, gauges, spark testers

hazards include: high voltage, high temperature

maintenance procedures include: spark plug change intervals, ignition cable replacement

B-7.03 Repairs gasoline intake and exhaust systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-7.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-7.03.02P	select and use components to perform repair	components are selected and used according to repair requirements and manufacturers' service information
B-7.03.03P	remove and replace gasoline intake and exhaust system components	gasoline intake and exhaust system components are removed and replaced according to manufacturers' service information
B-7.03.04P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-7.03.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: scan tools, hand tools, air tools, power tools, torches, welders, vacuum and pressure gauges

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: intake manifolds and associated piping, exhaust manifolds and piping, mufflers, catalytic converters, turbocharger systems, supercharger systems, gaskets, seals, sealants, fastening devices

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

maintenance procedures include: cleaning throttle body, replacing air filters, changing supercharger oil, priming, lubricating and servicing turbocharger and supercharger systems

Knowledge

Learning Outcomes	Learning Objectives	
B-7.03.01L	demonstrate knowledge of gasoline intake and exhaust systems , their components , characteristics, applications and operation	identify types of gasoline intake and exhaust systems and their components , and describe their characteristics and applications
		describe operating principles of gasoline intake and exhaust systems and their components
		identify related systems and describe their relationship to gasoline intake and exhaust systems
B-7.03.02L	demonstrate knowledge of procedures used to repair gasoline intake and exhaust systems , and their components	identify tools and equipment used to repair gasoline intake and exhaust systems , and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to gasoline intake and exhaust systems
		describe procedures used to repair gasoline intake and exhaust systems
		describe procedures used to remove and reinstall gasoline intake and exhaust system components
		describe procedures used to adjust, calibrate, repair and replace gasoline intake and exhaust system components
		identify types and sources of gasoline intake and exhaust system faults
		describe maintenance procedures
		describe procedures used to verify repair
		identify materials that can be recycled

Range of Variables

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

components include: intake manifolds and associated piping, exhaust manifolds and piping, mufflers, catalytic converters, turbocharger systems, supercharger systems, gaskets, seals, sealants, fastening devices

related systems include: emissions, lubricating, fuel delivery

tools and equipment include: scan tools, hand tools, air tools, power tools, torches, welders, vacuum and pressure gauges

hazards include: high temperature, noxious fumes, flammability

gasoline intake and exhaust system faults include: leaks, blockages, noise, vibration

maintenance procedures include: cleaning throttle body, replacing air filters, changing supercharger oil, priming, lubricating and servicing turbocharger and supercharger systems

B-7.04 Repairs gasoline emission control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-7.04.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-7.04.02P	select and use gasoline emission control system components for repair	gasoline emission control system components are selected and used according to repair requirements and manufacturers' service information
B-7.04.03P	remove and replace gasoline emission control system components	gasoline emission control system components are removed and replaced according to manufacturers' service information
B-7.04.04P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-7.04.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: hand tools, air tools, power tools, cleaning and service tools, scan tools, DMMs, oscilloscopes, reprogramming equipment, gas analyzers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

components include: solenoids, EGR valves, hoses, catalytic converters, PCV valves, gaskets, seals, sealants, fastening devices

maintenance procedures include: cleaning EGR valves/passages, replacing PCV valves

Knowledge		
Learning Outcomes	Learning Objectives	
B-7.04.01L	demonstrate knowledge of gasoline emission control systems , their components , characteristics, applications and operation	identify gasoline emission control systems and their components , and describe their characteristics and applications
		describe operating principles of gasoline emission control systems and their components
		identify types of emission gases and how they are formed
		identify related systems and describe their relationship to gasoline emission control systems
B-7.04.02L	demonstrate knowledge of procedures used to repair gasoline emission control systems and their components	identify tools and equipment used to repair gasoline emission control systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to gasoline emission control systems and their components
		describe procedures used to repair and maintain gasoline emission control systems
		describe procedures used to remove and reinstall gasoline emission control system components

		describe procedures used to adjust, repair and replace gasoline emission control system components
		describe maintenance procedures
		describe procedures used to verify repair
		identify materials that can be recycled
B-7.04.03L	demonstrate knowledge of regulatory requirements pertaining to gasoline emission control systems	identify standards and regulations pertaining to gasoline emission control systems

Range of Variables

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

components include: solenoids, EGR valves, hoses, catalytic converters, PCV valves, gaskets, seals, sealants, fastening devices

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

related systems include: gasoline fuel delivery systems, exhaust systems, intake systems, ignition systems

tools and equipment include: hand tools, air tools, power tools, cleaning and service tools, scan tools, DMMs, oscilloscopes, reprogramming equipment, gas analyzers

hazards include: high temperature, noxious fumes, flammability

maintenance procedures include: cleaning EGR valves/passages, replacing PCV valves

Task B-8 Diagnoses diesel engine support systems

Task Descriptor

Automotive service technicians diagnose diesel engine support systems according to manufacturers' service information.

B-8.01 Diagnoses diesel fuel delivery and injection systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-8.01.01P	verify concern	concern is verified to determine diagnostic strategy
B-8.01.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information

B-8.01.03P	identify types of diesel fuel injection systems	diesel fuel injection systems are identified to understand components' location and function according to type
B-8.01.04P	inspect and test diesel fuel	diesel fuel properties and contaminants are identified
B-8.01.05P	inspect components	components are inspected for wear, damage and defects
B-8.01.06P	perform tests	tests are performed according to manufacturers' service information and safety procedures are followed
B-8.01.07P	identify diesel fuel injection system faults	diesel fuel injection system faults are identified
B-8.01.08P	record, interpret and analyze results of functional tests and data	results of functional tests and data are recorded, interpreted, analyzed and compared to manufacturers' service information

Range of Variables

tools and equipment include: fuel pressure gauges, scan tools, vacuum gauges, DMMs, oscilloscopes, graduated cylinders, hydrometer

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

components include: lift pumps, fuel filters, tanks, fuel heater, lines, gaskets, seals, injectors, fuel water separators

diesel fuel properties and contaminants include: specific gravity, water, metal, dirt, quality, colour, odour

tests include: pressure, volume, restriction

diesel fuel injection system faults include: lack of power, smoke, hard start

data includes: timing, fuel rate, balance rate

Knowledge

	Learning Outcomes	Learning Objectives
B-8.01.01L	demonstrate knowledge of diesel fuel delivery and injection systems, their components , characteristics, applications and operation	identify types of diesel fuel delivery and injection systems and their components , and describe their characteristics and applications
		describe operating principles of diesel fuel delivery and injection systems and their components
		identify types of pre-heat systems and describe their purpose and operation

B-8.01.02L	demonstrate knowledge of procedures used to diagnose diesel fuel delivery and injection systems and their components	identify tools and equipment used to diagnose diesel fuel delivery and injection systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to diesel fuel delivery and injection systems and their components
		identify methods to test fuel quality and describe their associated procedures
		describe procedures used to diagnose diesel fuel delivery and injection systems and their components
		describe procedures used to remove and reinstall diesel fuel delivery and injection system components
		identify materials that can be reconditioned, reused or recycled
B-8.01.03L	demonstrate knowledge of regulatory requirements pertaining to diesel fuel injection systems	identify codes, standards and regulations pertaining to diesel fuel injection systems

Range of Variables

components include: lift pumps, fuel filters, tanks, fuel heater, lines, gaskets, seals, injectors, fuel water separators

pre-heat systems include: glow plugs, intake heaters, timers

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

tools and equipment include: fuel pressure gauges, scan tools, vacuum gauges, DMMs, oscilloscopes, graduated cylinders, hydrometer

hazards include: high pressure fuel, high injection voltage

diesel fuel injection system faults include: lack of power, smoke, hard start

B-8.02**Diagnoses diesel intake and exhaust systems**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-8.02.01P	verify concern	concern is verified to determine diagnostic strategy
B-8.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-8.02.03P	inspect diesel intake and exhaust systems and their components	diesel intake and exhaust systems components are inspected for damage and restrictions
B-8.02.04P	take measurements on turbocharger systems	measurements are taken on turbocharger systems according to manufacturers' service information
B-8.02.05P	inspect turbocharger system components for damage	turbocharger system components are inspected for damage
B-8.02.06P	perform tests on intake and exhaust systems	tests on intake and exhaust systems are performed according to manufacturers' service information
B-8.02.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: air filter, piping, manifolds, turbocharger, air charge coolers (intercoolers), gaskets, seals, clamps

damage includes: broken fins, leaks, noisy bearings

measurements include: end play and boost pressure

tests include: back pressure, smoke test

Knowledge

	Learning Outcomes	Learning Objectives
B-8.02.01L	demonstrate knowledge of diesel intake and exhaust systems, their components , characteristics, applications and operation	identify types of diesel intake systems and exhaust systems, and their components , and describe their characteristics and applications
		describe operating principles of diesel intake systems and exhaust systems, and their components
B-8.02.02L	demonstrate knowledge of procedures used to diagnose diesel intake and exhaust systems and their components	identify tools and equipment used to diagnose diesel intake and exhaust systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to diesel intake and exhaust systems and their components
		describe procedures used to diagnose diesel intake and exhaust systems and their components
		identify types and sources of diesel intake and exhaust system faults
B-8.02.03L	demonstrate knowledge of regulatory requirements pertaining to diesel intake and exhaust systems	identify codes, standards and regulations pertaining to diesel intake and exhaust systems

Range of Variables

components include: air filter, piping, manifolds, turbocharger, air charge coolers (intercoolers), gaskets, seals, clamps

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

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

hazards include: high temperature, noxious fumes, run away condition, engine overspeed

diesel intake and exhaust system faults include: leaks, blockages, noise, vibration

B-8.03**Diagnoses diesel emission control systems**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-8.03.01P	verify concern	concern is verified to determine diagnostic strategy
B-8.03.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-8.03.03P	access DTCs and data from OBD system	DTCs and data from OBD systems are accessed
B-8.03.04P	identify type of diesel emission control systems and components	type of diesel emission control systems and components are identified to determine type of tests required
B-8.03.05P	inspect diesel emission control systems and components	diesel emission control systems and components are inspected for wear, damage and defects
B-8.03.06P	perform tests	tests are performed according to manufacturers' service information
B-8.03.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

diesel emission control systems include: EGR, PCV, Selective Catalyst Reduction (SCR), diesel exhaust fluid (DEF), diesel oxidation catalyst (DOC), diesel particulate filter (DPF); variable geometry turbocharger (VGT)

components include: EGR valve/particulate filter/cooler, DEF tank/heater/injector, gaskets, seals, sensors, fastening devices

Knowledge

	Learning Outcomes	Learning Objectives
B-8.03.01L	demonstrate knowledge of diesel emission control systems , their components , characteristics, applications and operation	identify diesel emission control systems and their components , and describe their characteristics and applications describe operating principles of diesel emission control systems and their components identify diesel emissions and how they are formed identify warning indicators and describe their characteristics, applications and operation
B-8.03.02L	demonstrate knowledge of procedures used to diagnose diesel emission control systems and their components	identify tools and equipment used to diagnose diesel emission control systems and their components , and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to diesel emission control systems and their components describe procedures used to diagnose diesel emission control systems identify materials that can be reconditioned, reused or recycled
B-8.03.03L	demonstrate knowledge of regulatory requirements pertaining to diesel emission control systems	identify codes, standards and regulations pertaining to diesel emission control systems

Range of Variables

diesel emission control systems include: EGR, PCV, Selective Catalyst Reduction (SCR), diesel exhaust fluid (DEF), diesel oxidation catalyst (DOC), diesel particulate filter (DPF); variable geometry turbocharger (VGT)

components include: EGR valve/particulate filter/cooler, DEF tank/heater/injector, gaskets, seals, sensors, fastening devices

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

warning indicators include: warning messages, warning lights, audible signals

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

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

hazards include: corrosive diesel exhaust fluid, high temperature, noxious fumes

Task B-9 Repairs diesel engine support systems

Task Descriptor

Automotive service technicians repair and maintain diesel engine support systems according to manufacturers' service information.

B-9.01 Repairs diesel fuel delivery and injection systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-9.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-9.01.02P	select and use diesel fuel delivery and injection system components for repair	diesel fuel delivery and injection system components are selected and used according to repair requirements and manufacturers' service information
B-9.01.03P	depressurize diesel fuel delivery and injection systems	diesel fuel delivery and injection systems are depressurized according to manufacturers' service information to remove and disassemble system
B-9.01.04P	remove, service or replace diesel fuel delivery and injection system components	diesel fuel delivery and injection system components are removed, serviced or replaced according to manufacturers' service information
B-9.01.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-9.01.06P	pressurize and bleed diesel fuel delivery and injection systems	diesel fuel delivery and injection systems are pressurized and bled according to manufacturers' service information
B-9.01.07P	remove, clean and replace components	components are removed, cleaned and replaced according to manufacturers' service information
B-9.01.08P	perform diesel fuel injection system timing procedures	diesel fuel injection system timing procedures are performed according to manufacturers' service information
B-9.01.09P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

components include: fuel filters, tanks, lines, hoses, pumps, gaskets, seals, fastening devices, fuel water separators

maintenance procedures include: performing fuel treatment, removing water, replacing filter

Knowledge		
	Learning Outcomes	Learning Objectives
B-9.01.01L	demonstrate knowledge of diesel fuel delivery and injection systems , their components , characteristics, applications and operation	identify types of diesel fuel delivery and injection systems and their components , and describe their characteristics and applications
		describe operating principles of diesel fuel delivery and injection systems and their components
		identify types of pre-heat systems 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 procedures used to repair diesel fuel delivery and injection systems and their components	identify tools and equipment used to repair diesel fuel delivery and injection systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to diesel fuel delivery and injection systems and their components
		describe procedures used to remove and reinstall diesel fuel delivery and injection systems and components
		describe procedures used to repair diesel fuel delivery and injection systems
		describe maintenance procedures
		describe procedures used to verify repair
B-9.01.03L	demonstrate knowledge of regulatory requirements pertaining to diesel fuel delivery and injection systems	identify codes, standards and regulations pertaining to diesel fuel delivery and injection systems

Range of Variables

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

components include: fuel filters, tanks, lines, hoses, pumps, gaskets, seals, fastening devices, fuel water separators

pre-heat systems include: glow plugs, intake heaters, timers

related systems include: intake and exhaust, emission control

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

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

maintenance procedures include: performing fuel treatment, removing water, replacing filter

B-9.02 Repairs diesel intake and exhaust systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-9.02.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-9.02.02P	select and use diesel intake and exhaust system components to perform repair	diesel intake and exhaust system components are selected and used according to repair requirements and manufacturers' service information
B-9.02.03P	remove and replace diesel intake and exhaust system components	diesel intake and exhaust system components are removed and replaced
B-9.02.04P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-9.02.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: scan tools, hand tools, air tools, power tools, pyrometers, reprogramming equipment

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: manifolds, mufflers, air charge coolers (intercoolers), turbochargers, gaskets, seals, sealants, fastening devices

maintenance procedures include: cleaning passages, replacing filters, priming, lubricating and servicing turbocharger systems

Knowledge

Learning Outcomes	Learning Objectives
B-9.02.01L	demonstrate knowledge of diesel intake and exhaust systems, their components characteristics, applications and operation
	identify types of diesel intake and exhaust systems and their components , and describe their characteristics and applications
	describe operating principles of diesel intake and exhaust systems, and their components
B-9.02.02L	demonstrate knowledge of procedures used to repair diesel intake and exhaust systems, and their components
	identify tools and equipment used to repair diesel intake and exhaust systems, and their components , and describe their characteristics, applications and procedures for use
	identify hazards and describe safe work practices pertaining to diesel intake and exhaust systems, and their components
	describe procedures used to repair diesel intake and exhaust systems, and their components
	identify types and sources of diesel intake and exhaust system faults
	describe procedures used to adjust, repair and replace components
	describe procedures used to perform decarbonisation of turbocharger systems
	describe manufacturers' specific maintenance procedures
	describe procedures used to verify repair
	identify materials that can be reconditioned, reused or recycled
B-9.02.03L	demonstrate knowledge of regulatory requirements pertaining to diesel intake and exhaust systems
	identify codes, standards and regulations pertaining to diesel intake and exhaust systems

Range of Variables

components include: manifolds, mufflers, air charge coolers (intercoolers), turbochargers, gaskets, seals, sealants, fastening devices

tools and equipment include: scan tools, hand tools, air tools, power tools, pyrometers, reprogramming equipment

hazards include: high temperature, noxious fumes, run away condition, engine overspeed

maintenance procedures include: cleaning passages, replacing filters, priming, lubricating and servicing turbocharger systems

B-9.03**Repairs diesel emission control systems**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
B-9.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-9.03.02P	select and use components for repair	components are selected and used according to repair requirements and manufacturers' service information
B-9.03.03P	remove and replace diesel emission control systems and components	diesel emission control systems and components are removed and replaced according to manufacturers' service information
B-9.03.04P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
B-9.03.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: scan tools, hand tools, air tools, power tools, vacuum gauges, smoke generators, leak detectors, DMMs, oscilloscopes, reprogramming equipment, opacity meter

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: EGR valve/particulate filter/cooler, DEF tank/heater/injector, gaskets, seals, sensors, fastening devices

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

maintenance procedures include: cleaning EGR system and restricted passages, replacing filters, performing regeneration procedures

Knowledge

	Learning Outcomes	Learning Objectives
B-9.03.01L	demonstrate knowledge of diesel emission control systems , their components , characteristics, applications and operation	identify diesel emission control systems and their components , and describe their characteristics and applications describe operating principles of diesel emission control systems and their components identify types of diesel emissions and how they are formed
B-9.03.02L	demonstrate knowledge of procedures used to repair diesel emission control systems and their components	identify tools and equipment used to repair diesel emission control systems and their components , and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to diesel emission control systems and their components describe procedures used to repair diesel emission control systems describe procedures used to service, repair and replace diesel emission control systems and components describe maintenance procedures describe procedures used to verify repair identify materials that can be reconditioned, reused or recycled
B-9.03.03L	demonstrate knowledge of regulatory requirements pertaining to diesel emission control systems	identify codes, standards and regulations pertaining to diesel emission control systems

Range of Variables

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

components include: EGR valve/particulate filter/cooler, DEF tank/heater/injector, gaskets, seals, sensors, fastening devices

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

tools and equipment include: scan tools, hand tools, air tools, power tools, vacuum gauges, smoke generators, leak detectors, DMMs, oscilloscopes, reprogramming equipment, opacity meter

hazards include: high temperature, noxious fumes, corrosive diesel exhaust fluid

maintenance procedures include: cleaning EGR system and restricted passages, replacing filters, performing regeneration procedures

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 pre-set 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, steering and brake control.

Automotive service technicians diagnose vehicle networking systems according to manufacturers' service information.

