

RED SEAL OCCUPATIONAL STANDARD

Automotive Service Technician



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RED SEAL
OCCUPATIONAL
STANDARD
AUTOMOTIVE SERVICE TECHNICIAN



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FOREWORD

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

Background

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to cooperate with provincial and territorial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. Employment and Social Development Canada (ESDC) sponsors 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 analyses of occupations.

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

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STRUCTURE OF THE OCCUPATIONAL STANDARD

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

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

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

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

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: a graph which depicts the national percentages of exam questions assigned to the major work activities

Task Matrix and Examination Weightings: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard and their respective exam weightings

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

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

Knowledge:

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

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

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

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

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

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

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

DESCRIPTION OF THE AUTOMOTIVE SERVICE TECHNICIAN TRADE

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

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

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

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

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

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

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

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

TRENDS IN THE AUTOMOTIVE SERVICE TECHNICIAN TRADE

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

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

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

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

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

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

ESSENTIAL SKILLS SUMMARY

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

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

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

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

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

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

READING

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

DOCUMENT USE

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

WRITING

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

ORAL COMMUNICATION

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

NUMERACY

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

THINKING

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

WORKING WITH OTHERS

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

DIGITAL TECHNOLOGY

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

CONTINUOUS LEARNING

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

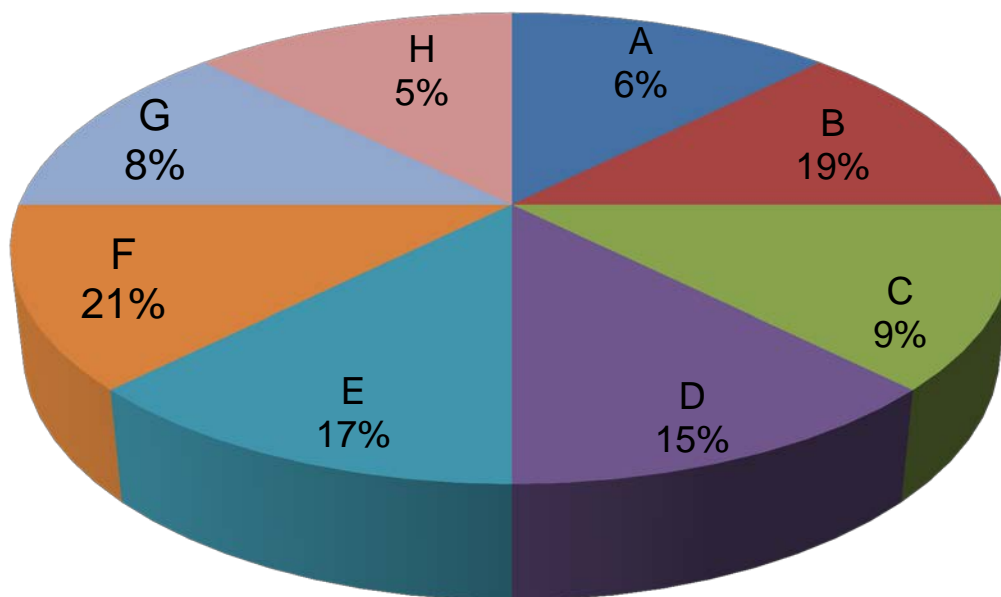
INDUSTRY EXPECTED PERFORMANCE

All tasks must be performed according to the applicable jurisdictional regulations and standards. All health and safety standards must be respected and observed. Work should be done efficiently and at a high quality without material waste or environmental damage. All requirements of the manufacturer specifications must be met. Automotive service technicians should work professionally and strive to meet or exceed client expectations. As they progress in their career there is an expectation they continue to upgrade their skills and knowledge to keep pace with industry and promote continuous learning in their trade including mentoring of apprentices. At a journey person level of performance, all tasks must be done with minimal direction and supervision

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	6%
MWA B	Diagnoses and Repairs Engine and Engine Support Systems	19%
MWA C	Diagnoses and Repairs Vehicle Module Communications Systems	9%
MWA D	Diagnoses and Repairs Driveline Systems	15%
MWA E	Diagnoses and Repairs Electrical and Comfort Control Systems	17%
MWA F	Diagnoses and Repairs Steering and Suspension, Braking, Control Systems, Tires, Hubs and Wheel Bearings	21%
MWA G	Diagnoses and Repairs Restraint Systems, Body Components, Accessories and Trim	8%
MWA H	Diagnoses and Repairs Hybrid and Electric Vehicles (EV)	5%

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, the breakdown of questions assigned to the Tasks. The Interprovincial examination for this trade has 125 questions.

