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RED SEAL OCCUPATIONAL STANDARD

Automotive Service Technician

INTERPROVINCIAL STANDARD
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Red Seal Occupational Standard

Automotive Service Technician

Title: Automotive Service Technician

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PDF
Cat. No.: Em15-3/10-2023E-PDF
ISBN/ISSN: 978-0-660-68197-9

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:

Trades and Apprenticeship Division
Apprenticeship and Sectoral Initiatives Directorate
Employment and Social Development Canada
140 Promenade du Portage, Phase IV
Gatineau, Quebec K1A 0J9

Acknowledgements

The CCDA and ESDC wish to express sincere appreciation for the contribution of the many tradespersons, industrial establishments, professional associations, labour organizations, provincial and territorial government departments and agencies, and all others who contributed to this publication.

Special thanks are offered to the following representatives who contributed greatly to the original draft of the standard and provided expert advice throughout its development:

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Michael Blatz	Manitoba
Jodi Collins	Saskatchewan
Lyndon Cummings	Saskatchewan
Russ Hunter	British Columbia
Neil Jensen	Alberta
Reid Johnstone	Manitoba
John Lundrigan	Newfoundland and Labrador
Darren MacRoberts	Nova Scotia
Luke Monk	Nova Scotia
Scott Parsons	Newfoundland and Labrador
Daniel Roy	New Brunswick
Shaughn Thompson	New Brunswick
Dan Van Holst	Ontario
David Vollmer	Ontario
Matt Wilkie	British Columbia

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 Not Validated by that province or territory
ND	trade Not Designated 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.

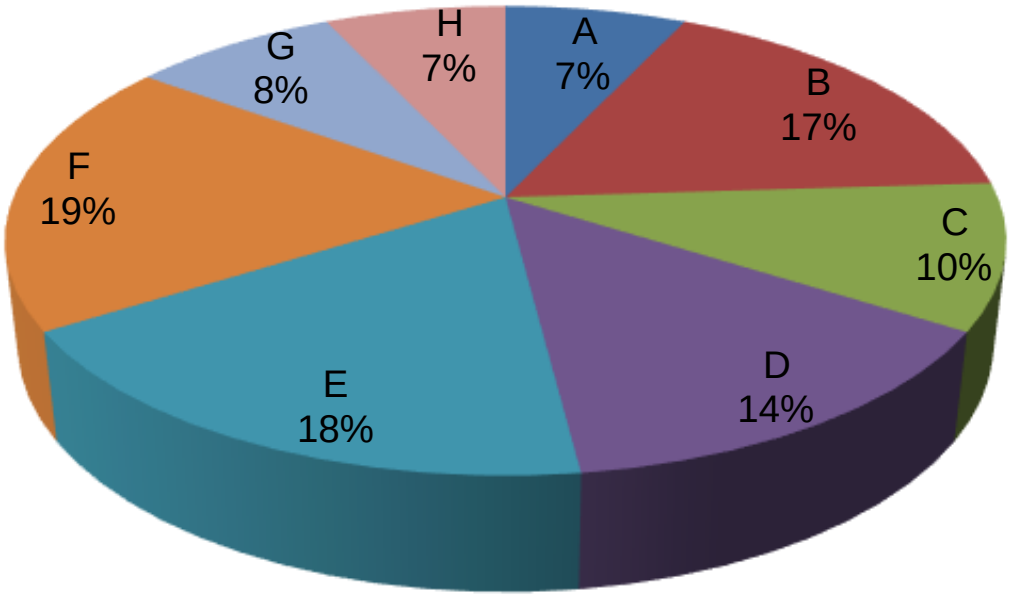
Industry Expected Performance

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
	A-2.04 Uses electronic service tools and systems for diagnostics and programming	A-2.05 Uses documentation and technical information	
Task A-3 Uses communication and mentoring techniques 8%	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).