C-10.01 Reads diagnostic trouble codes (DTCs)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
C-10.01.01P	verify concern	concern is verified to determine diagnostic strategy
C-10.01.02P	identify diagnostic systems	diagnostic systems are identified to determine tools used, data link connection (DLC) location and system operation
C-10.01.03P	select and use scan tools	scan tools are selected and used to collect DTCs from modules
C-10.01.04P	scan modules	modules are scanned to find active DTCs and latest software
C-10.01.05P	perform functional tests	functional tests are performed according to manufacturers' service information
C-10.01.06P	refer to manufacturers' diagnostic procedures	manufacturers' diagnostic procedures are referred to for DTCs definition

Range of Variables

modules include: powertrain control module (PCM), transmission control module (TCM), body control module (BCM), electronic brake control module (EBCM)

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

Knowledge		
	Learning Outcomes	Learning Objectives
C-10.01.01L	demonstrate knowledge of vehicle networking systems, their components and operation	identify types of network protocols and describe their purpose
		describe networking of modules and multiplexing
		identify and interpret DTCs
		identify parameters of inputs and outputs and describe their relationships
C-10.01.02L	demonstrate knowledge of procedures used to read DTCs	identify tools and equipment used to diagnose network and electronic circuitry and describe their characteristics, applications and procedures for use
		describe procedures used to read DTCs

Range of Variables

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

networking of modules and multiplexing include: wiring designs, star and loop, wireless

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools

C-10.02 Monitors data

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills		
	Performance Criteria	Evidence of Attainment
C-10.02.01P	verify concern	concern is verified to determine diagnostic strategy
C-10.02.02P	select and use scan tools	scan tools are selected and used to monitor data
C-10.02.03P	select and organize relevant data	relevant data is selected and organized to compare results to manufacturers' service information
C-10.02.04P	record data	data is recorded to aid with diagnosis

Range of Variables

data includes: inputs, outputs, module and network status

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

Knowledge		
	Learning Outcomes	Learning Objectives
C-10.02.01L	demonstrate knowledge of vehicle networking systems, their components and operation	describe networking of modules and multiplexing
		identify and interpret data
C-10.02.02L	demonstrate knowledge of procedures used to monitor data	identify parameters of inputs and outputs and describe their relationships
		identify tools and equipment used to monitor data and describe their characteristics, applications and procedures for use
		describe procedures used to monitor data

Range of Variables

networking of modules and multiplexing include: wiring designs, star and loop, wireless

data includes: inputs, outputs, module and network status

C-10.03 Tests system circuitry and components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills		
	Performance Criteria	Evidence of Attainment
C-10.03.01P	verify concern	concern is verified to determine diagnostic strategy
C-10.03.02P	select and use tools and equipment	tools and equipment are selected and used to test system circuitry and components according to manufacturers' service information
C-10.03.03P	determine faulty system circuitry and components	faulty system circuitry and components are determined according to test results

Range of Variables

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools, LED circuit testers

system circuitry and components include: wiring, modules, fuses, relays, grounds

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

Knowledge		
	Learning Outcomes	Learning Objectives
C-10.03.01L	demonstrate knowledge of vehicle networking systems, their components and operation	identify types of network protocols and describe their purpose
		describe networking of modules and multiplexing
		identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships
C-10.03.02L	demonstrate knowledge of procedures used to diagnose vehicle networking system components	identify tools and equipment used to diagnose network and electronic circuitry, and describe their characteristics, applications and procedures for use
		describe procedures used to diagnose vehicle networking systems
C-10.03.03L	demonstrate knowledge of circuits, their components and operation	interpret diagnostic flowcharts and schematics
		identify type of network wiring and describe their characteristics, composition and applications
C-10.03.04L	demonstrate knowledge of procedures used to diagnose circuits and components	describe 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, star and loop, wireless

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

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools, LED circuit testers

network wiring includes: one-wire, two-wire, optical

C-10.04 Interprets test results

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
C-10.04.01P	verify concern	concern is verified to determine diagnostic strategy
C-10.04.02P	compare test values	test values are compared to manufacturers' service information
C-10.04.03P	determine faulty circuitry and components	faulty circuitry and components are determined by analyzing test results
C-10.04.04P	refer to recorded data	recorded data is referenced to assist in diagnosis

Range of Variables

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

data includes: inputs, outputs, module and network status

Knowledge

	Learning Outcomes	Learning Objectives
C-10.04.01L	demonstrate knowledge of procedures used to interpret test results	describe procedures used to interpret test results
		identify and interpret data
		identify parameters of inputs and outputs and describe their relationships

Range of Variables

data includes: inputs, outputs, module and network status

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, steering and brake control.

Automotive service technicians repair vehicle networking systems according to manufacturers' service information.

C-11.01 Updates component software

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
C-11.01.01P	verify manufacturers' service information	latest software update is verified through manufacturers' service information
C-11.01.02P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to task and manufacturers' service information to update module software
C-11.01.03P	program modules	modules are programmed using updated manufacturers' service information and software
C-11.01.04P	configure modules	modules are configured according to vehicle requirements and options
C-11.01.05P	verify operation of updated modules	operation of updated modules is verified by matching software code to manufacturers' service information

Range of Variables

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

diagnostic tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools, hand tools, air tools, power tools, manufacturer-compliant programming tools, laptops, computers, voltage maintainer

Knowledge

	Learning Outcomes	Learning Objectives
C-11.01.01L	demonstrate knowledge of procedures used to update component software	identify <i>diagnostic tools and equipment</i> used to update component software and describe their characteristics, applications and procedures for use
		identify and describe safe work practices pertaining to vehicle networking systems
		describe procedures used to update component software
C-11.01.02L	demonstrate knowledge of procedures used to reprogram software	identify procedures and <i>methods used to access/transfer and reprogram software</i>

Range of Variables

diagnostic tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools, hand tools, air tools, power tools, manufacturer-compliant programming tools, laptops, computers, voltage maintainer

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

C-11.02 Replaces components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
C-11.02.01P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to <i>manufacturers' service information</i>
C-11.02.02P	follow <i>vehicle-specific cautionary procedures</i>	<i>vehicle-specific cautionary procedures</i> are followed to prevent personal injury and damage to components
C-11.02.03P	identify and install compatible electronic components	compatible electronic components are identified and installed according to vehicle specifications
C-11.02.04P	transfer module-specific data	module-specific data is transferred to component
C-11.02.05P	configure modules	modules are configured according to vehicle requirements and options

Range of Variables

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools, hand tools, air tools, power tools, manufacturer-compliant programming tools, laptops, computers, voltage maintainer
manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

vehicle-specific cautionary procedures include: using anti-static straps, disabling restraint systems, following manufacturer's service information

Knowledge		
	Learning Outcomes	Learning Objectives
C-11.02.01L	demonstrate knowledge of procedures used to replace vehicle networking system components	identify tools and equipment used to replace vehicle networking system components and describe their characteristics, applications and procedures for use
		identify and describe safe work practices pertaining to vehicle networking systems
		describe procedures used to replace vehicle networking system components
C-11.02.02L	demonstrate knowledge of procedures used to reprogram software	identify methods used to access/transfer and reprogram software and describe their associated procedures

Range of Variables

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools, hand tools, air tools, power tools, manufacturer-compliant programming tools, laptops, computers, voltage maintainer
methods used to access/transfer and reprogram software include: USB, Internet, scan tool

C-11.03 Repairs system circuitry and components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills		
	Performance Criteria	Evidence of Attainment
C-11.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
C-11.03.02P	follow vehicle-specific cautionary procedures	vehicle-specific cautionary procedures are followed to prevent personal injury and damage to components

Range of Variables

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, hand tools, wiring repair tools, scan tools, manufacturer-compliant programming tools

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

vehicle-specific cautionary procedures include: using anti-static straps, disabling restraint systems, following manufacturers' service information

Knowledge		
Learning Outcomes	Learning Objectives	
C-11.03.01L	demonstrate knowledge of procedures used to repair networking system circuitry and components	identify tools and equipment used to repair networking system circuitry and components and describe their characteristics, applications and procedures for use
		identify and describe safe work practices pertaining to vehicle networking systems
		describe procedures used to repair networking system circuitry and components

Range of Variables

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, hand tools, wiring repair tools, scan tools, manufacturer-compliant programming tools

C-11.04 Verifies vehicle module communications system repair

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills		
Performance Criteria	Evidence of Attainment	
C-11.04.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information to verify and confirm system repair
C-11.04.02P	perform verification test	verification test is performed to confirm system repair

Range of Variables

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools, manufacturer-compliant programming tools

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

Knowledge		
	Learning Outcomes	Learning Objectives
C-11.04.01L	demonstrate knowledge of procedures used to verify module communications system repair	identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships
		identify tools and equipment used to verify module communications system repair, and describe their characteristics, applications and procedures for use
		identify and describe safe work practices pertaining to vehicle networking systems
		describe procedures used to verify repair of vehicle module communication systems

Range of Variables

tools and equipment include: DMMs, oscilloscopes, probes, breakout boxes, scan tools, manufacturer-compliant programming tools

Major Work Activity D

Diagnoses and repairs driveline systems

Task D-12 Diagnoses driveline systems

Task Descriptor

Driveline systems provide a means of transmitting rotational torque from the engines/motors to the drive wheels in complex and innovative methods. This includes CV axles, drive shafts, transmissions and transaxles, transfer cases, clutches, final drive and differential assemblies.

Automotive service technicians diagnose driveline systems according to manufacturers' service information.

D-12.01 Diagnoses drive shafts and axles

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
D-12.01.01P	verify concern	concern is verified to determine diagnostic strategy
D-12.01.02P	perform road test	road test is performed to identify drive shaft and axle concerns
D-12.01.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-12.01.04P	identify type of drive shaft and axle system	type of drive shaft and axle system is identified to determine operation
D-12.01.05P	inspect vehicle's drive shaft and axle components	vehicle's drive shaft and axle components are inspected according to manufacturers' service information
D-12.01.06P	perform functional tests	functional tests are performed according to manufacturers' service information
D-12.01.07P	interpret and analyze results of functional tests and inspections	results of functional tests and inspections are interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

drive shaft and axle concerns include: noise, vibration and harshness (NVH)

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

drive shaft and axle systems include: 2WD, 4WD, solid axle, independent, full-floating and semi-floating axle engagement mechanisms

components include: drive shafts, cardan joints, bearings, CV axles, CV joints

functional tests include: sensory inspection, runout, angle measurement

Knowledge		
	Learning Outcomes	Learning Objectives
D-12.01.01L	demonstrate knowledge of drive shafts and axles, their components, characteristics, applications and operation	identify types of drive shafts and their components , and describe their composition , characteristics and applications
		identify types of axles and their components, and describe their characteristics and applications
		describe operating principles of drive shafts and axles, and their components
		describe axle disconnects, locking hubs and their purpose
		describe importance of multiple piece drive shaft phasing, indexing and angles
D-12.01.02L	demonstrate knowledge of procedures used to diagnose drive shafts and axles and their components	identify types of lubricants, fasteners, gaskets, seals and sealants, and describe their applications
		identify tools and equipment used to diagnose drive shafts and axles, and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to drive shafts and axles, and their components
		describe procedures used to diagnose drive shafts and axles and their components

Range of Variables

types of drive shafts include: 1 piece, 2 piece

components include: drive shafts, cardan joints, bearings, CV axles, CV joints

composition (of drive shafts) includes: steel, aluminum, composites

axles include: half shafts, floating, semi-floating

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

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

hazards include: exposed rotating parts, pinch points

D-12.02 Diagnoses manual transmissions and transaxles

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
D-12.02.01P	verify concern	concern is verified to determine diagnostic strategy
D-12.02.02P	perform road test	road test is performed to identify manual transmission and transaxle concerns
D-12.02.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-12.02.04P	identify model of manual transmission and transaxle	model of manual transmission and transaxle is identified
D-12.02.05P	check manual transmission and transaxle fluid conditions	manual transmission and transaxle fluid conditions are checked
D-12.02.06P	inspect manual transmission and transaxle components and controls	manual transmission and transaxle components and controls are inspected according to manufacturers' service information
D-12.02.07P	inspect and test electrical components	electrical components are inspected and tested according to manufacturers' service information
D-12.02.08P	inspect engine and driveline mounts	engine and driveline mounts are inspected for wear and damage
D-12.02.09P	interpret and analyze results of tests and inspections	results of tests and inspections are interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

manual transmission and transaxle concerns include: vibrations, noises, driveability, functionality

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

fluid conditions include: levels, leaks, contamination

controls include: shift rods and cables, linkage, bushings, sensors, actuators, modules

Knowledge		
	Learning Outcomes	Learning Objectives
D-12.02.01L	demonstrate knowledge of manual transmissions and transaxles, their components, characteristics, applications and operation	identify types of manual transmissions and transaxles, and their components, and describe their characteristics and applications
		describe operating principles of manual transmissions and transaxles, and their components
		explain manual transmissions and transaxles power flow
		describe gear ratios, their purpose and calculation
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
D-12.02.02L	demonstrate knowledge of procedures used to diagnose manual transmissions and transaxles and their components	identify types of engine and driveline mounts, their construction and application
		identify tools and equipment used to diagnose manual transmissions and transaxles and their components, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to manual transmissions and transaxles and their components
		describe procedures used to diagnose manual transmissions and transaxles and their components
		identify materials that can be reconditioned, reused or recycled

Range of Variables

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

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

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

D-12.03 Diagnoses automatic transmissions and transaxles

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
D-12.03.01P	verify concern	concern is verified to determine diagnostic strategy
D-12.03.02P	perform road test	road test is performed to identify automatic transmission and transaxle concerns
D-12.03.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-12.03.04P	identify model and type of automatic transmission and transaxle	model and type of automatic transmission and transaxle is identified
D-12.03.05P	check fluid level and condition, and visually inspect automatic transmission and transaxle	fluid level and condition are checked, and assembly is inspected for leaks or damage
D-12.03.06P	inspect automatic transmission and transaxle components and controls	automatic transmission and transaxle components and controls are inspected according to manufacturers' service information
D-12.03.07P	perform functional tests	functional tests are performed according to manufacturers' service information
D-12.03.08P	inspect and test electrical components	electrical components are inspected and tested
D-12.03.09P	inspect engine and driveline mounts	engine and driveline mounts are inspected for wear and damage
D-12.03.10P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted and analyzed and compared to manufacturers' service information and required repair is determined

Range of Variables

automatic transmission and transaxle concerns include: vibrations, noises, driveability, leaks

tools and equipment include: hand tools, pressure gauges, scan tools, reprogramming equipment, DMMs, oscilloscopes, chassis ears, stethoscopes, vibration analyzers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

types of automatic transmissions and transaxles include: conventional planetary, continually/constantly variable transmission (CVT), dual clutch transmission (DCT)

controls include: shifter, linkage, electronic

functional tests include: scan tool output, hydraulic line pressure

electrical components include: solenoids, switches, sensors, control modules, actuators

Knowledge		
	Learning Outcomes	Learning Objectives
D-12.03.01L	demonstrate knowledge of automatic transmissions and transaxles, their components, characteristics, applications and operation	identify types of automatic transmissions and transaxles , and their components, and describe their characteristics and applications
		describe operating principles of automatic transmissions and transaxles, and their components
		explain hydraulic principles related to automatic transmissions and transaxles
		explain automatic transmission and 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 warning indicators and describe their characteristics, applications and operation

D-12.03.02L	demonstrate knowledge of procedures used to diagnose automatic transmissions and transaxles	identify tools and equipment used to diagnose automatic transmissions and transaxles and their components, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to automatic transmissions and transaxles and their components
		describe procedures used to diagnose automatic transmissions and transaxles and their components
		identify materials that can be reconditioned, reused or recycled

Range of Variables

types of automatic transmissions and transaxles include: conventional planetary, continually/constantly variable transmission (CVT), dual clutch transmission (DCT)

hydraulic principles include: Pascal's law, fluid dynamics

warning indicators include: warning messages, warning lights, audible signals

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

tools and equipment include: hand tools, pressure gauges, scan tools, reprogramming equipment, DMMs, oscilloscopes, chassis ears, stethoscopes, vibration analyzers

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

D-12.04 Diagnoses clutches

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
D-12.04.01P	verify concern	concern is verified to determine diagnostic strategy
D-12.04.02P	perform road test	road test is performed to identify clutch concerns
D-12.04.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-12.04.04P	identify type of clutch control	type of clutch control is identified
D-12.04.05P	check fluid level and condition, and inspect for leaks	fluid level and condition are checked, and assembly is inspected for leaks

D-12.04.06P	inspect clutch components	clutch components are inspected according to manufacturers' service information
D-12.04.07P	interpret and analyze results of tests and inspections	results of tests and inspections are interpreted, analyzed and compared to manufacturers' service information and required repair is determined

Range of Variables

clutch concerns include: slippage, chatter, odour, driveability, pedal operation

tools and equipment include: hand tools, air tools, power tools

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

types of clutch control include: hydraulic, electric

clutch components include: clutch disc, pressure plate, flywheel, release bearing, primary cylinder, secondary cylinder

Knowledge		
	Learning Outcomes	Learning Objectives
12.04.01L	demonstrate knowledge of clutches, their components , characteristics, applications and operation	identify types of clutches and their components , and describe their characteristics and applications
		describe operating principles of clutches and their components
		identify hydraulic and electric clutch actuating systems and their components, and describe their characteristics, applications and operating principles
		identify types of fluids, fasteners, tubing, hoses and seals and describe their applications
		describe clutch system power flow
12.04.02L	demonstrate knowledge of procedures used to diagnose clutches and their components	identify related systems and describe their relationship to clutch systems
		identify tools and equipment used to diagnose clutches and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to clutches and their components
		describe procedures used to diagnose clutches and their components
		identify materials that can be reconditioned, reused or recycled

Range of Variables

clutch components include: clutch disc, pressure plate, flywheel, release bearing, primary cylinder, secondary cylinder

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

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

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

D-12.05 Diagnoses transfer cases

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
D-12.05.01P	verify concern	concern is verified to determine diagnostic strategy
D-12.05.02P	perform road test	road test is performed to identify transfer case concerns
D-12.05.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-12.05.04P	identify model and type of transfer case	model and type of transfer cases are identified
D-12.05.05P	identify types of all-wheel drive (AWD) systems	types of AWD systems are identified
D-12.05.06P	check transfer case fluid conditions	transfer case fluid conditions are checked
D-12.05.07P	inspect transfer case, components and controls	transfer case, components and controls are inspected according to manufacturers' service information
D-12.05.08P	inspect AWD components and controls	AWD components and controls are inspected according to manufacturers' service information
D-12.05.09P	inspect and test electrical components	electrical components are inspected and tested
D-12.05.10P	perform functional tests	functional tests are performed according to manufacturers' service information
D-12.05.11P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

transfer case concerns include: vibrations, noises, driveability, warning lights, leaks

tools and equipment include: scan tools, hand tools, air tools, power tools

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

type of transfer cases include: part-time, full-time, automatic, AWD, power transfer unit (PTU)

fluid conditions include: leaks, levels, contamination

controls include: vacuum, mechanical, shifters, linkage

electrical components include: actuators, solenoids, sensors, switches

functional tests include: output control, range control

Knowledge		
	Learning Outcomes	Learning Objectives
D-12.05.01L	demonstrate knowledge of transfer cases, their components, characteristics, applications and operation	identify types of transfer cases and their components, and describe their characteristics and applications
		describe operating principles of transfer cases and their components
		identify types of AWD systems, their components and operation
		identify related systems and describe their relationship to transfer cases
		identify types of controls and electrical components and describe their operation
		describe transfer case power flow
		describe gear ratios, their purpose and calculations
D-12.05.02L	demonstrate knowledge of procedures used to diagnose transfer cases and their components	identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
		identify tools and equipment used to diagnose transfer cases and their components, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to transfer cases and their components
		describe procedures used to diagnose transfer cases and their components
		identify materials that can be reconditioned, reused or recycled