AUTOMOTIVE SERVICE TECHNICIAN TASK MATRIX

A – Performs common occupational skills

6%

Task A-1 Performs safety-related functions 31%	A-1.01 Maintains safe work environment	A-1.02 Uses personal protective equipment (PPE) and safety equipment		
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 technical information			
Task A-3 Uses communication and mentoring techniques 19%	A-3.01 Uses communication techniques	A-3.02 Uses mentoring techniques		

B – Diagnoses and repairs engine and engine support systems

19%

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
25%

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

Task B-7
Repairs gasoline engine support systems
19%

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

Task B-8 Diagnoses diesel engine support systems 12%
Task B-9 Repairs diesel engine support systems 9%

B-8.01 Diagnoses diesel fuel delivery and injection systems	B-8.02 Diagnoses diesel intake/exhaust systems	B-8.03 Diagnoses diesel emission control systems
B-9.01 Repairs diesel fuel delivery and injection systems	B-9.02 Repairs diesel intake/exhaust systems	B-9.03 Repairs diesel emission control systems

C – Diagnoses and repairs vehicle module communications systems

9%

Task C-10 Diagnoses vehicle networking systems 67%

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

Task C-11 Repairs vehicle networking systems 33%

C-11.01 Updates component software	C-11.02 Replaces components	C-11.03 Verifies vehicle module communications system repair
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D – Diagnoses and repairs driveline systems

15%

Task D-12
Diagnoses driveline systems
59%

D-12.01 Diagnoses drive shafts and axles	D-12.02 Diagnoses manual transmissions/transaxles	D-12.03 Diagnoses automatic transmissions/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
41%

D-13.01 Repairs drive shafts and axles	D-13.02 Repairs manual transmissions/transaxles	D-13.03 Repairs automatic transmissions/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

17%

Task E-14
Diagnoses electrical systems and components
41%

E-14.01 Diagnoses basic wiring and electrical systems	E-14.02 Diagnoses starting/charging systems and batteries	E-14.03 Diagnoses lighting and wiper systems
E-14.04 Diagnoses entertainment systems	E-14.05 Diagnoses electrical options	E-14.06 Diagnoses instrumentation and information displays
E-14.07 Diagnoses electrical accessories		

Task E-15
Repairs electrical systems and components
19%

E-15.01 Repairs basic wiring and electrical systems	E-15.02 Repairs starting/charging systems and batteries	E-15.03 Repairs lighting and wiper systems
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Task E-16 Diagnoses heating, ventilation and air conditioning (HVAC) and comfort control systems 25%
Task E-17 Repairs HVAC and comfort control systems 15%

E-15.04 Repairs entertainment systems	E-15.05 Repairs electrical options	E-15.06 Repairs instrumentation and information displays
E-15.07 Installs electrical accessories	E-15.08 Repairs electrical accessories	
E-16.01 Diagnoses air flow control systems	E-16.02 Diagnoses refrigerant systems	E-16.03 Diagnoses heating systems
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 and suspension, braking, control systems, tires, hubs and wheel bearings

21%

Task F-18 Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings 59%
Task F-19 Repairs steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings 41%

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-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

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

8%

Task G-20 Diagnoses restraint systems, body components, accessories and trim 64%	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 36%	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 vehicles (EV)

5%

Task H-22 Diagnoses hybrid and EV 64%	H-22.01 Implements specific safety protocols for hybrid and EV	H-22.02 Diagnoses hybrid and EV systems
	Task H-23 Repairs hybrid and EV 36%	H-23.01 Repairs hybrid vehicle systems