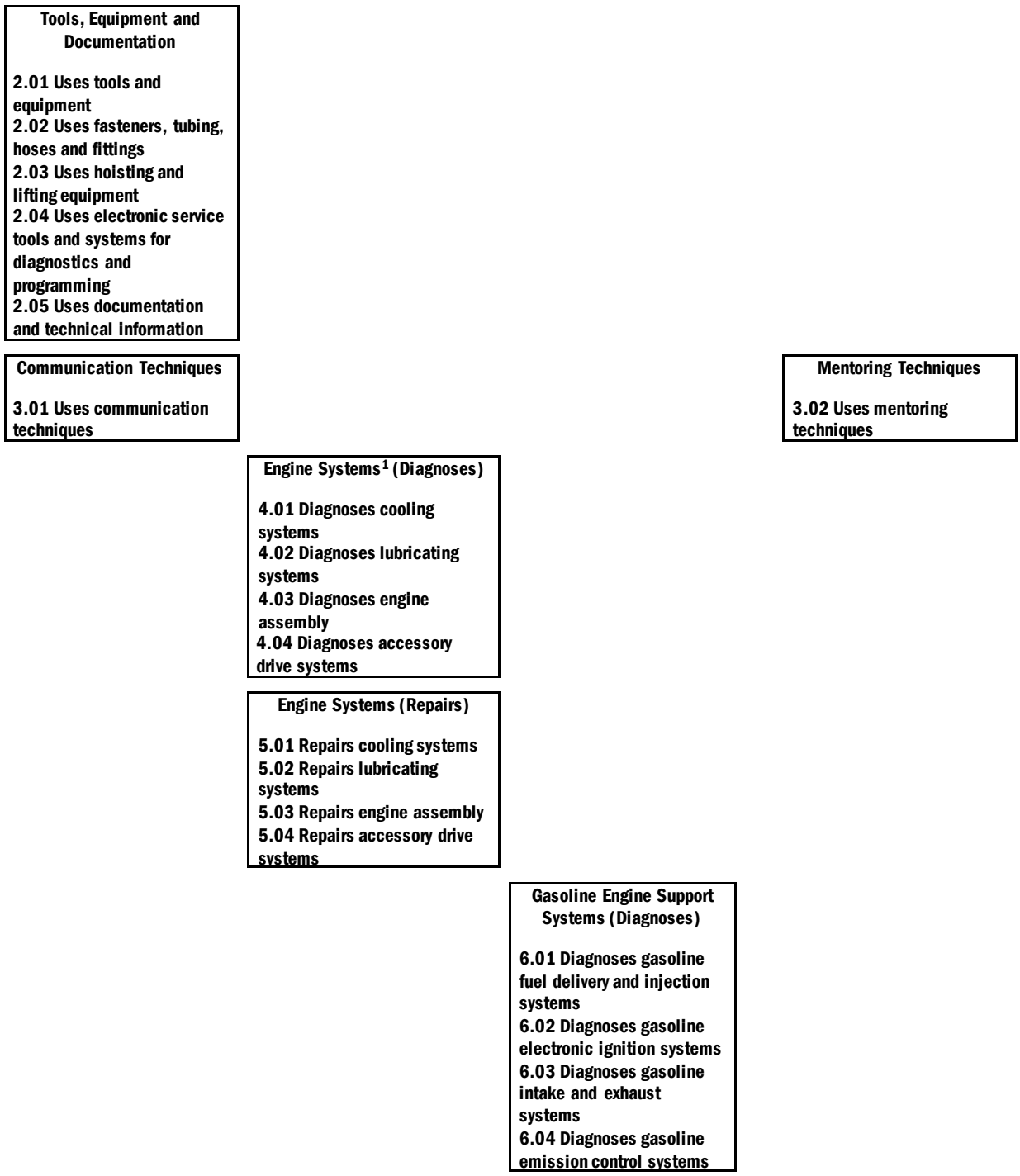
3. Total Training Hours

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)			



[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

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

[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 ***PPE and safety equipment specific to hybrid and EV systems***	***PPE and safety equipment specific to hybrid and EV systems*** is selected and used according to ***standards and regulations***, and ***manufacturers' service information***
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 ***standards and regulations***, and ***manufacturers' service information***
A-1.03.03P	recognize ***safety hazards specific to working on hybrid vehicles and EVs***	***safety hazards specific to working on hybrid vehicles and EVs*** are identified
A-1.03.04P	ensure that ***safety protocols for hybrid and EV systems*** have been implemented	***safety protocols for hybrid and EV systems*** have been implemented according to ***standards and regulations***, and ***manufacturers' service information***

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

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

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: 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, 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, 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: EGR, EVAP, secondary air injection, exhaust system, PCV, induction system, VCT

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

emission gases include: CO, CO_2, NO_x, HC, O_2

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, 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***
		describe procedures used to verify repair
B-7.01.03L	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: 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, CO_2, NO_x, HC, O_2