Range of Variables

related systems include: transmissions, drivelines, mounts

controls include: vacuum, mechanical, shifters, linkage

electrical components include: actuators, solenoids, sensors, switches

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

tools and equipment include: scan tools, hand tools, air tools, power tools

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

D-12.06 Diagnoses final drive assemblies

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	<i>Performance Criteria</i>	<i>Evidence of Attainment</i>
D-12.06.01P	verify concern	concern is verified to determine diagnostic strategy
D-12.06.02P	perform road test	road test is performed to identify final drive concerns
D-12.06.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-12.06.04P	identify model and type of final drive assembly	model and type of final drive assembly is identified
D-12.06.05P	check final drive assembly fluid conditions	final drive assembly fluid conditions are checked
D-12.06.06P	inspect final drive assembly components and controls	final drive assembly components and controls are inspected according to manufacturers' service information
D-12.06.07P	perform functional tests	functional tests are performed according to manufacturers' service information
D-12.06.08P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information and required repair is determined

Range of Variables

final drive concerns include: vibrations, noises, driveability, leaks, electronic controls

tools and equipment include: hand tools, scan tools, air tools, power tools, measuring tools, chassis ears, stethoscopes, vibration analyzers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

types of final drive assemblies include: AWD, transaxle, integral, removable, locking, limited slip, torque distribution

fluid conditions include: leaks, levels, contamination

Knowledge		
Learning Outcomes	Learning Objectives	
D-12.06.01L	demonstrate knowledge of final drive assemblies, their components, characteristics, applications and operation	identify types of final drive assemblies and their components, and describe their characteristics and applications
		describe operating principles of final drive assemblies and their components
		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 used to diagnose final drive assemblies and their components	identify tools and equipment used to diagnose final drive assemblies and their components, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to final drive assemblies and their components
		describe procedures used to diagnose final drive assemblies and their components
		identify materials that can be reconditioned, reused or recycled

Range of Variables

types of final drive assemblies include: AWD, transaxle, integral, removable, locking, limited slip, torque distribution

related systems include: transmissions, drivelines, mounts

procedures used to diagnose include: road test, sensory inspection, bearing inspection, gear tooth patterns

tools and equipment include: hand tools, scan tools, air tools, power tools, measuring tools, chassis ears, stethoscopes, vibration analyzers

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

Task D-13 Repairs driveline systems

Task Descriptor

Driveline systems provide a means of transmitting rotational torque from the engine/motors to the drive wheels in complex and innovative methods. This includes CV axles, drive shafts, transmissions and transaxles, transfer cases, clutches, final drive and differential assemblies.

Automotive service technician repair and maintain driveline systems according to manufacturers' service information.

D-13.01 Repairs drive shafts and axles

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
D-13.01.01P	identify type of drive shaft and axle system	type of drive shaft and axle system is identified
D-13.01.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-13.01.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
D-13.01.04P	remove, replace, recondition or service drive shaft components	drive shaft components are removed, replaced, reconditioned or serviced according to manufacturers' service information
D-13.01.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
D-13.01.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

drive shafts and axle systems include: 2WD, 4WD, solid axle, independent, full-floating and semi-floating axle engagement mechanisms

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: gaskets, seals, lubricants

drive shaft components include: cardan joints, bearings, CV axles, CV joints

Knowledge

Learning Outcomes	Learning Objectives
D-13.01.01L demonstrate knowledge of drive shaft and axle systems , their components, characteristics, applications and operation	identify types of drive shaft and axle systems , and their components, and describe their characteristics and applications
	describe operating principles of drive shaft and axle systems , and their components
	identify types of axles and their components, and describe their characteristics and applications
	describe axle disconnects, locking hubs and their purpose
	describe importance of multiple piece drive shaft phasing, indexing and driveline angles
	identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
D-13.01.02L demonstrate knowledge of procedures used to repair drive shafts and axles , and their components	identify tools and equipment used to repair drive shafts and axles and their components, and describe their characteristics, applications and procedures for use
	identify hazards and describe safe work practices pertaining to drive shafts and axles , and their components
	describe procedures used to adjust, repair and replace drive shafts and axles , and their components
	describe maintenance procedures
	describe procedures used to verify repair
	identify materials that can be reconditioned, reused or recycled

Range of Variables

drive shafts and axle systems include: 2WD, 4WD, solid axle, independent, full-floating and semi-floating axle engagement mechanisms

axles include: half shafts, floating, semi-floating

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

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

D-13.02 Repairs manual transmissions and transaxles

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
D-13.02.01P	determine model of manual transmission and transaxles	model of manual transmission and transaxles is determined
D-13.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-13.02.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
D-13.02.04P	remove, replace, recondition or service components and controls	components and controls are removed, replaced, reconditioned or serviced according to manufacturers' service information
D-13.02.05P	remove and replace mounts	mounts are removed and replaced according to manufacturers' service information
D-13.02.06P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
D-13.02.07P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: parts, gaskets, seals, lubricants, sealants

Knowledge

	Learning Outcomes	Learning Objectives
D-13.02.01L	demonstrate knowledge of manual transmissions and transaxles, their components, characteristics, applications and operation	identify types of manual transmissions and transaxles and their components, and describe their characteristics and applications describe operating principles of manual transmissions and transaxles and their components describe manual transmission and transaxle power flow identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
D-13.02.02L	demonstrate knowledge of procedures used to repair manual transmissions and transaxles, and their components	identify tools and equipment used to repair manual transmissions and transaxles, and their components, and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to manual transmissions and transaxles, and their components describe procedures used to remove and reinstall manual transmissions and transaxles describe procedures used to adjust, repair and replace manual transmissions and transaxles, and their components describe procedures used to replace engine and driveline mounts describe maintenance procedures describe procedures used to verify repair identify materials that can be reconditioned, reused or recycled

Range of Variables

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

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

D-13.03 Repairs automatic transmissions and transaxles

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
D-13.03.01P	identify model and <i>type of automatic transmission and transaxle</i>	model and <i>type of automatic transmission and transaxle</i> are identified according to <i>manufacturers' service information</i>
D-13.03.02P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to task and <i>manufacturers' service information</i>
D-13.03.03P	select <i>repair materials</i>	<i>repair materials</i> are selected according to repair requirements and <i>manufacturers' service information</i>
D-13.03.04P	remove, replace, recondition or service components and controls	components and controls are removed, replaced, reconditioned or serviced according to <i>manufacturers' service information</i>
D-13.03.05P	perform maintenance procedures	maintenance procedures are performed according to <i>manufacturers' service information</i>
D-13.03.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

types of automatic transmissions and transaxles include: conventional planetary, CVT, DCT
manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

repair materials include: parts, gaskets, seals, lubricants, sealants

Knowledge

Learning Outcomes	Learning Objectives
D-13.03.01L	demonstrate knowledge of automatic transmissions and transaxles, their components, characteristics, applications and operation
	identify <i>types of automatic transmissions and transaxles</i> and their components, and describe their characteristics and applications
	describe operating principles of automatic transmissions and transaxles and their components
	explain <i>hydraulic principles</i> related to automatic transmissions and transaxles

		describe automatic transmission and transaxle power flow
		interpret electric and hydraulic schematics
		identify types of lubricants, fasteners, tubing, hoses, gaskets, seals and sealants, and describe their applications
D-13.03.02L	demonstrate knowledge of procedures used to repair automatic transmissions and transaxles, and their components	identify tools and equipment used to repair automatic transmissions and transaxles, and their components, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to automatic transmissions and transaxles, and their components
		describe procedures used to remove and reinstall automatic transmissions and transaxles
		describe procedures used to adjust, repair and replace automatic transmissions and transaxles, and their components
		describe procedures used to replace engine and driveline mounts
		describe maintenance procedures
		describe procedures used to verify repair
		identify materials that can be reconditioned, reused or recycled

Range of Variables

types of automatic transmissions and transaxles include: conventional planetary, CVT, DCT

hydraulic principles include: Pascal's law, fluid dynamics

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

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

D-13.04 Repairs clutches

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
D-13.04.01P	determine type of clutch	type of clutch is determined
D-13.04.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-13.04.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
D-13.04.04P	remove, replace, recondition or service components	components are removed, replaced, reconditioned or serviced according to manufacturers' service information
D-13.04.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
D-13.04.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

clutches include: single and multi-disc systems

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: parts, fluids, seals, lubricants, sealants

Knowledge

Learning Outcomes		Learning Objectives
D-13.04.01L	demonstrate knowledge of clutches , their components, characteristics, applications and operation	identify types of clutches and their components, and describe their characteristics and applications
		describe operating principles of clutches and their components
		identify types of flywheels and their components, and describe their characteristics, applications and operation
		identify clutch actuating systems and their components, and describe their characteristics, applications and operation

		identify types of fluids, fasteners, tubing, hoses and seals, and describe their applications
D-13.04.02L	demonstrate knowledge of procedures used to repair clutches and their components	identify tools and equipment used to repair clutches and their components, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to clutches and their components
		describe procedures used to remove and reinstall clutches
		describe procedures used to adjust, repair and replace clutches and flywheels, and their components
		describe maintenance procedures
		describe procedures used to verify repair
		identify materials that can be reconditioned, reused or recycled

Range of Variables

clutches include: single and multi-disc systems

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

hazards include: airborne contaminants, pinch points, exposed rotating components

D-13.05 Repairs transfer cases

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
D-13.05.01P	identify model and type of transfer case	model and type of transfer case is identified
D-13.05.02P	identify type of AWD system	type of AWD system is identified
D-13.05.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-13.05.04P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information

D-13.05.05P	remove, replace, recondition or service components and controls	components and controls are removed, replaced, reconditioned or serviced according to manufacturers' service information
D-13.05.06P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
D-13.05.07P	verify repair	repair is verified by system re-test and road test

Range of Variables

types of transfer cases include: part-time, full-time, automatic, AWD, PTU

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: gaskets, fluids, seals, lubricants, sealants

controls include: vacuum, mechanical, shifters, linkage

Knowledge

	Learning Outcomes	Learning Objectives
D-13.05.01L	demonstrate knowledge of transfer cases, their components, characteristics, applications and operation	identify types of transfer cases and their components, and describe their characteristics and applications describe operating principles of transfer cases and their components identify types of AWD systems, their components and operation identify related systems and describe their relationship to transfer cases identify types of controls and electrical components , and describe their characteristics and applications describe transfer case power flow identify types of lubricants, fasteners, gaskets, seals and sealants, and describe their applications

D-13.05.02L	demonstrate knowledge of procedures used to repair transfer cases and their components	identify tools and equipment used to repair transfer cases and their components, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to transfer cases and their components
		describe procedures used to remove and reinstall transfer cases
		describe procedures used to adjust, repair and replace transfer cases and their components
		describe maintenance procedures
		describe procedures used to verify repair
		identify materials that can be reconditioned, reused or recycled

Range of Variables

types of transfer cases include: part-time, full-time, automatic, AWD, PTU

related systems include: transmissions, drivelines, mounts

controls include: vacuum, mechanical, shifters, linkage

electrical components include: actuators, solenoids, sensors, switches

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

hazards include: pinch points, exposed rotating components, material combustibility, exposure, toxicity, lifting and support procedures

D-13.06 Repairs final drive assemblies

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
D-13.06.01P	identify model and type of final drive assemblies	model and type of final drive assemblies are identified
D-13.06.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-13.06.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information

D-13.06.04P	remove, replace, recondition or service components and controls	components and controls are removed, replaced, reconditioned or serviced according to manufacturers' service information
D-13.06.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
D-13.06.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

types of final drive assemblies include: AWD, transaxle, integral, removable, locking, limited slip and torque distribution

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: gaskets, fluids, seals, lubricants, sealants

Knowledge		
	Learning Outcomes	Learning Objectives
D13.06.01L	demonstrate knowledge of final drive assemblies, their components, characteristics, applications and operation	identify types of final drive assemblies and their components, and describe their characteristics and applications describe operating principles of final drive assemblies and their components describe final drive assembly power flow
D13.06.02L	demonstrate knowledge of procedures to repair final drive assemblies and their components	identify tools and equipment used to repair final drive assemblies and their components, and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to final drive assemblies and their components describe procedures used to repair final drive assemblies and their components describe procedures used to remove and reinstall final drive assemblies

	describe procedures used to adjust, repair and replace final drive assemblies and their components
	describe maintenance procedures
	describe procedures used to verify repair
	identify materials that can be reconditioned, reused or recycled

Range of Variables

types of final drive assemblies include: AWD, transaxle, integral, removable, locking, limited slip and torque distribution

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

hazards include: exposed rotating parts, pinch points, material combustibility, exposure, toxicity, lifting and support procedures

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: starting/charging systems and low voltage (12 volt) batteries, lighting and wiper systems, entertainment systems, electrical options, instrumentation and information displays, electrical accessories, and advanced driver assistance system (ADAS) components. 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.

Automotive service technicians diagnose electrical systems and components according to manufacturers' service information. Incorrect processes can result in personal injury and component failure.

E-14.01 Diagnoses wiring and electrical systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
E-14.01.01P	verify concern	concern is verified to determine diagnostic strategy
E-14.01.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-14.01.03P	identify electrical circuit operation and measurements	electrical circuit operation and measurements are identified prior to testing
E-14.01.04P	inspect components and wires	components and wires are inspected for signs of wear, damage or failure
E-14.01.05P	inspect connectors and connections	connectors and connections are inspected for conditions
E-14.01.06P	perform tests	tests are performed according to manufacturers' service information to pinpoint fault

E-14.01.07P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
E-14.01.08P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuits
E-14.01.09P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

diagnostic strategy includes: reviewing manufacturers' service information, checking applicable bulletins

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

conditions include: incorrect routing, corrosion, poor contacts, damaged terminals

tests include: functional output tests, voltage test, resistance check, amperage test, voltage drop

Knowledge

	Learning Outcomes	Learning Objectives
E-14.01.01L	demonstrate knowledge of electrical and electronic principles	explain electrical and electronic principles explain module 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 application of Ohm's law to electrical circuits identify types of wire and describe their characteristics, composition and applications describe relationship of wiring and electronic systems to vehicle networking system interpret diagnostic flowcharts and schematics

E-14.01.03L	demonstrate knowledge of procedures used to diagnose electrical circuits and their components	identify tools and equipment used to diagnose electrical circuits and their components, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to electrical circuits and their components
		describe procedures used to diagnose electrical circuits and their components

Range of Variables

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

module operation includes: inputs, outputs, process

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

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

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

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

hazards include: damaging electrical components, fire, soldering fumes

E-14.02 Diagnoses starting/charging systems and low voltage (12 volt) batteries

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-14.02.01P	verify concern	concern is verified to determine diagnostic strategy
E-14.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-14.02.03P	inspect components, wires and connectors	components, wires and connectors are inspected for wear, damage or failure
E-14.02.04P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components

E-14.02.05P	perform tests	tests are performed according to manufacturers' service information
E-14.02.06P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuits
E-14.02.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted and analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

diagnostic strategy includes: reviewing manufacturers' service information, checking applicable bulletins

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

tests include: alternator voltage regulator (AVR), voltage drop, parasitic draw

Knowledge		
	Learning Outcomes	Learning Objectives
E-14.02.01L	demonstrate knowledge of starting/charging systems, and low voltage (12 volt) batteries, their components , characteristics, applications and operation	identify types of starting/charging systems and low voltage (12 volt) batteries, and their components , and describe their characteristics and applications
		describe operating principles of starting/charging systems and low voltage (12 volt) batteries, and their components
		identify control systems and their components, and describe their characteristics, applications and operation
		describe relationship of starting/charging systems and low voltage (12 volt) batteries to vehicle networking system
		identify warning indicators

E-14.02.02L	demonstrate knowledge of procedures used to diagnose starting/charging systems and low voltage (12 volt) batteries, and their components	identify tools and equipment used to diagnose starting/charging systems and low voltage (12 volt) batteries, and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to starting/charging systems and low voltage (12 volt) batteries, and their components
		describe procedures used to diagnose starting/charging systems and low voltage (12 volt) batteries, and their components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste

Range of Variables

components include: generator, starter motor, low voltage (12 volt) batteries, circuit protection devices, cables, sensors, modules

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

warning indicators include: warning messages, warning lights, audible signals

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

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

hazards include: fire, battery explosions, corrosive materials, exposed rotating parts

E-14.03 Diagnoses lighting and wiper systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-14.03.01P	verify concern	concern is verified to determine diagnostic strategy
E-14.03.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-14.03.03P	inspect components , wires and connectors	components , wires and connectors are inspected for wear, damage or failure
E-14.03.04P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components

E-14.03.05P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuits
E-14.03.06P	perform tests	tests are performed according to manufacturers' service information to pinpoint fault
E-14.03.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

diagnostic strategy includes: reviewing manufacturers' service information, checking applicable bulletins

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

tests include: functional output tests, voltage test, resistance check, amperage test, voltage drop

Knowledge

	Learning Outcomes	Learning Objectives
E-14.03.01L	demonstrate knowledge of lighting and wiper systems , their components , characteristics, applications and operation	<p>identify types of lighting and wiper systems, and their components, and describe their characteristics and applications</p> <p>describe operating principles of lighting and wiper systems, and their components</p> <p>describe relationship of lighting and wiper systems to vehicle networking system</p>
E-14.03.02L	demonstrate knowledge of procedures used to diagnose lighting and wiper systems and their components	<p>identify tools and equipment used to diagnose lighting and wiper systems and their components, and describe their characteristics, applications and procedures for use</p> <p>identify hazards and describe safe work practices pertaining to lighting and wiper systems and their components</p> <p>describe procedures used to diagnose lighting and wiper systems and their components</p>
E-14.03.03L	demonstrate knowledge of regulatory requirements pertaining to lighting and wiper systems and their components	identify jurisdictional regulations pertaining to lighting and wiper systems and their components

Range of Variables

lighting and wiper systems include: electrically-controlled, electronically-controlled

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

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

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

hazards include: lamps (high intensity discharge [HID]), pinch points

E-14.04 Diagnoses entertainment systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-14.04.01P	verify concern	concern is verified to determine diagnostic strategy
E-14.04.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-14.04.03P	inspect components, wires and connectors	components, wires and connectors are inspected for wear, damage or failure
E-14.04.04P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
E-14.04.05P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuits
E-14.04.06P	identify presence of aftermarket devices	presence of aftermarket devices is identified and correct operation is ensured
E-14.04.07P	perform tests	tests are performed according to manufacturers' service information to pinpoint faults
E-14.04.08P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted and analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

diagnostic strategy includes: reviewing manufacturers' service information, checking applicable bulletins

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

tests include: functional output tests, voltage test, resistance check, amperage test, voltage drop

Knowledge

	Learning Outcomes	Learning Objectives
E-14.04.01L	demonstrate knowledge of entertainment systems , their components, characteristics, applications and operation	identify types of entertainment systems and their components, and describe their characteristics and applications describe operating principles of entertainment systems and their components describe relationship of entertainment system to vehicle networking system
E-14.04.02L	demonstrate knowledge of procedures used to diagnose entertainment systems and their components	identify tools and equipment used to diagnose entertainment systems and their components, and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to entertainment systems and their components describe procedures used to diagnose entertainment systems and their components

Range of Variables

entertainment systems include: audio, video, wireless/handsfree

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

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

hazards include: fire, accidental restraint system deployment

E-14.05 Diagnoses electrical options and accessories

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
E-14.05.01P	verify concern	concern is verified to determine diagnostic strategy
E-14.05.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-14.05.03P	identify presence of aftermarket devices	presence of aftermarket devices is identified and correct operation is ensured
E-14.05.04P	inspect components	components are inspected for wear, damage or failure
E-14.05.05P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
E-14.05.06P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuits
E-14.05.07P	perform tests	tests are performed according to manufacturers' service information to pinpoint faults
E-14.05.08P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

diagnostic strategy includes: reviewing manufacturers' service information, checking applicable bulletins

tools and equipment include: DMMs, scan tools, circuit testers, manufacturer-specific tools and equipment

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: switches, modules, actuators

tests include: functional tests, voltage test, resistance check, amperage test, voltage drop

Knowledge

Learning Outcomes	Learning Objectives
E-14.05.01L demonstrate knowledge of electrical and electronic principles	explain electrical theory
	explain module operation
	describe 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
	describe relationship of electrical options and accessories to vehicle networking system
E-14.05.03L demonstrate knowledge of electrical options and accessories , their components , characteristics, applications and operation	identify types of electrical options and accessories , and their components , and describe their characteristics and applications
	describe operating principles of electrical options and accessories , and their components
E-14.05.04L demonstrate knowledge of procedures used to diagnose electrical options and accessories	identify tools and equipment used to diagnose electrical options and accessories , and their components , and describe their characteristics, applications and procedures for use
	identify hazards and describe safe work practices pertaining to electrical options and accessories , and their components
	describe procedures used to diagnose electrical options and accessories , and their components
E-14.05.05L demonstrate knowledge of training requirements to diagnose electrical options and accessories	identify training requirements to diagnose electrical options and accessories

Range of Variables

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

module operation includes: inputs, outputs, process

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

electrical options and accessories include: power options (windows, mirrors, seats, door locks), theft deterrents, remote starters, heated and cooled seats, heated steering wheel, keyless entry, push-start

components include: switches, modules, actuators

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

tools and equipment include: DMMs, scan tools, circuit testers, manufacturer-specific tools and equipment

hazards include: fire, accidental restraint system deployment

E-14.06 Diagnoses instrumentation and information displays

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
E-14.06.01P	verify concern	concern is verified to determine diagnostic strategy
E-14.06.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-14.06.03P	inspect components	components are inspected for wear, damage or failure
E-14.06.04P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
E-14.06.05P	perform tests	tests are performed according to manufacturers' service information to pinpoint faults
E-14.06.06P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuits
E-14.06.07P	verify vehicle warning indicators	vehicle warning indicators are verified to ensure that they are functioning as intended (self-test and bulb check)

E-14.06.08P	verify display	display is verified to ensure that it is functioning as intended
E-14.06.09P	identify presence of aftermarket devices	presence of aftermarket devices is identified and correct operation is ensured
E-14.06.10P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

diagnostic strategy includes: reviewing manufacturers' service information, checking applicable bulletins

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: switches, modules, actuators, sensors

tests include: functional tests, voltage test, resistance check, amperage test, voltage drop

vehicle warning indicators include: tire pressure monitoring system (TPMS), seatbelt monitoring system, airbag monitoring system, ADAS indicators

Knowledge

	Learning Outcomes	Learning Objectives
E-14.06.01L	demonstrate knowledge of instrumentation and information displays , their components , characteristics, applications and operation	identify types of instrumentation and information displays , and their components , and describe their characteristics and applications
		describe operating principles of instrumentation and information displays , and their components
		describe relationship of instrumentation and information displays to vehicle networking system
E-14.06.02L	demonstrate knowledge of procedures used to diagnose instrumentation and information displays , and their components	identify tools and equipment used to diagnose instrumentation and information displays , and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to instrumentation and information displays , and their components
		describe procedures used to diagnose instrumentation and information displays , and their components
E-14.06.03L	demonstrate knowledge of regulatory requirements pertaining to instrumentation and information displays	identify jurisdictional regulations pertaining to instrumentation and information displays

Range of Variables

instrumentation and information displays include: gauges, warning indicators, audible indicators, heads-up display (HUD), driver information centre (DIC)

components include: switches, modules, actuators, sensors

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

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

hazards include: fire, accidental restraint system deployment

jurisdictional regulations include: odometer servicing

E-14.07 Diagnoses advanced driver assistance system (ADAS) components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
E-14.07.01P	verify concern	concern is verified to determine diagnostic strategy
E-14.07.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-14.07.03P	inspect advanced driver assistance system (ADAS) components	ADAS components are inspected for wear, damage or failure
E-14.07.04P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
E-14.07.05P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuits
E-14.07.06P	perform tests	tests are performed according to manufacturers' service information to pinpoint faults
E-14.07.07P	record, interpret and analyze results of inspections and tests	results of inspections and tests and are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

diagnostic strategy includes: reviewing manufacturers' service information, checking applicable bulletins

tools and equipment include: DMMs, hand tools, scan tools, manufacturer-specific tools and equipment

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

ADAS components include: around-view cameras, back up cameras, parking-aid sensors, modules, night vision sensors, driver drowsiness detection, rain sensors, navigation unit, UV sensors, haptic and audible alarms, warning lights

tests include: circuit, functional

Knowledge

	Learning Outcomes	Learning Objectives
E-14.07.01L	demonstrate knowledge of electrical and electronic principles	explain electrical theory explain module operation describe application of Ohm's law to electrical circuits
E-14.07.02L	demonstrate knowledge of circuits, their components and operation	interpret diagnostic flowcharts and schematics identify types of wire and describe their characteristics, composition and applications describe relationship of vehicle options to vehicle networking system
E-14.07.03L	demonstrate knowledge of ADAS components , characteristics, applications and operation	identify types of ADAS components , and describe their characteristics and applications describe operating principles of ADAS components
E-14.07.04L	demonstrate knowledge of procedures used to diagnose ADAS components	identify tools and equipment used to diagnose ADAS components , and describe their characteristics, applications and procedures for use describe procedures used to diagnose ADAS components
E-14.07.05L	demonstrate knowledge of training and certification requirements to diagnose ADAS components	identify training and certification requirements to diagnose ADAS components
E-14.07.06L	demonstrate knowledge of regulatory requirements pertaining to ADAS components	identify regulations pertaining to ADAS components

Range of Variables

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

module operation includes: inputs, outputs, process

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

ADAS components include: around-view cameras, back up cameras, parking-aid sensors, modules, night vision sensors, driver drowsiness detection, rain sensors, navigation unit, UV sensors, haptic and audible alarms, warning lights

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

tools and equipment include: DMMs, hand tools, scan tools, manufacturer-specific tools and equipment

Task E-15 Repairs electrical systems and components

Task Descriptor

Electrical systems include: starting/charging systems and low voltage (12 volt) batteries, lighting and wiper systems, entertainment systems, electrical options, instrumentation and information displays, electrical accessories, and ADAS components. 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.

Automotive service technicians repair and maintain electrical systems and components according to manufacturers' service information. Incorrect processes can result in personal injury and component failure.

E-15.01 Repairs wiring and electrical systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-15.01.01P	identify circuit operation and measurements	circuit operation and measurements are identified prior to repair
E-15.01.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-15.01.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
E-15.01.04P	replace or repair components	components are replaced or repaired according to manufacturers' service information
E-15.01.05P	repair wiring	wiring is repaired using methods
E-15.01.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: hand tools, soldering equipment, scan tools, DMMs

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: terminals, insulators, fastening devices

methods include: splicing, replacing terminal, soldering, crimping

Knowledge

	Learning Outcomes	Learning Objectives
E-15.01.01L	demonstrate knowledge of electrical and electronic principles	explain electrical theory explain module 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 application of Ohm's law to electrical circuits identify types of wire and describe their characteristics, composition and applications interpret diagnostic flowcharts and schematics
E-15.01.03L	demonstrate knowledge of procedures used to repair electrical circuits and their components	identify tools and equipment used to repair electrical circuits and their components, and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to electrical circuits and their components identify methods of wire repair and describe their associated procedures describe procedures used to repair and replace electrical circuits and their components describe procedures used to verify repair
E-15.01.04L	demonstrate knowledge of training requirements to repair electrical systems	identify training requirements to repair electrical systems

Range of Variables

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

module operation includes: inputs, outputs, process

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

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

tools and equipment include: hand tools, soldering equipment, scan tools, DMMs

hazards include: fire, fumes, burns

methods include: splicing, replacing terminal, soldering, crimping

E-15.02 Repairs starting/charging systems and low voltage (12 volt) batteries

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-15.02.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-15.02.02P	replace or repair starting/charging system components	starting/charging system components are replaced or repaired according to manufacturers' service information
E-15.02.03P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: scan tools, hand tools, DMMs, specialized tools, power tools

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

starting/charging system components include: generator, starter motor, low voltage (12 volt) batteries, circuit protection devices, cables

Knowledge

	Learning Outcomes	Learning Objectives
E-15.02.01L	demonstrate knowledge of starting/charging systems and low voltage (12 volt) batteries, their components and operation	identify types of starting/charging systems and low voltage (12 volt) batteries, and their components , and describe their characteristics and applications
		describe operating principles of starting/charging systems and low voltage (12 volt) batteries, and their components
		identify control systems and their components, and describe their characteristics, applications and operation
		describe relationship of starting/charging systems and low voltage (12 volt) batteries to vehicle networking system

E-15.02.02L	demonstrate knowledge of procedures to repair starting/charging system and low voltage (12 volt) batteries, and their components	identify tools and equipment used to repair starting/charging systems and low voltage (12 volt) batteries, and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to starting/charging systems and low voltage (12 volt) batteries, and their components
		describe procedures used to adjust, repair and replace starting/charging system components
		describe procedures used to verify repair
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste

Range of Variables

starting/charging system components include: generator, starter motor, low voltage (12 volt) batteries, circuit protection devices, cables

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

tools and equipment include: scan tools, hand tools, DMMs, specialized tools, power tools

hazards include: fire, battery explosions, corrosive materials

E-15.03 Repairs lighting and wiper systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-15.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-15.03.02P	adjust, replace or repair lighting and wiper components	lighting and wiper components are adjusted, replaced or repaired according to manufacturers' service information
E-15.03.03P	adjust and aim headlights	headlights are adjusted and aimed according to manufacturers' service information

E-15.03.04P	clear DTCs, program and reset adaptation settings	DTCs are cleared and adaptation settings are programmed and reset according to manufacturers' service information
E-15.03.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

lighting components include: light bulbs, switches, modules

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

Knowledge		
	Learning Outcomes	Learning Objectives
E-15.03.01L	demonstrate knowledge of lighting and wiper systems, their components , characteristics, applications and operation	identify lighting and wiper systems, and their components , and describe their characteristics and applications
		describe operating principles of lighting and wiper systems, and their components
		describe relationship of lighting and wiper systems to vehicle networking system
		identify tools and equipment used to repair lighting and wiper systems, and their components , and describe their characteristics, applications and procedures for use
E-15.03.02L	demonstrate knowledge of the procedures used to repair lighting and wiper systems, and their components	identify hazards and describe safe work practices pertaining to lighting and wiper systems and their components
		describe procedures used to adjust, repair and replace lighting and wiper system components
		describe procedures used to verify repair
E-15.03.03L	demonstrate knowledge of regulatory requirements pertaining to lighting and wiper systems	identify jurisdictional requirements pertaining to lighting and wiper systems

Range of Variables

lighting components include: light bulbs, switches, modules

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

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

hazards include: high voltage lighting, pinch points

E-15.04 Repairs entertainment systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-15.04.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-15.04.02P	replace or repair components	components are replaced or repaired according to manufacturers' service information
E-15.04.03P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
E-15.04.04P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: switches, modules, actuators, antennae, cabling

maintenance procedures include: replace key fob battery

Knowledge

	Learning Outcomes	Learning Objectives
E-15.04.01L	demonstrate knowledge of entertainment systems , their components , characteristics, applications and operation	identify types of entertainment systems and their components , and describe their characteristics and applications
		describe operating principles of entertainment systems and their components
		describe relationship of entertainment system to vehicle networking system

E-15.04.02L	demonstrate knowledge of procedures used to repair entertainment systems and their components	identify tools and equipment used to repair entertainment systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to entertainment systems and their components
		describe procedures used to adjust, repair and replace entertainment systems and their components
		describe maintenance procedures
		describe procedures used to verify repair

Range of Variables

entertainment systems include: audio, video, wireless/handsfree

components include: switches, modules, actuators, antennae, cabling

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

hazards include: fire, accidental restraint system deployment

maintenance procedures include: checking for updates

E-15.05 Repairs electrical options and accessories

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-15.05.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-15.05.02P	replace, repair and program components	components are replaced, repaired and programmed according to manufacturers' service information
E-15.05.03P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
E-15.05.04P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: switches, modules, actuators, antennae, cabling

maintenance procedures include: replace key fob battery

Knowledge		
	Learning Outcomes	Learning Objectives
E-15.05.01L	demonstrate knowledge of electrical and electronic principles	explain electrical theory
		explain module 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
E-15.05.03L	demonstrate knowledge of electrical options and accessories , their components , characteristics, applications and operation	identify types of electrical options and accessories and their components , and describe their characteristics and applications
		describe operating principles of electrical options and accessories and their components
E-15.05.04L	demonstrate knowledge of procedures used to repair electrical options and accessories and their components	identify tools and equipment used to repair electrical options and accessories and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to electrical options and accessories and their components
		describe procedures used to repair and replace electrical options and accessories and their components
		describe procedures used to verify repair
		describe maintenance procedures

Range of Variables

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

module operation includes: inputs, outputs, process

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

electrical options and accessories include: power options (windows, mirrors, seats, door locks), theft deterrents, remote starters, heated and cooled seats, heated steering wheel, keyless entry, push-start

components include: switches, modules, actuators, antennae, cabling

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

hazards include: fire, accidental restraint system deployment

maintenance procedures include: replace key fob battery

E-15.06 Repairs instrumentation and information displays

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-15.06.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-15.06.02P	replace, re-learn or program components	components are replaced, re-learned and programmed according to manufacturers' service information
E-15.06.03P	perform maintenance light or message reset	maintenance light or message reset is performed according to manufacturers' service information
E-15.06.04P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: switches, modules, actuators, sensors, antennae, cabling

Knowledge

Learning Outcomes	Learning Objectives
E-15.06.01L demonstrate knowledge of instrumentation and information displays , their components , characteristics, applications and operation	identify types of instrumentation and information displays , and their components , and describe their characteristics and applications
	describe operating principles of instrumentation and information displays , and their components
	describe relationship of instrumentation and information displays to vehicle networking system
E-15.06.02L demonstrate knowledge of procedures used to repair instrumentation and information displays , and their components	identify tools and equipment used to repair instrumentation and information displays , and their components , and describe their characteristics, applications and procedures for use
	identify hazards and describe safe work practices pertaining to instrumentation and information displays , and their components
	describe procedures used to adjust, calibrate, repair and replace instrumentation and information displays , and their components
	describe procedures used to perform maintenance light or message reset
E-15.06.03L demonstrate knowledge of regulatory requirements pertaining to instrumentation and information displays	describe procedures used to verify repair
	identify jurisdictional regulations pertaining to instrumentation and information displays

Range of Variables

instrumentation and information displays include: gauges, warning indicators, audible indicators, HUD, DIC

components include: switches, modules, actuators, sensors, antennae, cabling

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

hazards include: accidental deployment of restraint systems

jurisdictional regulations include: odometer servicing

E-15.07 Repairs advanced driver assistance system (ADAS) components

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-15.07.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-15.07.02P	replace, repair and program ADAS components	ADAS components are replaced, repaired and programmed according to manufacturers' service information
E-15.07.03P	calibrate and re-learn ADAS components	ADAS components are calibrated and re-learned according to manufacturers' service information
E-15.07.04P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: DMMs, hand tools, scan tools, manufacturer-specific tools and equipment, reprogramming equipment

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

ADAS components include: around-view cameras, back up cameras, parking-aid sensors, modules, night vision sensors, driver drowsiness detection, rain sensors, navigation unit, UV sensors, haptic and audible alarms, warning lights

Knowledge

	Learning Outcomes	Learning Objectives
E-15.07.01L	demonstrate knowledge of electrical and electronic principles	explain electrical theory
		explain module operation
		describe the application of Ohm's law to electrical circuits
E-15.07.02L	demonstrate knowledge of circuits, their components and operation	interpret diagnostic flowcharts and schematics
		identify types of wire and describe their characteristics, composition and applications

E-15.07.03L	demonstrate knowledge of ADAS components , characteristics, applications and operation	identify types of ADAS components , and describe their characteristics and applications
		describe operating principles of ADAS components
E-15.07.04L	demonstrate knowledge of procedures used to repair ADAS components	identify tools and equipment used to repair ADAS components , and describe their characteristics, applications and procedures for use
		describe procedures used to calibrate, re-learn, repair or replace ADAS components
		describe procedures used to verify repair
E-15.07.05L	demonstrate knowledge of training requirements to repair ADAS components	identify training requirements to repair ADAS components
E-15.07.06L	demonstrate knowledge of regulatory requirements pertaining to ADAS components	identify regulations pertaining to ADAS components

Range of Variables

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

module operation includes: inputs, outputs, process

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

ADAS components include: around-view cameras, back up cameras, parking-aid sensors, modules, night vision sensors, driver drowsiness detection, rain sensors, navigation unit, UV sensors, haptic and audible alarms, warning lights

tools and equipment include: DMMs, hand tools, scan tools, manufacturer-specific tools and equipment, reprogramming equipment

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

Task Descriptor

Heating, ventilation and air conditioning (HVAC) and comfort control systems heat and cool the passenger cabin for occupants' comfort.

Automotive service technicians diagnose HVAC and comfort control systems according to manufacturers' service information and jurisdictional regulations. Incorrect processes can result in personal injury, component failure and environmental damage.