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

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, 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, CO_2, NO_x, HC, O_2, 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
		identify materials that can be reconditioned, reused or recycled
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, CO_2, NO_x, HC, O_2, 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***
		identify parameters of inputs and outputs and describe their relationships
C-10.02.02L	demonstrate knowledge of procedures used to monitor ***data***	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 ***diagnostic tools and equipment*** 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 ***methods used to access/transfer and reprogram software***

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 ***tools and equipment***	***tools and equipment*** are selected and used according to ***manufacturers' service information***
C-11.02.02P	follow ***vehicle-specific cautionary procedures***	***vehicle-specific cautionary procedures*** 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
		identify types of lubricants, fasteners, gaskets, seals and sealants, and describe their applications
D-12.01.02L	demonstrate knowledge of ***procedures used to diagnose*** drive shafts and axles and their components	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
		identify types of engine and driveline mounts, their construction and application
D-12.02.02L	demonstrate knowledge of ***procedures used to diagnose*** manual transmissions and transaxles and their components	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, CVT, 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

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

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
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
D-12.05.02L	demonstrate knowledge of ***procedures used to diagnose*** transfer cases and their components	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	
	Performance Criteria	***Evidence of Attainment***
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 ***type of automatic transmission and transaxle***	model and ***type of automatic transmission and transaxle*** are identified according to ***manufacturers' service information***
D-13.03.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to task and ***manufacturers' service information***
D-13.03.03P	select ***repair materials***	***repair materials*** are selected according to repair requirements and ***manufacturers' service information***
D-13.03.04P	remove, replace, recondition or service components and controls	components and controls are removed, replaced, reconditioned or serviced according to ***manufacturers' service information***
D-13.03.05P	perform maintenance procedures	maintenance procedures are performed according to ***manufacturers' service information***
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 ***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

		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	identify types of ***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
E-14.03.02L	demonstrate knowledge of ***procedures used to diagnose lighting and wiper systems*** and their ***components***	identify ***tools and equipment*** used to diagnose ***lighting and wiper systems*** and their ***components***, and describe their characteristics, applications and procedures for use
		identify ***hazards*** and describe safe work practices pertaining to ***lighting and wiper systems*** and their ***components***
		describe ***procedures used to diagnose lighting and wiper systems*** and their ***components***
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 ***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, ultraviolet (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 programed 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
E-15.03.02L	demonstrate knowledge of the procedures used to repair lighting and wiper systems, and their ***components***	identify ***tools and equipment*** used to repair lighting and wiper systems, and their ***components***, and describe their characteristics, applications and procedures for use
		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
		describe procedures used to verify repair
E-15.06.03L	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, 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
		identify ***related systems*** and describe their relationship to refrigerant systems
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, 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)

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

steering system components include: tie rods, idler arms, pitman arms, center links, columns, rack-and-pinion, steering box, 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, 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	identify types of latches, locks and movable glass, and their ***components***, and describe their characteristics and applications
		describe operating principles of latches, locks and movable glass, and their ***components***
		distinguish between electrical and mechanical ***components***
G-20.04.02L	demonstrate knowledge of ***procedures used to diagnose*** latches, locks and movable glass, and their ***components***	identify ***tools and equipment*** used to diagnose latches, locks and movable glass, and their ***components***, and describe their application and procedures for use
		identify ***hazards*** and describe safe work practices pertaining to latches, locks and movable glass, and their ***components***
		identify ***procedures used to diagnose*** latches, locks and movable glass, and their ***components***

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***
		describe procedures used to verify repair
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 ***sources of wind noises, rattles and water leaks***
		explain principles of basic aerodynamics related to body design
		identify types of ***repair materials*** and describe their characteristics, applications and procedures for use
		identify types of ***body components*** and ***accessories***
G-21.02.02L	demonstrate knowledge of procedures used to repair wind noises, rattles and water leaks	identify ***tools and equipment*** used to repair 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 repair wind noises, rattles and water leaks
		describe ***maintenance procedures***
		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, 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
UV	ultraviolet
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	protection du corps – tablier d'atelier, manchon de protection anti chaleur/vêtements de protection contre les éclats d'arc
CSA approved safety footwear	chaussures de sécurité certifiées CSA
eye protection – face shield/goggles/safety glasses/welding goggles	protection des yeux – écran facial, lunettes, lunettes de sécurité et lunettes de soudeur
eye wash station	douche oculaire
fire extinguisher	extincteurs
first aid kits and station	trousses de premiers soins et poste de secours
hand protection – chemical/heat resistant, abrasion/leather, disposable nitrile gloves, insulated gloves (for hybrid vehicles and EV)	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)
hearing protection – earmuffs, ear plugs	protection des oreilles – protège-oreilles et bouche-oreilles
respiratory protection – dust and particle masks, chemical filtered mask	protection du système respiratoire – masque de protection contre la poussière et les particules et masque à filtre chimique
safety hook (for hybrid and electric vehicles)	crochet de sécurité (pour les véhicules hybrides et électriques)
safety pylons (for hybrid and electric vehicles)	pylônes de sécurité (pour les véhicules hybrides et électriques)