E-16.01 Diagnoses air flow control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-16.01.01P	verify concern	concern is verified to determine diagnostic strategy
E-16.01.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-16.01.03P	perform sensory inspection of components	sensory inspection of components is performed to identify wear, damage, defects and foreign materials
E-16.01.04P	inspect air flow circulation	air flow circulation is inspected and faults are identified
E-16.01.05P	interpret and record viewed values and DTCs	viewed values and DTCs are interpreted and recorded to determine condition of systems and components
E-16.01.06P	verify electronically-controlled system operation	electronically-controlled system is verified for operating faults

E-16.01.07P	interpret and follow wiring diagrams, and vacuum and air flow schematics	wiring diagrams, and vacuum and air flow schematics are interpreted and followed to determine structure and functionality of circuit
E-16.01.08P	perform tests	tests are performed according to manufacturers' service information to determine cause of failure
E-16.01.09P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

tools and equipment include: DMMs, oscilloscopes, scan tools, circuit testers, vacuum pumps, inspection camera, temperature probe

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: cabin filter, blower motors, actuators, ventilation systems, duct work, control units, connectors, blend door motors, resistors, HVAC controls, modules, switches, sensors

faults include: partially open/closed doors, restricted cabin filters, foreign materials, debris

operating faults include: blown fuses, seized motors and actuators, broken wires, disconnected ductwork

tests include: functional output, voltage drop, vacuum tests, continuity and resistance check, pressure, temperature checks

Knowledge

	Learning Outcomes	Learning Objectives
E-16.01.01L	demonstrate knowledge of air flow control systems, their components , characteristics, applications and operation	identify air flow control systems and their components , and describe their characteristics and applications describe operating principles of air flow control systems and their components identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
E-16.01.02L	demonstrate knowledge of procedures used to diagnose air flow control systems and their components	identify tools and equipment used to diagnose air flow control systems and their components, and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to air flow control systems and their components describe procedures used to diagnose air flow control systems and their components identify HVAC materials that can be reconditioned, reused or recycled identify practices that reduce HVAC material waste
E-16.01.03L	demonstrate knowledge of certification requirements according to jurisdictional regulations	identify certification requirements according to jurisdictional regulations

Range of Variables

components include: cabin filter, blower motors, actuators, ventilation systems, duct work, control units, connectors, blend door motors, resistors, HVAC controls, modules, switches, sensors

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

tools and equipment include: DMMs, oscilloscopes, scan tools, circuit testers, vacuum pumps, inspection camera, temperature probe

hazards include: airborne contaminants, mold spores, pinch points, high pressure gases

E-16.02 Diagnoses refrigerant systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-16.02.01P	verify concern	concern is verified to determine diagnostic strategy
E-16.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-16.02.03P	perform sensory inspection of components	components are inspected for wear, damage, defects and failure
E-16.02.04P	identify type of refrigerant	type of refrigerant is identified
E-16.02.05P	interpret and record pressure gauge readings, viewed values and DTCs	pressure gauge readings, viewed values and DTCs are interpreted and recorded to determine condition of systems and components
E-16.02.06P	perform leak test	leak tests are performed according to jurisdictional requirements to locate source of leakage
E-16.02.07P	perform tests	tests are performed according to manufacturers' service information to pinpoint failure
E-16.02.08P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuit
E-16.02.09P	verify electronically-controlled system operation	electronically-controlled system is verified for operating faults
E-16.02.10P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

jurisdictional requirements include: handling and disposal, storing and recycling, Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) licensing and certification

tests include: voltage drop, resistance check, pressure test, vacuum test

operating faults include: blown fuses, broken wires, low refrigerant (leak)

Knowledge

Learning Outcomes	Learning Objectives
E-16.02.01L demonstrate knowledge of refrigerant systems, their components , characteristics, applications and operation	identify refrigerant systems and their components , and describe their characteristics and applications
	describe operating principles of refrigerant systems and their components
	identify types of refrigerants and lubricants, and describe their characteristics, applications and procedures for use
	explain principles of refrigeration cycle
	describe procedures used to identify, recover, recycle, evacuate and recharge refrigerant systems
	identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
E-16.02.02L demonstrate knowledge of procedures used to diagnose refrigerant systems and their components	identify tools and equipment used to diagnose refrigerant systems and their components , and describe their characteristics, applications and procedures for use
	identify hazards and describe safe work practices pertaining to refrigerant systems and their components
	describe procedures used to diagnose refrigerant systems and their components
	identify HVAC materials that can be reconditioned, reused or recycled
	identify practices that reduce HVAC material waste
E-16.02.03L demonstrate knowledge of regulatory requirements pertaining to refrigerants and lubricants	identify jurisdictional requirements pertaining to refrigerants and lubricants

Range of Variables

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

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

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

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

hazards include: handling of refrigerant, risk of personal injury, rotating components, pinch points, airborne materials

jurisdictional requirements include: handling and disposal, storing and recycling, Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) licensing and certification

E-16.03 Diagnoses heating systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-16.03.01P	verify concern	concern is verified to determine diagnostic strategy
E-16.03.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-16.03.03P	perform sensory inspection of components	sensory inspection of components is performed to identify wear, damage and defects and faults
E-16.03.04P	perform tests	tests are performed according to manufacturers' service information to identify faults
E-16.03.05P	identify faults	system faults are identified
E-16.03.06P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: cabin filters, blower motors, actuators, heater core, thermostats, fans, controls, sensors

tests include: coolant level, pressure, circulation, temperature

faults include: leaks, engine temperature regulation, air flow restrictions, fluid levels

results include: low coolant level, plugged heater core, insufficient air flow, low coolant flow

Knowledge		
	Learning Outcomes	Learning Objectives
E-16.03.01L	demonstrate knowledge of heating systems, their components , characteristics, applications and operation	identify types of heating systems and their components , and describe their characteristics and applications
		describe operating principles of heating systems and their components
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants, and describe their applications
		identify related systems and describe their relationship to heating systems
E-16.03.02L	demonstrate knowledge of procedures used to diagnose heating systems and their components	identify tools and equipment used to diagnose heating systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to heating systems and their components
		describe procedures used to diagnose heating systems and their components
		identify HVAC materials that can be reconditioned, reused or recycled
		identify practices that reduce HVAC material waste

Range of Variables

components include: cabin filters, blower motors, actuators, heater core, thermostats, fans, controls, sensors

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

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

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

hazards include: airborne contaminants, mold spores, pinch points, burns

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

Task Descriptor

HVAC and comfort control systems heat and cool the passenger cabins for occupants' comfort. Automotive service technicians repair and maintain HVAC and comfort control systems according to manufacturers' service information and jurisdictional regulations. Incorrect processes can result in personal injury, component failure and environmental damage.

E-17.01 Repairs air flow control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-17.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-17.01.02P	select repair components and materials	repair components and materials are selected according to repair requirements and manufacturers' service information
E-17.01.03P	follow repair sequence	repair sequence is followed according to manufacturers' service information
E-17.01.04P	remove, repair or replace faulty components	faulty components are removed, repaired or replaced according to manufacturers' service information
E-17.01.05P	clean and deodorize air flow systems	air flow systems are cleaned and deodorized with materials
E-17.01.06P	clear DTCs, program and reset adaptation settings	DTCs are cleared and adaptation settings are programmed and reset
E-17.01.07P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
E-17.01.08P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: cabin filter, blower motors, actuators, ventilation systems, duct work, control units, connectors, blend door motors, resistors, HVAC controls, modules, switches, sensors

materials include: compressed air and pressurized deodorizers

Knowledge		
Learning Outcomes	Learning Objectives	
E-17.01.01L	demonstrate knowledge of air flow control systems, their components , characteristics, applications and operation	identify air flow control systems and their components , and describe their characteristics and applications
		describe operating principles of air flow control systems and their components
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
E-17.01.02L	demonstrate knowledge of procedures used to repair air flow control systems and their components	identify tools and equipment used to repair air flow control systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to air flow control systems and their components
		describe procedures used to repair air flow control systems
		describe procedures used to remove and reinstall air flow control system components
		describe procedures used to verify repair

Range of Variables

components include: cabin filter, blower motors, actuators, ventilation systems, duct work, control units, connectors, blend door motors, resistors, HVAC controls, modules, switches, sensors

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

hazards include: airborne contaminants, mold spores, pinch points

E-17.02 Repairs refrigerant systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-17.02.01P	select and use tools and equipment	tools and equipment are selected and used to evacuate and recharge system and to identify and recover types of refrigerants
E-17.02.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
E-17.02.03P	follow repair sequence	repair sequence is followed according to manufacturers' service information
E-17.02.04P	recover refrigerant and evacuate air conditioning system	refrigerant is recovered, air conditioning system is evacuated, and system is flushed according to manufacturers' service information and jurisdictional regulations
E-17.02.05P	remove and replace faulty components	faulty components are removed and replaced according to manufacturers' service information
E-17.02.06P	recharge system	system is recharged to recommended amounts and types of refrigerant oils and refrigerants according to manufacturers' service information
E-17.02.07P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
E-17.02.08P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: hand tools, air tools, power tools, scan tools, specialized A/C tools

repair materials include: gaskets, sealants, fastening devices

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: switches, wiring, expansion valves, orifice tubes, compressors, evaporators, condensers, lines and seals, types of refrigerant, sensors

Knowledge

	Learning Outcomes	Learning Objectives
E-17.02.01L	demonstrate knowledge of refrigerant systems, their components , characteristics, applications and operation	identify refrigerant systems and their components , and describe their characteristics and applications describe operating principles of refrigerant systems and their components identify types of refrigerants and lubricants, and describe their characteristics, applications and procedures for use explain principles of refrigeration cycle identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
E-17.02.02L	demonstrate knowledge of procedures used to repair refrigerant systems and their components	identify tools and equipment used to repair refrigerant systems and their components , and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to refrigerant systems and their components describe procedures used to repair refrigerant systems and their components describe procedures used to remove and reinstall refrigerant system components describe procedures used to identify, recover, recycle, evacuate and recharge refrigerant systems describe procedures used to verify repair identify HVAC materials that can be reconditioned, reused or recycled identify practices that reduce HVAC material waste
E-17.02.03L	demonstrate knowledge of regulatory requirements pertaining to refrigerants and lubricants	identify jurisdictional requirements pertaining to refrigerants and lubricants

Range of Variables

components include: switches, wiring, expansion valves, orifice tubes, compressors, evaporators, condensers, lines and seals, types of refrigerant, sensors

tools and equipment include: hand tools, air tools, power tools, scan tools, specialized A/C tools

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

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

E-17.03 Repairs heating systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
E-17.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-17.03.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
E-17.03.03P	follow repair sequence	repair sequence is followed according to manufacturers' service information
E-17.03.04P	remove and replace faulty components	faulty components are removed and replaced according to manufacturers' service information
E-17.03.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
E-17.03.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: gaskets, sealants, fastening devices

components include: heater cores, heater hoses, thermostats, coolant flow valves, gaskets, radiators, water pumps, engine temperature regulation, sensors, modules, switches

maintenance procedures include: coolant flush, coolant evaluation, radiator cleaning

Knowledge

Learning Outcomes	Learning Objectives	
E-17.03.01L	demonstrate knowledge of heating systems, their components , characteristics, applications and operation	identify types of heating systems and their components , and describe their characteristics and applications
		describe operating principles of heating systems and their components
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
E-17.03.02L	demonstrate knowledge of procedures used to repair heating systems	identify tools and equipment used to repair heating systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to heating systems and their components
		describe procedures used to repair heating systems
		describe procedures used to remove and reinstall heating system components
		describe procedures used to fill and bleed heating systems
		describe procedures used to verify repair
		identify HVAC materials that can be reconditioned, reused or recycled
		identify practices that reduce HVAC material waste

Range of Variables

components include: heater cores, heater hoses, thermostats, coolant flow valves, gaskets, radiators, water pumps, engine temperature regulation, sensors, modules, switches

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

hazards include: airborne contaminants, mold spores, pinch points, burns, personal injuries

Major Work Activity F

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

Task F-18 Diagnoses steering, suspension, braking and 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), dynamic stability control (DSC), and ADAS 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.

Automotive service technicians diagnose these systems according to manufacturers' service information.

F-18.01 Diagnoses steering, suspension and control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
F-18.01.01P	verify concern	concern is verified to determine diagnostic strategy
F-18.01.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information

F-18.01.03P	perform road test	road test is performed, and steering, suspension and control system concerns are identified
F-18.01.04P	determine type of steering system	type of steering system is determined by visual inspection and manufacturers' service information
F-18.01.05P	determine type of suspension system	type of suspension system is determined by visual inspection and manufacturers' service information
F-18.01.06P	determine type of control systems for steering and suspension systems	type of control system is determined according to vehicle service information and manufacturers' service information
F-18.01.07P	inspect steering, suspension and control components	steering, suspension and control components are inspected according to manufacturers' service information and inspection procedures
F-18.01.08P	perform tests	tests are performed according to manufacturers' service information to determine cause of failure
F-18.01.09P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

concerns include: vibrations, noises, pulls, tire wear, misalignment, harshness

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

suspension systems include: MacPherson strut, leaf spring, independent, monobeam, electronically-controlled suspension systems

tests include: clearances, ride height, leaks and road tests, dry park

Knowledge

	Learning Outcomes	Learning Objectives
F-18.01.01L	demonstrate knowledge of suspension systems , their components , characteristics, applications and operation	identify types of suspension systems and their components , and describe their characteristics and applications
		describe operating principles of suspension systems and their components
		identify types of springs and describe their purpose and operation

		identify types of dampers and their components, and describe their purpose and operation
		describe suspension geometry
F-18.01.02L	demonstrate knowledge of procedures used to diagnose suspension systems and their components	identify tools and equipment used to diagnose suspension systems and their components , and describe their characteristics, applications and procedures for use
		describe procedures used to diagnose suspension systems and their components
F-18.01.03L	demonstrate knowledge of steering systems , their components , characteristics, applications and operation	identify types of steering systems and their components and operation
		describe operating principles of steering systems and their components
		identify types of steering columns and their components, and describe their characteristics and applications
		identify related systems and describe their relationship to steering systems
		identify types of steering assist systems and their components, and describe their characteristics, applications and operation
		identify types of power steering pumps and their components, and describe their characteristics, applications and operation
		identify types of fluids and lubricants, fasteners, tubing, hoses, gaskets and seals and describe their applications
		describe procedures used to disarm passive restraints
		describe steering geometry
F-18.01.04L	demonstrate knowledge of procedures used to diagnose steering systems and their components	identify tools and equipment used to diagnose steering systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to steering systems and their components
		describe procedures used to diagnose steering systems and their components

F-18.01.05L	demonstrate knowledge of electronically-controlled suspension systems, their components, characteristics, applications and operation	identify types of electronically-controlled suspension systems and their components, and describe their characteristics and applications
		describe operating principles of electronically-controlled suspension systems and their components
F-18.01.06L	demonstrate knowledge of procedures used to diagnose electronically-controlled suspension systems and their components	describe procedures used to diagnose electronically-controlled suspension systems and their components
F-18.01.07L	demonstrate knowledge of procedures used to diagnose and perform wheel alignments	describe procedures used to diagnose and perform wheel alignments

Range of Variables

suspension systems include: MacPherson strut, leaf spring, independent, monobeam, electronically-controlled suspension systems

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

springs include: coil, leaf, torsion bar, air

dampers include: struts, shocks

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

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

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

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

steering columns include: tilt, telescopic, electronically-controlled

related systems include: lane departures, active park assist

steering assist systems include: electric, hydraulic, variable

power steering pumps include: hydraulic, gear, vane

hazards include: accidental deployment of passive restraints (air bags, clock springs), telescopic columns, loaded components, high temperature, high pressure, pinch/crush points, hoisting

F-18.02 Diagnoses braking and control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
F-18.02.01P	verify concern	concern is verified to determine diagnostic strategy
F-18.02.02P	perform road test when safe to do so to identify braking concerns	road test is performed if safe to do so and braking concerns are identified

F-18.02.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-18.02.04P	determine type of braking system	type of braking system is determined
F-18.02.05P	inspect braking system components and fluids	braking system components and fluids are inspected according to manufacturers' service information
F-18.02.06P	identify control system components	control system components are identified, and their operation is related to vehicle and other systems
F-18.02.07P	perform tests	tests are performed according to manufacturers' service information
F-18.02.08P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

braking concerns include: vibrations, noises, lack of brake assist, pulls, soft or low pedal, harshness

tools and equipment include: scan tools, pressure gauges, measuring tools, hand tools, air tools, power tools, DMMs, oscilloscopes

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

braking systems include: hydraulic, electric, park brake

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

control systems include: TCS, ABS, stability control

Knowledge

	Learning Outcomes	Learning Objectives
F-18.02.01L	demonstrate knowledge of braking systems , their components , characteristics, applications and operation	identify types of braking systems and their components , and describe their characteristics and applications
		describe operating principles of braking systems and their components
		explain hydraulic principles related to braking systems
		identify types of braking systems in hybrid and EVs
		identify types of power assists and their components, and describe their characteristics, applications and operation
		identify types of brake fluids and describe their characteristics, applications and procedures for use

		identify types of fittings, flaring, tubing and hoses and describe their characteristics, applications and procedures for use
		identify types of trailer brakes and controls and describe their components and operation
		identify hazards and describe safe work practices pertaining to braking and control systems, and their components
F-18.02.02L	demonstrate knowledge of procedures used to diagnose braking systems and their components	identify tools and equipment used to diagnose braking systems and their components , and describe their characteristics, applications and procedures for use
		describe procedures used to diagnose braking systems and their components
F-18.02.03L	demonstrate knowledge of control systems , their components, characteristics, applications and operation	identify types of control systems and their components, and describe their characteristics, applications and operation
F-18.02.04L	demonstrate knowledge of procedures used to diagnose control systems and their components	identify tools and equipment used to diagnose control systems and their components, and describe their characteristics, applications and procedures for use
		describe procedures used to diagnose control systems and their components

Range of Variables

braking systems include: hydraulic, electric, park brake

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

power assists include: vacuum, hydraulic, electric

hazards include: hydraulic pressure, airborne contaminants, hoisting

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

tools and equipment include: scan tools, pressure gauges, measuring tools, hand tools, air tools, power tools, DMMs, oscilloscopes

control systems include: TCS, ABS, stability control

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

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
F-18.03.01P	verify concern	concern is verified to determine diagnostic strategy
F-18.03.02P	perform road test when safe to do so	road test is performed when safe to do so and tire, wheel, hub and wheel bearing concerns are identified
F-18.03.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-18.03.04P	inspect tires and wheels	tires and wheels are inspected for damage, defects, irregular wear, and specified application and size
F-18.03.05P	inspect hubs and wheel bearings	hubs and wheel bearings are inspected for excessive play and noise
F-18.03.06P	perform tests	tests are performed according to manufacturers' service information
F-18.03.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

concerns include: vibrations, noises (growl, rumble, whine), pulls, irregular wear, failure, age, harshness

tools and equipment include: measuring tools, pressure gauges, chassis ears, stethoscopes, vibration analyzers, TPMS equipment, hand tools, air tools, power tools, scan tools

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

tests include: wheel balance, runout, TPMS

Knowledge

Learning Outcomes		Learning Objectives
F-18.03.01L	demonstrate knowledge of tires, wheels, hubs, wheel bearings, their components , characteristics, applications and operation	identify types of tires and describe their construction
		interpret tire codes and sidewall markings
		describe importance of tire pressure and rotation

		identify types of wheels and their components and construction
		identify types of hubs and bearing assemblies, and their components, and describe their operation
		identify types of TPMS and describe their applications
		identify types of lubricants and describe their characteristics, applications and procedures for use
		describe the relationship between steering, suspension and wheel assemblies
F-18.03.02L	demonstrate knowledge of procedures used to diagnose tires, wheels, hubs and wheel bearings, and their components	identify tools and equipment used to diagnose tires, wheels, hubs, wheel bearings, and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to tires, wheels, hubs and wheel bearings, and their components
		describe procedures used to diagnose tires, wheels, hubs and wheel bearings, and their components

Range of Variables

components include: wheel fasteners, bearings, seals, gaskets, sensors, switches, modules

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

types of wheels include: steel, alloy

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

types of hubs include: pressed in, integral, tapered roller

types of TPMS include: passive, active

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

tools and equipment include: measuring tools, pressure gauges, chassis ears, stethoscopes, vibration analyzers, TPMS equipment, hand tools, air tools, power tools, scan tools

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

F-18.04**Diagnoses advanced driver assistance system (ADAS) components related to steering, suspension and braking systems**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
F-18.04.01P	verify concern	concern is verified to determine diagnostic strategy
F-18.04.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-18.04.03P	inspect ADAS components related to steering, suspension and braking systems	ADAS components related to steering, suspension and braking systems are inspected for wear, damage, failure or obstructions
F-18.04.04P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
F-18.04.05P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuits
F-18.04.06P	perform tests and calibrations	tests and calibrations are performed according to manufacturers' service information to pinpoint failure
F-18.04.07P	record, interpret and analyze results of inspections, tests and calibrations	results of inspections, tests and calibrations are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

tools and equipment include: DMMs, oscilloscopes, hand tools, scan tools, manufacturer-specific calibration tools and equipment, small levels

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

ADAS components related to steering, suspension and braking systems include: windshield cameras, forward radar sensors, blind spot radar sensors, switches, modules

tests and calibrations include: circuit test, functional test, dynamic calibration, static calibration

Knowledge

	Learning Outcomes	Learning Objectives
F-18.04.01L	demonstrate knowledge of ADAS components related to steering, suspension and braking systems , characteristics, applications and operation	identify types of ADAS components related to steering, suspension and braking systems and describe their characteristics and applications
		describe operating principles of ADAS components related to steering, suspension and braking systems
F-18.04.02L	demonstrate knowledge of procedures used to diagnose ADAS components related to steering, suspension and braking systems	identify tools and equipment used to diagnose ADAS components related to steering, suspension and braking systems , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to ADAS components related to steering, suspension and braking systems
		describe procedures used to diagnose ADAS components related to steering, suspension and braking systems
F-18.04.03L	demonstrate knowledge of training requirements to diagnose ADAS components related to steering, suspension and braking systems	identify training requirements to diagnose ADAS components related to steering, suspension and braking systems

Range of Variables

ADAS components related to steering, suspension and braking systems include: windshield cameras, forward radar sensors, blind spot radar sensors, switches, modules

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

tools and equipment include: DMMs, oscilloscopes, hand tools, scan tools, manufacturer-specific calibration tools and equipment, small levels

hazards include: road testing defective components

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

Task Descriptor

Steering, suspension, braking and control systems, tires, wheels, hubs and wheel bearings work together with the vehicle's control systems.

Automotive service technicians repair and maintain these systems according to manufacturers' service information. Incorrect processes can result in personal injury and component failure.

F-19.01 Repairs steering, suspension and control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
F-19.01.01P	select and use tools and equipment	tools and equipment are selected and used according to vehicle specifications and manufacturers' service information
F-19.01.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
F-19.01.03P	remove, replace and service steering and suspension system components	steering and suspension system components are removed, replaced and serviced according to manufacturers' service information
F-19.01.04P	verify functionality of control systems	control systems are functional and no DTCs are present
F-19.01.05P	perform adjustments and calibrations	adjustments and calibrations are performed according to manufacturers' service information and procedures
F-19.01.06P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
F-19.01.07P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: hand tools, air tools, power tools, scan tools, pullers, presses, reprogramming equipment, alignment machine, DMMs, oscilloscopes

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: gaskets, sealants, fasteners

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

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

maintenance procedures include: tire pressure, tire rotation, service chassis, tire condition

Knowledge		
	Learning Outcomes	Learning Objectives
F-19.01.01L	demonstrate knowledge of suspension and steering systems , their components , characteristics, applications and operation	identify types of suspension and steering systems , and their components , and describe their characteristics and applications
		describe operating principles of suspension and steering systems , and their components
		identify types of springs and describe their purpose and operation
		identify types of dampers and describe their components and operation
		identify related systems and describe their relationship to steering systems
F-19.01.02L	demonstrate knowledge of procedures used to repair suspension systems and their components	identify tools and equipment used to repair suspension systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to suspension systems and their components
		describe procedures used to repair suspension systems
		describe procedures used to remove and reinstall suspension system components
		describe procedures used to adjust, repair and replace suspension system components

F-19.01.03L	demonstrate knowledge of procedures used to repair steering systems and their components	identify tools and equipment used to repair steering systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to steering systems and their components
		describe procedures used to remove and reinstall steering system components
		describe procedures used to adjust, repair and replace steering system components
F-19.01.04L	demonstrate knowledge of procedures used to repair wheel alignment and electronically-controlled suspension systems	describe procedures used to remove and reinstall electronically-controlled suspension systems components
		describe procedures used to adjust, repair and replace electronically-controlled suspension systems components
		describe procedures to perform wheel alignments
		describe procedures to reset steering sensors
		describe maintenance procedures
		describe procedures used to verify repair

Range of Variables

suspension systems include: MacPherson strut, leaf spring, independent, monobeam, electronically-controlled suspension systems

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, switches, sensors

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

related systems include: lane departures, active park assist

tools and equipment include: hand tools, air tools, power tools, scan tools, pullers, presses, reprogramming equipment, alignment machine, DMMs, oscilloscopes

hazards include: accidental deployment of passive restraints (air bags, clock springs), telescopic columns, loaded components (ball joints, struts, springs)

maintenance procedures include: tire pressure, tire rotation, service chassis, tire condition

F-19.02 Repairs braking and control systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
F-19.02.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-19.02.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
F-19.02.03P	remove, replace and service components	components are removed, replaced and serviced according to manufacturers' service information
F-19.02.04P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
F-19.02.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: hand tools, air tools, power tools, scan tools, pressure gauges, measuring tools, lathe, reprogramming equipment, DMMs, oscilloscopes

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: gaskets, fastening devices, lubricants

maintenance procedures include: tire pressure, tire rotation, service chassis, tire condition

Knowledge

Learning Outcomes	Learning Objectives
F-19.02.01L demonstrate knowledge of braking systems , their components , characteristics, applications and operation	identify types of braking systems and their components , and describe their characteristics and applications
	describe operating principles of braking systems and their components
	explain hydraulic principles related to braking systems
	identify types of power assists and their components, and describe their characteristics, applications and operation
	identify types of control systems and their components, and describe their characteristics, applications and operation

		identify types of brake fluids and describe their characteristics, applications and procedures for use
		identify types of fittings, flaring, tubing and hoses and describe their characteristics, 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 procedures used to repair braking systems and their components	identify tools and equipment used to repair braking systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to braking systems and their components
		describe procedures used to repair braking systems and their components
		describe procedures used to flush and bleed hydraulic and anti-lock brakes
		describe procedures used to measure and machine components
		describe procedures used to adjust, repair and replace braking system components
		describe maintenance procedures
		describe procedures used to verify repair
F-19.02.03L	demonstrate knowledge of 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, switches, sensors, modules

power assists include: vacuum, hydraulic, electric

control systems include: TCS, ABS, stability control

tools and equipment include: hand tools, air tools, power tools, scan tools, pressure gauges, measuring tools, lathe, reprogramming equipment, DMMs, oscilloscopes

hazards include: hydraulic pressure, airborne contaminants

maintenance procedures include: tire pressure, tire rotation, service chassis, tire condition

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

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
F-19.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-19.03.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
F-19.03.03P	perform manufacturer and jurisdiction-approved procedures	procedures are performed according to manufacturers' service information and jurisdictional specifications/regulations
F-19.03.04P	mount tire on wheel, balance wheel assemblies and set pressure	tire is mounted on wheel, wheel assembly is balanced and tire pressure is set according to manufacturers' service information
F-19.03.05P	reset, reprogram and calibrate TPMS	TPMS is reset, reprogrammed and calibrated according to manufacturers' service information
F-19.03.06P	remove, replace and service wheels, hubs and wheel bearings	wheels, hubs and wheel bearings are removed, replaced and serviced according to manufacturers' service information
F-19.03.07P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
F-19.03.08P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: gaskets, sealants, fastening devices, lubricants

procedures include: dismounting and mounting, repairing punctures, cleaning, resealing, servicing bearings, balancing

maintenance procedures include: torque fasteners to specifications, rotations, set tire pressure

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 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 TPMS and describe their applications identify types of lubricants and describe their characteristics, applications and procedures for use describe the relationship between steering, suspension and wheel assemblies
F-19.03.02L	demonstrate knowledge of procedures used to repair tires, wheels, hubs and wheel bearings	identify tools and equipment used to repair tires, wheels, hubs and wheel bearings, and describe their characteristics, applications and procedures for use identify hazards and describe safe work practices pertaining to tires, wheels, hubs and wheel bearings describe procedures used to repair and replace tires, wheels, hubs and wheel bearings describe procedures used to remove and reinstall tires, wheels, hubs and wheel bearings describe maintenance procedures describe procedures used to verify repair

Range of Variables

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

types of wheels include: steel, alloy

types of TPMS include: passive, active

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

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

maintenance procedures include: torque fasteners to specifications, rotations, set tire pressure

F-19.04 Repairs advanced driver assistance system (ADAS) components related to steering, suspension and braking systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
F-19.04.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-19.04.02P	replace, repair and program ADAS components related to steering, suspension and braking systems	ADAS components related to steering, suspension and braking systems are replaced, repaired and programmed according to manufacturers' service information
F-19.04.03P	adjust ADAS components related to steering, suspension and braking systems	ADAS components related to steering, suspension and braking systems are adjusted according to manufacturers' service information
F-19.04.04P	calibrate ADAS components related to steering, suspension and braking systems	ADAS components related to steering, suspension and braking systems are calibrated according to manufacturers' service information
F-19.04.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: DMMs, oscilloscopes, hand tools, scan tools, manufacturer-specific calibration tools and equipment, small levels

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

ADAS components relating to steering, suspension and braking systems include: windshield cameras, forward radar sensors, blind spot radar sensors, switches, modules

Knowledge

	Learning Outcomes	Learning Objectives
F-19.04.01L	demonstrate knowledge of ADAS components related to steering, suspension and braking systems , their characteristics, applications and operation	identify types of ADAS components related to steering, suspension and braking systems , and describe their characteristics and applications
		describe operating principles of ADAS components related to steering, suspension and braking systems

F-19.04.02L	demonstrate knowledge of procedures used to repair ADAS components related to steering, suspension and braking systems	identify tools and equipment used to repair ADAS components related to steering, suspension and braking systems , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to ADAS components related to steering, suspension and braking systems
		describe procedures used to adjust, calibrate, repair or replace ADAS components related to steering, suspension and braking systems
		describe procedures used to verify repair
		describe procedures and obligations to document calibration and repairs
F-19.04.03L	demonstrate knowledge of training requirements to diagnose ADAS components related to steering, suspension and braking systems	identify training requirements to diagnose ADAS components related to steering, suspension and braking systems

Range of Variables

ADAS components relating to steering, suspension and braking systems include: windshield cameras, forward radar sensors, blind spot radar sensors, switches, modules

tools and equipment include: DMMs, oscilloscopes, hand tools, scan tools, manufacturer-specific calibration tools and equipment, small levels

hazards include: road testing defective components

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.

Automotive service technicians diagnose restraint systems, body components, accessories and trim according to manufacturers' service information. Incorrect processes can result in personal injury and component failure.

G-20.01 Diagnoses restraint systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
G-20.01.01P	verify concern	concern is verified to determine diagnostic strategy
G-20.01.02P	identify type of restraint system	type of restraint system is identified according to manufacturers' service information
G-20.01.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-20.01.04P	identify components	components are identified according to manufacturers' service information
G-20.01.05P	inspect components	components are inspected for wear, impediments to airbag systems, damage and defects and proper mechanical operation

G-20.01.06P	inspect restraint system monitoring and warning indicators	restraint system monitoring and warning indicators are inspected according to manufacturers' service information
G-20.01.07P	interpret restraint system DTCs	restraint system DTCs are interpreted according to manufacturers' service information
G-20.01.08P	perform tests	tests are performed according to manufacturers' service information
G-20.01.09P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

types of restraint systems include: active, passive

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

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

impediments to airbag systems include: seat covers, incorrect accessory placement

damage and defects include: tears, frays, modifications

restraint system monitoring and warning indicators include: warning messages, warning lights, audible signals

Knowledge

	Learning Outcomes	Learning Objectives
G-20.01.01L	demonstrate knowledge of restraint systems, their components , characteristics, applications and operation	identify types of restraint systems and their components , and describe their characteristics and applications
		describe operating principles of restraint systems and their components
		identify types of restraint system monitoring and warning indicators and describe their purpose
G-20.01.02L	demonstrate knowledge of procedures used to diagnose restraint systems and their components	identify tools and equipment used to diagnose restraint systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to restraint systems and their components
		describe procedures used to diagnose restraint systems and their components

Range of Variables

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

types of restraint systems include: active, passive

restraint system monitoring and warning indicators include: warning messages, warning lights, audible signals

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

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

hazards include: handling, disposal, storage, manufacturers' protocols

G-20.02 Diagnoses wind noises, rattles and water leaks

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
G-20.02.01P	verify concern	concern is verified to determine diagnostic strategy
G-20.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-20.02.03P	perform tests	tests are performed according to manufacturers' service information to identify and locate wind noises, rattles and water leaks
G-20.02.04P	perform inspections	inspections are performed to determine, isolate and locate wind noises, rattles or water leaks
G-20.02.05P	inspect suspected area for apparent related damage	all related damage is identified
G-20.02.06P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed, and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

tests include: interior pressure test, water test, road test, drag test

inspections include: sensory, mechanical

Knowledge		
	Learning Outcomes	Learning Objectives
G-20.02.01L	demonstrate knowledge of wind noises, rattles and water leaks and their causes	identify sources of wind noises, rattles and water leaks and their causes
		explain principles of basic aerodynamics related to body design
		identify types of seals, adhesives, sealing materials and fasteners and describe their characteristics, applications and procedures for use
G-20.02.02L	demonstrate knowledge of procedures used to diagnose wind noises, rattles and water leaks	identify tools and equipment used to diagnose wind noises, rattles and water leaks, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to wind noises, rattles and water leaks
		describe procedures used to diagnose wind noises, rattles and water leaks

Range of Variables

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

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

hazards include: handling, disposal, storage, manufacturers' protocols

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

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
G-20.03.01P	verify concern	concern is verified to determine diagnostic strategy
G-20.03.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-20.03.03P	inspect interior and exterior components, accessories and trim	interior and exterior components, accessories and trim are inspected to identify flaws
G-20.03.04P	perform tests	tests are performed according to manufacturers' service information to determine cause of flaws
G-20.03.05P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

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

flaws include: fit, finish, form, function

Knowledge

Learning Outcomes	Learning Objectives
G-20.03.01L	demonstrate knowledge of interior and exterior components, accessories and trim, their characteristics, applications and operation
	identify interior and exterior components, accessories and trim, and describe their characteristics and applications
	describe operating principles of interior and exterior components, accessories and trim

G-20.03.02L	demonstrate knowledge of procedures used to diagnose interior and exterior components, accessories and trim	identify tools and equipment used to diagnose interior and exterior components, accessories and trim, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to interior and exterior components, accessories and trim
		describe procedures used to diagnose interior and exterior components, accessories and trim
		identify flaws in interior and exterior components, accessories and trim

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

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

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

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

flaws include: fit, finish, form, function

G-20.04 Diagnoses latches, locks and movable glass

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
G-20.04.01P	verify concern	concern is verified to determine diagnostic strategy
G-20.04.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-20.04.03P	identify types of latches, locks, and movable glass, and their components	types of latches, locks and movable glass, and their components are identified according to manufacturers' service information
G-20.04.04P	inspect components of latches, locks and movable glass	components of latches, locks and movable glass are inspected for fit, function and proper operation

G-20.04.05P	check warning indicators	warning indicators are checked according to manufacturers' service information
G-20.04.06P	identify latches, locks and movable glass faults	latches, locks and movable glass faults are identified according to manufacturers' service information
G-20.04.07P	perform mechanical tests	mechanical tests are performed according to manufacturers' service information
G-20.04.08P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined

Range of Variables

tools and equipment include: trim panel tools, hand tools, scan tools, air tools, power tools, DMMs, oscilloscopes

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

warning indicators include: warning messages, warning lights, audible signals

Knowledge

	Learning Outcomes	Learning Objectives
G-20.04.01L	demonstrate knowledge of latches, locks and movable glass, their components , characteristics, applications and operation	<p>identify types of latches, locks and movable glass, and their components, and describe their characteristics and applications</p> <p>describe operating principles of latches, locks and movable glass, and their components</p> <p>distinguish between electrical and mechanical components</p>
G-20.04.02L	demonstrate knowledge of procedures used to diagnose latches, locks and movable glass, and their components	<p>identify tools and equipment used to diagnose latches, locks and movable glass, and their components, and describe their application and procedures for use</p> <p>identify hazards and describe safe work practices pertaining to latches, locks and movable glass, and their components</p> <p>identify procedures used to diagnose latches, locks and movable glass, and their components</p>

Range of Variables

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

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

tools and equipment include: trim panel tools, hand tools, scan tools, air tools, power tools, DMMs, oscilloscopes

hazards include: pinch points, handling of glass

Task G-21 Repairs 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.