Standard Tool Kit / Trousse d'outils standards

air die grinder	meule pneumatique à rectifier les matrices
air hammer/chisel	marteau et burin pneumatique
air ratchet	cliquet pneumatique
antifreeze tester	hydromètre
axle boot clamp tools	outil de resserrage de cache poussière
battery post service and reshape tool	outil d'entretien et de profilage des bornes de batterie
belt tension release tool	outil de relâche de tension de la courroie
blow gun	pistolet à air
bolt and nut extractor set (easy-outs)	jeu d'extracteurs de boulons et d'écrous
brake service tools (adjusters, spring removal and installation tools, caliper tools)	outils d'entretien des freins (réglage, retrait et installation des ressorts, outils pour les étriers de freins)
caulking gun	pistolet à calfeutrer
compression testers	compressiomètre
creeper	sommier roulant
crowfoot wrenches	pied-de-biche
dial indicator set	comparateur à cadran
digital multimeter (DMM)	multimètre à affichage numérique
drill and bits	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	pinces – à manchon coulissant, à bec effilé, universelle et réglables, coupantes de côté, pour anneau élastique et pour circlips intérieur, pince-étau
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 adapteurs
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	outils d’extraction des bornes de batterie
test lamp	lampe témoin
thread files	filetage rapporté
tin snips – centre, left and right cut	cisailles de ferblantier – coupe centrale, gauche et droite
tire pressure gauge	manomètre pour pneus
torque angle meter/indicator	goniomètre et indicateur d’angle de couple
torque wrenches – various sizes and ranges	clés dynamométriques – diverses dimensions et plages
torx bits and sockets	mèche à six lobes et douilles
tread depth gauge (for tires and brakes)	jauge de profondeur (pour les pneus et les freins)
trouble light	lampe baladeuse
tube bending tool	outil de cintrage des tubes
tube cutters	coupe-tube
upholstery tools – trim panel tools, hog ring pliers	outils pour garnissage – outils pour panneau de garnissage, pinces pour anneau ouvert
utility knife	couteau universel
vacuum pump	pompe à vide
vacuum/pressure gauge	manomètre à vide
vernier caliper – SAE and metric	pied à coulisse – mesures SAE et métrique
wire brush	brosse métallique
wire stripper/crimping tool	pince à dénuder et à sertir
wrench set – SAE and metric/various designs	jeu de clés – mesures SAE et métrique et de diverses formes

Shop Tools and Equipment / Outils et équipement d’atelier

acetylene torches	chalumeaux oxyacétylénique
air compressor – hoses, inline filter and water separators	compresseur d’air – tuyaux, filtre de conduite et séparateur d’eau
air conditioning flushing equipment	équipement de rinçage du système de conditionnement d’air
air conditioning leak detection and inspection equipment	équipement d’inspection et de détection des fuites du système de conditionnement d’air
air conditioning recovery/recycle/recharge station	poste de récupération, de recyclage et de rechargement du système de conditionnement d’air
air conditioning refrigerant identifier	identificateur de réfrigérant du système de conditionnement d’air
air conditioning service and repair tools	outils pour la réparation et l’entretien du conditionnement d’air
airbag removal tools	outil d’extraction du coussin de sécurité auto gonflable
airbag simulators	simulateurs pour coussins auto gonflables
anti-static devices	appareils antistatiques
ball joint press and adapters	presse pour rotule et adaptateurs
battery chargers/boosting equipment	chargeurs de batteries et équipement de démarrage-secours
battery power supply	alimentation de la batterie
battery, alternator and starter tester (AVR)	vérificateur de batterie, d’alternateur et de démarreur (AVR)
bearing remover	extracteur de roulement
belt tension gauge	jauge de tension de courroie
bench grinders	tourets
bench vises	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
alternator voltage regulator (AVR)	régulateur de tension (AVR)
ammeter	ampèremètre
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	operated by compressed air	**pneumatique**	qui fonctionne à l'air comprimé
pyrometer	instrument used to measure temperatures using infrared light	**pyromètre**	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