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

G-21.01 Repairs restraint systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
G-21.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-21.01.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
G-21.01.03P	remove, service and replace components	components are removed, serviced and replaced according to manufacturers' service information
G-21.01.04P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: scan tools, hand tools, air tools, power tools, repair kit, simulators, test leads, DMMs, oscilloscopes

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: connectors, fasteners, shrink tubes, wire repair kits

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

Knowledge		
	Learning Outcomes	Learning Objectives
G-21.01.01L	demonstrate knowledge of restraint systems, their components , characteristics, applications and operation	identify types of restraint systems and their components , and describe their characteristics and applications
		describe operating principles of restraint systems and their components
		identify restraint system monitoring and warning indicators and describe their purpose
G-21.01.02L	demonstrate knowledge of procedures used to repair restraint systems and their components	identify tools and equipment used to repair restraint systems and their components , and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to restraint systems and their components
		describe procedures used to repair restraint systems
		describe procedures used to remove, repair, replace, adjust and reinstall electrical or restraint system mechanical components
		describe care, handling and storage procedures of restraint system components
G-21.01.03L	demonstrate knowledge of regulatory requirements pertaining to restraint systems	describe jurisdictional requirements and procedures used to recycle or dispose of restraint system components

Range of Variables

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

types of restraint systems include: active, passive

tools and equipment include: scan tools, hand tools, air tools, power tools, repair kit, simulators, test leads, DMMs, oscilloscopes

hazards include: unintentional deployment during handling, disposal, storage, servicing

mechanical components include: buckles, retractors, seat belt track, seat track frame, seat belt covers, air bags

jurisdictional requirements include: disposal, repair, motor vehicle inspection

G-21.02 Repairs wind noises, rattles and water leaks

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
G-21.02.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-21.02.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
G-21.02.03P	remove, service, adjust and replace components	components are removed, serviced, adjusted and replaced according to manufacturers' service information
G-21.02.04P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
G-21.02.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

maintenance procedures include: cleaning, adjusting, calibrating

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 principles of basic aerodynamics related to body design
	identify types of <i>repair materials</i> and describe their characteristics, applications and procedures for use
G-21.02.02L demonstrate knowledge of procedures used to repair wind noises, rattles and water leaks	identify types of <i>body components and accessories</i>
	identify <i>tools and equipment</i> used to repair wind noises, rattles and water leaks, and describe their characteristics, applications and procedures for use
	identify <i>hazards</i> and describe safe work practices pertaining to wind noises, rattles and water leaks
	describe procedures used to repair wind noises, rattles and water leaks
	describe <i>maintenance procedures</i>
	describe 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

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

hazards include: glass breakage, air bag placement, rotating parts, sharp edges, slippery floors

maintenance procedures include: cleaning, adjusting, calibrating

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

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
G-21.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-21.03.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
G-21.03.03P	remove, service, adjust and replace components	components are removed, serviced, adjusted and replaced according to manufacturers' service information , safety precautions and protocols
G-21.03.04P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
G-21.03.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

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

maintenance procedures include: cleaning, adjusting, calibrating

Knowledge

Learning Outcomes		Learning Objectives
G-21.03.01L	demonstrate knowledge of interior and exterior components, accessories and trim, their characteristics, applications and operation	identify types of interior and exterior components, accessories and trim, and describe their characteristics and applications
		describe operating principles of interior and exterior components, accessories and trim

G-21.03.02L	demonstrate knowledge of procedures used to repair interior and exterior components, accessories and trim	identify tools and equipment used to repair interior and exterior components, accessories and trim, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to interior and exterior components, accessories and trim
		describe procedures used to repair interior and exterior components, accessories and trim
		identify types of repair materials and describe their characteristics, applications and procedures for use
		describe procedures used to adjust, repair and replace interior and exterior components, accessories and trim
		describe maintenance procedures
		describe 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

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

hazards include: glass breakage, air bag placement, rotating parts, sharp edges, slippery floors

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

maintenance procedures include: cleaning, adjusting, calibrating

G-21.04 Repairs latches, locks and movable glass

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
G-21.04.01P	select and use tools and equipment	tools and equipment are selected and used according to manufacturers' service information and repair to be performed
G-21.04.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information

G-21.04.03P	remove, service, adjust and replace components	components are removed, serviced, adjusted and replaced according to manufacturers' service information , safety precautions and protocols
G-21.04.04P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
G-21.04.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

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

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

repair materials include: gaskets, sealants, fastening devices, lubricants

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

maintenance procedures include: lubricating, cleaning, adjusting, calibrating

Knowledge		
	Learning Outcomes	Learning Objectives
G-21.04.01L	demonstrate knowledge of latches, locks and movable glass, their characteristics, applications and operation	identify types of latches, locks and movable glass, and describe their characteristics and applications
		describe operating principles of latches, locks and movable glass
		identify warning indicators and describe their characteristics, applications and operation
G-21.04.02L	demonstrate knowledge of procedures used to repair latches, locks and movable glass	identify tools and equipment used to repair latches, locks and movable glass, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to latches, locks and movable glass
		describe procedures used to repair latches, locks and movable glass
		describe maintenance procedures
		describe procedures used to verify repair

Range of Variables

warning indicators include: warning messages, warning lights, audible signals

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

hazards include: pinch points, handling of glass, sharp edges

maintenance procedures include: lubricating, cleaning, adjusting, calibrating

Major Work Activity H

Diagnoses and repairs hybrid and electric vehicle (EV) systems

Task H-22 Diagnoses hybrid and electric vehicle (EV) systems

Task Descriptor

Hybrid and electric vehicles (EV) include: electric motors, inverters, converters, high voltage batteries and associated support systems. This task includes battery electric vehicles (BEV), hybrid electric vehicles (HEV) and plug-in hybrid electric vehicles (PHEV).

Automotive service technicians diagnose hybrid and EV according to manufacturers' service information. Safety is of paramount importance due to the risk of fire and electrocution when working with high voltages.

H-22.01 Diagnoses hybrid vehicle systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
H-22.01.01P	verify concern	concern is verified to determine diagnostic strategy
H-22.01.02P	identify type of hybrid vehicle system	type of hybrid vehicle system is identified
H-22.01.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-22.01.04P	inspect components	components are inspected for wear, damage and defects
H-22.01.05P	retrieve DTCs	DTCs are retrieved according to manufacturers' service information
H-22.01.06P	perform tests	tests are performed according to manufacturers' service information to pinpoint failure

H-22.01.07P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
H-22.01.08P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined
H-22.01.09P	isolate problem	problem is isolated according to manufacturers' service information

Range of Variables

diagnostic strategy includes: reviewing service information, checking applicable TSB

hybrid vehicle systems include: series, parallel, series/parallel

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: modules, inverters, high voltage batteries, drive motors, converters, wiring, onboard charger (PHEV)

tests include: functional tests, voltage and amperage tests, resistance check, voltage isolation tests, network tests

Knowledge

	Learning Outcomes	Learning Objectives
H-22.01.01L	demonstrate knowledge of hybrid vehicle systems , their components , characteristics, applications and operation	identify hybrid vehicle systems and their components , and describe their characteristics and applications
		describe operating principles of hybrid vehicle systems and their components
		identify types of motors and describe their characteristics, applications and operation
		describe operation of DC to AC inverters
		describe operation of DC to DC converters
		describe onboard chargers (PHEV)

H-22.01.02L	demonstrate knowledge of procedures used to diagnose hybrid vehicle systems and their components	identify tools and equipment used to diagnose hybrid vehicle systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hybrid vehicle systems and their components
		describe procedures used to diagnose hybrid vehicle systems and their components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
H-22.01.03L	demonstrate knowledge of training and certification requirements to diagnose hybrid vehicle systems and their components	identify training and certification requirements to diagnose hybrid vehicle systems and their components

Range of Variables

hybrid vehicle systems include: series, parallel, series/parallel

components include: modules, inverters, high voltage batteries, drive motors, converters, wiring, onboard charger (PHEV)

types of motors include: 3 phase AC permanent magnet, 3 phase AC induction

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

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

hazards include: fire, shocks, arc flash, sparks, high temperatures, heavy components, sharp edges

H-22.02 Diagnoses electric vehicle (EV) systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
H-22.02.01P	verify concern	concern is verified to determine diagnostic strategy
H-22.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-22.02.03P	inspect components	components are inspected for wear, damage and defects

H-22.02.04P	retrieve DTCs	DTCs are retrieved according to manufacturers' service information
H-22.02.05P	perform tests	tests are performed according to manufacturers' service information to pinpoint failure
H-22.02.06P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
H-22.02.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined
H-22.02.08P	isolate problem	problem is isolated according to manufacturers' service information

Range of Variables

diagnostic strategy includes: reviewing service information, checking applicable TSB

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: modules, inverters, high voltage batteries, drive motors, converters, wiring, onboard chargers (PHEV), sensors

tests include: functional tests, voltage tests, amperage tests, resistance check, voltage isolation and insulation tests

Knowledge

	Learning Outcomes	Learning Objectives
H-22.02.01L	demonstrate knowledge of EV systems, their components , characteristics, applications and operation	identify EV systems and their components , and describe their characteristics and applications
		describe operating principles of EV systems and their components
		identify types of motors and describe their characteristics, applications and operation
		describe operation of DC to AC inverters
		describe operation of DC to DC converters
		describe onboard chargers (PHEV)

H-22.02.02L	demonstrate knowledge of procedures used to diagnose EV systems and their components	identify tools and equipment used to diagnose EV systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to EV systems and their components
		describe procedures used to diagnose EV systems and their components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
H-22.02.03L	demonstrate knowledge of training and certification requirements to diagnose EV systems and their components	identify training and certification requirements to diagnose EV systems and their components

Range of Variables

components include: modules, inverters, high voltage batteries, drive motors, converters, wiring, onboard chargers (PHEV), sensors

types of motors include: 3 phase AC permanent magnet, 3 phase AC induction

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

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

hazards include: fire, shocks, arc flash, sparks, high temperatures, heavy components, sharp edges

H-22.03 Diagnoses high voltage batteries

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
H-22.03.01P	verify concern	concern is verified to determine diagnostic strategy
H-22.03.02P	identify type of high voltage battery	type of high voltage battery is identified
H-22.03.03P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-22.03.04P	inspect components	components are inspected for wear, damage and defects
H-22.03.05P	retrieve DTCs	DTCs are retrieved according to manufacturers' service information

H-22.03.06P	perform tests	tests are performed according to manufacturers' service information to pinpoint failure
H-22.03.07P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of battery and components
H-22.03.08P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined
H-22.03.09P	isolate problem	problem is isolated according to manufacturers' service information

Range of Variables

diagnostic strategy includes: reviewing service information, checking applicable TSB

types of high voltage batteries include: nickel metal hydride, lithium ion

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: contactors, control modules, cooling, bus bars, high voltage connections, high voltage interlocks, sensors

tests include: functional tests (contactor, coolant pump, cell balance tests), state of health check, state of charge check, predicted vehicle range check, voltage balance check, pressure tests

Knowledge

	Learning Outcomes	Learning Objectives
H-22.03.01L	demonstrate knowledge of high voltage batteries, their components , characteristics, applications and operation	identify types of high voltage batteries , and describe their characteristics and applications describe operating principles of high voltage batteries and their components
H-22.03.02L	demonstrate knowledge of procedures used to diagnose high voltage batteries and their components	identify tools and equipment used to diagnose high voltage batteries and their components , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to high voltage batteries and their components describe procedures used to diagnose high voltage batteries and their components

		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
H-22.03.03L	demonstrate knowledge of training and certification requirements to diagnose high voltage batteries and their components	identify training and certification requirements to diagnose high voltage batteries and their components

Range of Variables

components include: contactors, control modules, cooling, bus bars, high voltage connections, high voltage interlocks, sensors

types of high voltage batteries include: nickel metal hydride, lithium ion

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

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

hazards include: fire, shocks, arc flash, sparks, high temperatures, heavy components, sharp edges

H-22.04 Diagnoses hybrid and electric vehicle (EV) HVAC systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
H-22.04.01P	verify concern	concern is verified to determine diagnostic strategy
H-22.04.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-22.04.03P	inspect components	components are inspected for wear, damage and defects
H-22.04.04P	retrieve DTCs	DTCs are retrieved according to manufacturers' service information
H-22.04.05P	perform tests	tests are performed according to manufacturers' service information to pinpoint failure
H-22.04.06P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components

H-22.04.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' service information , and required repair is determined
H-22.04.08P	isolate problem	problem is isolated according to manufacturers' service information

Range of Variables

diagnostic strategy includes: reviewing service information, checking applicable TSB

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers, HVAC-specific tools and equipment

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: electric cooling pumps, high voltage compressors, positive temperature coefficient (PTC), refrigerant control valves, sensors, switches, modules

tests include: functional tests, voltage and amperage tests, resistance check, voltage isolation and insulation tests, performance tests, leak tests

Knowledge

	Learning Outcomes	Learning Objectives
H-22.04.01L	demonstrate knowledge of hybrid and EV HVAC systems, their components , characteristics, applications and operation	identify types of hybrid and EV HVAC systems and their components , and describe their characteristics and applications
		describe operating principles of hybrid and EV HVAC systems
H-22.04.02L	demonstrate knowledge of procedures used to diagnose hybrid and EV HVAC systems and their components	identify tools and equipment used to diagnose hybrid and EV HVAC systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hybrid and EV HVAC systems and their components
		describe procedures used to diagnose hybrid and EV HVAC systems and their components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste

H-22.04.03L	demonstrate knowledge of training and certification requirements to diagnose hybrid and EV HVAC systems and their components	identify training requirements to diagnose hybrid and EV HVAC systems and their components
H-22.04.04L	demonstrate knowledge of regulatory requirements relating to hybrid and EV HVAC systems	identify and interpret jurisdictional regulations pertaining to hybrid and EV HVAC systems

Range of Variables

components include: electric cooling pumps, high voltage compressors, positive temperature coefficient (PTC), refrigerant control valves, sensors, switches, modules

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

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers, HVAC-specific tools and equipment

hazards include: shocks, arc flash, sparks, high temperatures, pressurized gas

Task H-23 Repairs hybrid and electric vehicle (EV) systems

Task Descriptor

Hybrid vehicles and EV include: electric motors, inverters, converters, high voltage batteries and associated support systems. This task includes BEV, HEV and PHEV.

Automotive service technicians perform maintenance and repairs on hybrid and EV systems according to manufacturers' service information. Safety is of paramount importance due to the risk of electrocution when working with high voltages.

H-23.01 Repairs hybrid vehicle systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
H-23.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-23.01.02P	remove and inspect components	components are removed and inspected according to manufacturers' service information

H-23.01.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
H-23.01.04P	replace or repair components	components are replaced or repaired according to manufacturers' service information
H-23.01.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
H-23.01.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: modules, inverters, high voltage batteries, drive motors, converters, wiring, onboard charger (PHEV), sensors, coolers

repair materials include: gaskets, sealants, lubricants, coolants

maintenance procedures include: changing oil, servicing cooling system

Knowledge

	Learning Outcomes	Learning Objectives
H-23.01.01L	demonstrate knowledge of hybrid vehicle systems , their components , characteristics, applications and operation	identify hybrid vehicle systems and their components , and describe their characteristics and applications
		describe operating principles of hybrid vehicle systems and their components
H-23.01.02L	demonstrate knowledge of procedures to repair hybrid vehicle systems and their components	identify tools and equipment used to repair hybrid vehicle systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hybrid vehicle systems and their components
		describe procedures used to remove, repair and replace hybrid vehicle system components
		describe maintenance procedures

		describe procedures used to verify repair
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
H-23.01.03L	demonstrate knowledge of training and certification requirements to repair hybrid vehicle systems and their components	identify training and certification requirements to repair hybrid vehicle systems and their components

Range of Variables

hybrid vehicle systems include: series, parallel, series/parallel

components include: modules, inverters, high voltage batteries, drive motors, converters, wiring, onboard charger (PHEV), sensors, coolers

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

hazards include: fire, shocks, arc flash, sparks, high temperatures, heavy components

maintenance procedures include: changing oil, servicing cooling system

H-23.02 Repairs electric vehicle (EV) systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
H-23.02.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-23.02.02P	remove and inspect components	components are removed and inspected according to manufacturers' service information
H-23.02.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
H-23.02.04P	replace or repair components	components are replaced or repaired according to manufacturers' service information
H-23.02.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
H-23.02.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: modules, inverters, high voltage batteries, drive motors, converters, wiring, onboard chargers (PHEV), sensors, coolers

repair materials include: gaskets, sealants, lubricants, coolants

maintenance procedures include: changing fluids, servicing cooling system

Knowledge		
	Learning Outcomes	Learning Objectives
H-23.02.01L	demonstrate knowledge of EV systems, their components , characteristics, applications and operation	identify types of EV systems and their components , and describe their characteristics and applications
		describe operating principles of EV systems and their components
H-23.02.02L	demonstrate knowledge of procedures to repair EV systems and their components	identify tools and equipment used to repair EV systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to EV systems and their components
		describe procedures used to replace or repair EV system components
		describe maintenance procedures
		describe procedures used to verify repair
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
H-23.02.03L	demonstrate knowledge of training and certification requirements to repair EV systems and their components	identify training and certification requirements to repair EV systems and their components

Range of Variables

components include: modules, inverters, high voltage batteries, drive motors, converters, wiring, onboard chargers (PHEV), sensors, coolers

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

hazards include: fire, shocks, arc flash, sparks, high temperatures, heavy components

maintenance procedures include: changing fluids, servicing cooling system

H-23.03 Services high voltage batteries

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

	Performance Criteria	Evidence of Attainment
H-23.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-23.03.02P	remove and inspect components	components are removed and inspected according to manufacturers' service information
H-23.03.03P	select service materials	service materials are selected according to manufacturers' service information
H-23.03.04P	repair or replace components	components are repaired or replaced according to manufacturers' service information
H-23.03.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' service information
H-23.03.06P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: contactors, control modules, cooling, bus bars, high voltage connections, high voltage interlocks, sensors

service materials include: gaskets, sealants

maintenance procedures include: re-conditioning of high voltage battery, performing high voltage battery health check

Knowledge

Learning Outcomes	Learning Objectives
H-23.03.01L	demonstrate knowledge of high voltage batteries, their components , characteristics, applications and operation
	identify types of high voltage batteries and their components , and describe their characteristics and applications
	describe operating principles of high voltage batteries and their components
H-23.03.02L	demonstrate knowledge of procedures to service high voltage batteries and their components
	identify tools and equipment used to service high voltage batteries and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to high voltage batteries and their components
	describe procedures used to service high voltage batteries and their components
	describe maintenance procedures
	describe procedures used to verify repair
	identify materials that can be reconditioned, reused or recycled
	identify practices that reduce material waste
H-23.03.03L	demonstrate knowledge of training and certification requirements to service high voltage batteries and their components
	identify training and certification requirements to service high voltage batteries and their components

Range of Variables

components include: contactors, control modules, cooling, bus bars, high voltage connections, high voltage interlocks, sensors

types of high voltage batteries include: nickel metal hydride, lithium ion

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

hazards include: fire, shocks, arc flash, sparks, high temperatures, heavy components, sharp edges

maintenance procedures include: re-conditioning of high voltage battery, performing high voltage battery health check

H-23.04 Repairs hybrid and electric vehicle (EV) HVAC systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Skills

Performance Criteria		Evidence of Attainment
H-23.04.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-23.04.02P	remove and inspect components	components are removed and inspected according to manufacturers' service information
H-23.04.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' service information
H-23.04.04P	replace components	components are replaced according to manufacturers' service information
H-23.04.05P	verify repair	repair is verified by system re-test and road test

Range of Variables

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers, HVAC-specific tools and equipment

manufacturers' service information includes: maintenance schedule, specifications, recommendations, procedures, standards, bulletins, schematics

components include: electric cooling pumps, high voltage compressors, PTC heater, refrigerant control valves, sensors, switches, modules

repair materials include: gaskets, sealants, lubricants, refrigerants, coolants

Knowledge

Learning Outcomes		Learning Objectives
H-23.04.01L	demonstrate knowledge of hybrid and EV HVAC systems, their components , characteristics, applications and operation	identify types of hybrid and EV HVAC systems, and their components , and describe their characteristics and applications
		describe operating principles of hybrid and EV HVAC systems
H-23.04.02L	demonstrate knowledge of procedures to repair hybrid and EV HVAC systems, and their components	identify tools and equipment used to repair hybrid and EV HVAC systems, and their components , and describe their applications and procedures for use

		identify hazards and describe safe work practices pertaining to hybrid and EV HVAC systems, and their components
		describe procedures used to replace hybrid and EV HVAC system components
		describe procedures used to verify repair
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
H-23.04.03L	demonstrate knowledge of training and certification requirements to repair hybrid and EV HVAC systems, and their components	identify training and certification requirements to repair hybrid and EV HVAC systems, and their components
H-23.04.04L	demonstrate knowledge of regulatory requirements pertaining to refrigerants	identify jurisdictional regulations pertaining to refrigerants

Range of Variables

components include: electric cooling pumps, high voltage compressors, PTC heater, refrigerant control valves, sensors, switches, modules

tools and equipment include: specialized PPE, safety devices, scan tools, specialized DMMs, oscilloscopes, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers, HVAC-specific tools and equipment

hazards include: fire, shocks, arc flash, sparks, high temperatures, pressurized gas

Appendix A

Acronyms

ABS	antilock braking systems
AEB	automatic emergency braking
ACC	adaptive cruise control
ADAS	advanced driver assistance systems
AVR	alternator voltage regulator
AWD	all-wheel drive
BCM	body control module
BEV	battery electric vehicle
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
DMM	digital multimeters
DPF	diesel particulate filter
DSC	dynamic stability control
DTC	diagnostic trouble code
EBCM	electronic brake control module
EGR	exhaust gas recirculation
EV	electric vehicle
EVAP	evaporative emission control systems
GDI	gasoline direct injection
GHS	Globally Harmonized System
GMAW	gas metal arc welding
HEV	hybrid electric vehicle
HID	high intensity discharge
HRAI	Heating, Refrigeration and Air Conditioning Institute of Canada
HUD	heads-up display
HVAC	heating, ventilation and air conditioning
ISO	International Standards Organization
LIN	local interface network
MIG	metal inert gas welding
NA	naturally aspirated

NVH	noise, vibration and harshness
OBD	on-board diagnostics
OBD II	on-board diagnostics II
OCS	occupant classification system
OEM	original equipment manufacturer
OH&S	Occupational Health and Safety
PCM	powertrain control module
PCV	positive crankcase ventilation
PHEV	plug-in hybrid electric vehicle
PPE	personal protective equipment
PTC	positive temperature coefficient
PTU	power transfer unit
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
TDG	Transportation of Dangerous Goods
TPMS	tire pressure monitoring system
TSB	technical service bulletins
VCT	variable cam-timing
VGT	variable geometry turbocharger
VIN	vehicle identification number
VVT	variable valve timing
WHMIS	Workplace Hazardous Materials Information System

Appendix B

Tools and Equipment / Outils et équipement

Personal Protective Equipment (PPE) and Safety Equipment / Équipement de protection individuelle et équipement de sécurité

body protection – shop apron/heat resistant arm protectors/arc flash protective clothing

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 nitrile gloves, insulated gloves (for hybrid vehicles and EV)

hearing protection – earmuffs, 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)

protection du corps – tablier d'atelier, manchon de protection antichaleur/ vêtements de protection contre les éclats d'arc

chaussures de sécurité certifiées CSA

protection des yeux – écran facial, lunettes, lunettes de sécurité et lunettes de soudeur

douche oculaire

extincteurs

trousses de premiers soins et poste de secours

protection des mains – gants résistants aux produits chimiques, à la chaleur et aux abrasions, gants de cuir, gants jetables en latex, gants isolants (pour les véhicules hybrides et électriques)

protection des oreilles – protège-oreilles et bouche-oreilles

protection du système respiratoire – masque de protection contre la poussière et les particules et masque à filtre chimique

crochet de sécurité (pour les véhicules hybrides et électriques)

pylônes de sécurité (pour les véhicules hybrides et électriques)

Standard Tool Kit / Trousse d'outils standards

air die grinder

air hammer/chisel

air ratchet

antifreeze tester

axle boot clamp tools

battery post service and reshape tool

belt tension release tool

blow gun

bolt and nut extractor set (easy-outs)

brake service tools (adjusters, spring removal and installation tools, caliper tools)

caulking gun

compression testers

creeper

crowfoot wrenches

dial indicator set

digital multimeter (DMM)

drill and bits

meule pneumatique à rectifier les matrices

marteau et burin pneumatique

cliquet pneumatique

hydromètre

outil de resserrage de cache poussière

outil d'entretien et de profilage des bornes de batterie

outil de relâche de tension de la courroie

pistolet à air

jeu d'extracteurs de boulons et d'écrous

outils d'entretien des freins (réglage, retrait et installation des ressorts, outils pour les étriers de freins)

pistolet à calfeutrer

compressiomètre

sommier roulant

pied-de-biche

comparateur à cadran

multimètre à affichage numérique

perceuse et mèches

drill gauge	calibre à foret
feeler gauges – SAE and metric	jauge d'épaisseur à lames – mesures SAE et métrique
fender covers	protège-aile
filter wrenches	clé à filtre
flare nut wrenches – SAE and metric	clé polygonale ouverte – mesures SAE et métrique
flaring tool (SAE, metric and ISO)	outil à évaser (SAE, métrique et ISO)
flashlights	lampes de poche
fuel injector noid lights	lampe de vérification de l'alimentation électrique des injecteurs
fuel/transmission/air conditioning line disconnect set	jeu de déconnecteurs de canalisation de carburant, de boîte de vitesses et d'air climatisé
hacksaw	scie à métaux
hammers – ball peen, dead blow, rubber mallet, softface	marTEaux – à panne ronde, sans rebond, maillet en caoutchouc et massette
hex keys and sockets – SAE and metric	clé hexagonale coudée et douilles – mesures SAE et métrique
impact driver and bits	clé à impact et mèches
impact wrench (gun) and impact socket set – SAE and metric	clé à chocs et jeu de douilles – mesures SAE et métrique
inspection mirror	miroir d'inspection
jumper lead	fil volant
magnetic pick-up tool	tige aimanté
mechanic's pick set	jeu de pics de mécanicien/mécanicienne
metal files	limes en métal
micrometer – SAE and metric	micromètre – mesures SAE et métrique
nut driver set – SAE and metric	jeu de tourne-écrou – mesures SAE et métrique
pliers – slip joint, needle nose, multipurpose adjustable, side cutter, snap ring, inside pliers, locking, terminal crimp	pincés – à manchon coulissant, à bec effilé, universelle et réglables, coupantes de côté, pour anneau élastique et pour circlips intérieur, pince-étai
pry bars	levier
pullers – gear, pulley, battery terminal and steering wheel	extracteurs – d'engrenage, de poulie, de borne de batterie et de volant
punches and chisels	poinçons et burins
ratchet and sockets – SAE and metric, swivel, spark plug, extensions and adapters	clé à cliquet et douilles – mesures SAE et métrique, tourillons, bougies d'allumage, rallonges et adaptateurs
refractometer	réfractomètre
rivet gun	pistolet à riveter
scraper (gasket and carbon)	grattoir de joint et à décalaminer
screwdriver set	jeu de tournevis
seal drivers and extractors	mandrin pour l'installation de joints et extracteurs de joints
soldering tools	outils de brasage
spark plug gapper	outil de réglage des bougies
spark tester	testeur d'étincelles
standard test leads and probes	fils d'essai et sondes
stethoscope	stéthoscope de mécanicien
straight edge	règle de vérification
stud extractor	extracteur de goujon
tap and die set – SAE, metric and pipe thread	jeu de tarauds et filières – mesures SAE, métrique et filetage de tuyaux
tape and ruler	ruban à mesurer et règle

terminal remover tools
 test lamp
 thread files
 tin snips – centre, left and right cut

tire pressure gauge
 torque angle meter/indicator
 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

outils d'extraction des bornes de batterie
 lampe témoin
 filetage rapporté
 cisailles de ferblantier – coupe centrale, gauche et droite

manomètre pour pneus
 goniomètre et indicateur d'angle de couple
 clés dynamométriques – diverses dimensions et plages

mèche à six lobes et douilles
 jauge de profondeur (pour les pneus et les freins)

lampe baladeuse
 outil de cintrage des tubes
 coupe-tube

outils pour garnissage – outils pour panneau de garnissage, pinces pour anneau ouvert

couteau universel
 pompe à vide
 manomètre à vide
 pied à coulisse – mesures SAE et métrique
 brosse métallique
 pince à dénuder et à sertir
 jeu de clés – mesures SAE et métrique et de diverses formes

Shop Tools and Equipment / Outils et équipement d'atelier

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 refrigerant identifier

air conditioning service and repair tools

airbag removal tools

airbag simulators
 anti-static devices
 ball joint press and adapters
 battery chargers/boosting equipment

battery power supply
 battery, alternator and starter tester (AVR)

bearing remover
 belt tension gauge
 bench grinders
 bench vises

chalumeaux oxyacétylénique
 compresseur d'air – tuyaux, filtre de conduite et séparateur d'eau

équipement de rinçage du système de conditionnement d'air

équipement d'inspection et de détection des fuites du système de conditionnement d'air

poste de récupération, de recyclage et de rechargement du système de conditionnement d'air

identificateur de réfrigérant du système de conditionnement d'air

outils pour la réparation et l'entretien du conditionnement d'air

outil d'extraction du coussin de sécurité autogonflable

simulateurs pour coussins autogonflables

appareils antistatiques

presse pour rotule et adaptateurs

chargeurs de batteries et équipement de démarrage-secours

alimentation de la batterie

vérificateur de batterie, d'alternateur et de démarreur (AVR)

extracteur de roulement

jauge de tension de courroie

tourets

étaux d'établi

black light	lampe UV
borescope	endoscope
cylinder hone	rodoir de cylindre
brake drum gauge	jauge de tambour de frein
brake lathe	tour pour freins
brake pressure tester	contrôleur de pression des freins
brake rotor gauge	jauge de disque de frein
brake system bleeder	appareil de purge des freins
camshaft bearing tools (removal and installation)	mandrin pour coussinet d'arbre à came (retrait et installation)
CAT-IV digital multimeter (for hybrid vehicles)	appareil de mesure CAT-IV (pour les véhicules hybrides)
chassis ears	stéthoscope électronique pour multipoint
clutch alignment tools	centreurs d'embrayage
clutch installers and removers	mandrins de pose et de dépose
compression leak-down tester	contrôleur d'étanchéité de chambre de compression
computer – laptop, PC, tablet	ordinateur – portatif, personnel, tablette
coolant drain pans	entonnoir de vidange de liquide de refroidissement
cooling system pressure tester	contrôleur de pression de système de refroidissement
cooling system recovery and flushing station	station de vidange et de récupération pour le système de refroidissement
core plug/expansion plug installation tool	outil d'installation du bouchon expansible
cylinder ridge reamer	enlève-collerette
drill press	perceuse à colonnes
electrical short detector	détecteur de court-circuit électrique
engine and transmission supports	support de la boîte de vitesses et support de moteur
engine stand – portable	support pour moteur – portatif
EVAP test equipment (smoke generator)	équipement d'essai des émissions de vapeurs de carburant (fumigateur)
exhaust fan, ventilation hoses	ventilateur d'extraction, tuyau de ventilation
exhaust pipe bender	cintreuse à tuyau d'échappement
fuel injector flushing kit	injecteur de carburant trousse de vidange
fuel quality tester	appareil de contrôle de la qualité du carburant
fuel recovery and storage station	matériel de récupération et de stockage de carburant
funnels	entonnoir
gear puller set	jeu d'extracteurs d'engrenage
grease gun – oil dispensing system, fluid suction pump	pistolet graisseur – système de distribution d'huile, pompe d'aspiration de liquides
hydraulic press	presse hydraulique
insulated tools (for hybrid vehicles)	outil isolé (pour les véhicules hybrides)
jack stands and supports	chandelles et supports
leak detection tank (tires)	bassin de détection de fuites (pneus)
lock out tools	outils de verrouillage
lock pick set	ensemble de déverrouillage – outils de verrouillage
manometer	manomètre
oil drain barrels and disposal system	barils de vidange d'huile et système d'élimination
oscilloscope	oscilloscope
parts washers/steam cleaners and blaster	bac de dégraissage et de nettoyage à la vapeur et sableuse

piston ring compressor	collier à segments de piston
piston ring installer	outil d'installation de segment de piston
power steering pressure tester	contrôleur de pression de la direction assistée
pressure washer	nettoyeur à pression
propane enrichment tools	outils d'enrichissement du propane
shop vacuum	aspirateur d'atelier
slide hammer	marteau à inertie
specialized tools for air conditioning systems	outils spécialisés pour le système de conditionnement d'air
specialized tools for engines and transmission	outils spécialisés pour le moteur et la boîte de vitesses
spreaders	entretoises
spring compressors – coil spring and strut spring	compresseurs de ressort – ressort hélicoïdal et à jambe de force Macpherson
tire changing machine	machine à monter et à démonter les pneus
tire pressure monitoring system (TPMS) repair tools	outils de réparation des systèmes de surveillance de la pression des pneus
tire repair equipment	équipement pour la réparation des pneus
transmission fixtures	accessoires pour la boîte de vitesses
transmission flushing equipment	équipement de rinçage de boîte de vitesses
transmission pressure test kit	trousse de vérification de la pression de la boîte de vitesses
vacuum fill tools	outil de remplissage par le vide
valve spring compressor	compresseur de ressorts de soupape
vehicle service information system	système d'information sur l'entretien du véhicule
welding equipment – GMAW, GTAW, MIG, SMAW, oxy-fuel	matériel de soudage à l'arc sous gaz avec fil plein (GMAW), à l'électrode de tungstène (TIG), sous protection gazeuse (MIG) et de soudage aux gaz
wheel alignment equipment	équipement pour le réglage de la géométrie des roues
wheel balancer	équilibreuse de roues
wheel chocks	cales de roue
wheel ramps	rampes pour les roues

Shop Lifting Equipment / Équipement de levage d'atelier

battery tables/lifts	tables pour batteries/diable
chain falls	moufles à chaîne
engine hanging supports	appareils de support pour moteurs
engine hoisting equipment	appareils de levage pour moteurs
floor jack	cric rouleur
forklift (for EV batteries)	chariots élévateurs à fourche (pour les batteries de véhicules électriques)
hydraulic transmission jack	vérin hydraulique pour boîte de vitesses
overhead cranes	ponts roulants
vehicle hoist	pont élévateur

Measuring Tools and Equipment / Instruments de mesure

air conditioning pressure gauge	manomètre pour le système de conditionnement d'air
ammeter	ampèremètre
AVR (alternator voltage regulator)	régulateur de tension (AVR)
back pressure gauge	manomètre d'aspiration

ball joint dial indicator set	jeu de comparateurs à cadran pour joint à rotule
battery load tester	appareil de vérification des batteries
breakout box	boîte de dérivation
coolant system pressure tester	contrôleur de pression du système de refroidissement
cylinder bore gauges – small bore gauge, telescoping gauge	comparateurs à cadran pour cylindre – jauge d'alésage de petit calibre, jauge télescopique
electronic vibration analyzer	analyseur électronique de vibrations
fuel pressure gauges	manomètre à carburant
headlight aiming equipment	appareil de réglage des phares
hole gauge	calibre d'alésage
inclinometer	inclinomètre
infrared temperature gun	pistolets de température à infrarouge
micrometer – SAE and metric	micromètre – mesures SAE et métrique
oil pressure gauge set – engine/transmission	jeu de manomètres à huile – moteur et boîte de vitesses
plastic precision clearance gauge	jauge plastique
power steering pressure tester	contrôleur de pression de la direction assistée
pyrometer	pyromètre
refractometer	réfractomètre
refractor	réfracteur
scan tools	analyseurs-contrôleurs
spring scale	balance à ressort

Appendix C

Glossary / Glossaire

accessories	features that are not originally equipped by the manufacturer	accessoire	équipement qui n'est pas installé par le fabricant
alternator voltage regulator (AVR)	refers to a device that is used to test generators/alternators for electrical output, voltage and amperage	régulateur de tension (AVR)	appareil servant à vérifier la sortie électrique, la tension et l'intensité des générateurs et des alternateurs
controller area network (CAN)	a protocol for communication between electronic/computer modules	controller area network (CAN)	protocole de communication entre les modules électroniques et l'ordinateur
digital multimeter (DMM)	a digital electronic measuring instrument that combines several functions in one unit	multimètre à affichage numérique	appareil numérique de mesure qui combine plusieurs fonctions de mesure
inclinometer	device used to measure the incline of an object, measured in degrees	inclinomètre	appareil qui sert à mesurer, en degrés, l'inclinaison d'un objet
J2534 standard	an interface standard designed by SAE (Society of Automotive Engineers) for vehicle electronics reprogramming	norme J2534	J2534 est une norme d'interface créée par la SAE (Society of Automotive Engineers) pour la reprogrammation de l'électronique des automobiles
low voltage	for automotive applications, this refers to 12 volt systems	basse tension	pour les applications automobiles, cela s'applique aux systèmes de 12 V
manometer	a graduated tube containing water which measures pressure/vacuum in units of water column	manomètre à eau	tube à graduation, contenant de l'eau, qui mesure la pression et la dépression en unités de colonne d'eau
micrometer	a precision measuring device for small distances	micromètre	instrument de mesures précises destiné à mesurer des petites distances
Ohm's Law	the relationship between current, resistance and voltage in any electrical circuit	loi d'Ohm	relation entre le courant électrique, la résistance et la tension dans un circuit électrique
on-board diagnostics system (OBD)	part of a vehicle's engine management software used to monitor system performance	système de diagnostic embarqué (OBD)	systèmes de diagnostics embarqués faisant partie intégrante du logiciel de gestion du véhicule utilisé pour mesurer la performance d'un système
options	features that are originally equipped at time of manufacture	équipement en option	équipement installé lors de la fabrication
pneumatic pyrometer	operated by compressed air instrument used to measure temperatures using infrared light	pneumatique pyromètre	qui fonctionne à l'air comprimé instrument utilisé pour la mesure de la température avec lumière infrarouge

refractometer	test instrument used to measure the strength of antifreeze or specific gravity of electrolyte in a cell of a lead/acid battery	réfracteur	instrument d'essai utilisé pour mesurer l'efficacité d'un antigel ou la densité relative des électrolytes d'un compartiment d'une batterie au plomb-acide
sensory inspection	using one or more senses to perform an inspection	inspection sensorielle	utilisation d'un ou de plusieurs sens pour effectuer une inspection
Watt's Law	the relationship of power to current, voltage and resistance in any electrical circuit	loi de Watt	relation entre la puissance et le courant électrique, la tension et la résistance dans un circuit électrique