MAJOR WORK ACTIVITY A

Performs common occupational skills

TASK A-1 Performs safety-related functions

TASK DESCRIPTOR

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

A-1.01 Maintains safe work environment

Essential Skills Oral Communication, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 and dispose of hazardous materials	hazardous materials are handled, removed and disposed of according to jurisdictional regulations and manufacturers' 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 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' 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, air quality, obstructions, defective equipment, and flammable, reactive, toxic and explosive materials

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

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

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
A-1.01.02L	demonstrate knowledge of regulatory requirements pertaining to safety	identify and describe jurisdictional safety regulations to maintain a safe work environment
		identify components of WHMIS/GHS
		identify and describe jurisdictional requirements for handling and disposing of hazardous materials

RANGE OF VARIABLES

safety regulations include: OH&S, WHMIS/GHS

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

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

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

Document Use, Thinking, Reading

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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' information
A-1.02.02P	recognize workplace hazards that require the use of PPE and safety equipment	workplace hazards that require the 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' information
A-1.02.04P	operate safety equipment	safety equipment is operated according to jurisdictional regulations and manufacturers' information
A-1.02.05P	recognize, remove and replace defective PPE	defective PPE is identified, removed, repaired, serviced, or replaced according to manufacturers' information
A-1.02.06P	recognize, remove, service or replace defective safety equipment	defective safety equipment is identified, removed, repaired, serviced, or replaced according to manufacturers' information
A-1.02.07P	report defective PPE and safety equipment to supervisor	supervisor is notified of all defective PPE and safety equipment

RANGE OF VARIABLES

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

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

jurisdictional regulations include: WHMIS/GHS, OH&S

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

RANGE OF VARIABLES

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

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

TASK A-2 Uses tools, equipment and documentation

TASK DESCRIPTOR

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

A-2.01 Uses tools and equipment

Essential Skills Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 to recognize wear, damage, defects or expiry	wear, damage, defects or expiry are identified according to safety regulations and manufacturers' information
A-2.01.04P	clean, lubricate and maintain tools and equipment	tools and equipment are cleaned, lubricated and maintained and according to manufacturers' 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' information
A-2.01.06P	calibrate measuring tools	measuring tools' settings are calibrated to manufacturers' information
A-2.01.07P	operate shop tools and equipment	operation of shop tools and equipment follows manufacturers' information

RANGE OF VARIABLES

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

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

A-2.01.04L	demonstrate knowledge of welding, cutting and heating equipment and their applications	identify types of welding, cutting and heating equipment and describe their applications
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RANGE OF VARIABLES

power tools include: electric, pneumatic, hydraulic

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

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

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

A-2.02 Uses fasteners, tubing, hoses and fittings

Essential Skills Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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' information
A-2.02.02P	remove and install fasteners	fasteners are removed and installed according to 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' information
A-2.02.06P	flare tubing	tubing is flared to standards, application and manufacturers' information

KNOWLEDGE

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

A-2.03

Uses hoisting and lifting equipment

Essential Skills Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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' 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
A-2.03.03P	operate vehicle hoists and lifting equipment	vehicle hoists and lifting equipment 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' 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

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

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

RANGE OF VARIABLES

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

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

A-2.04**Uses technical information****Essential Skills**

Document Use, Reading, Digital Technology

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

SKILLS**Performance Criteria****Evidence of Attainment**

A-2.04.01P	access technical diagnostic and repair information	technical diagnostic and repair information is accessed
A-2.04.02P	interpret and apply technical information	technical information is interpreted and applied through diagnostic and repair procedure
A-2.04.03P	create parts and labour lists and work orders	estimates and work orders are created according to company policy

KNOWLEDGE**Learning Outcomes****Learning Objectives**

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

RANGE OF VARIABLES

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

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

TASK A-3 Uses communication and mentoring techniques

TASK DESCRIPTOR

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

A-3.01 Uses communication techniques

Essential Skills Oral Communication, Document Use, Working with Others

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

SKILLS

	Performance Criteria	Evidence of Attainment
A-3.01.01P	demonstrates two-way communication practices one-on-one and in a group	instructions and messages are understood by all parties involved in communication
A-3.01.02P	listens using active listening practices	steps of active listening are utilized
A-3.01.03P	receives and responds to feedback on work	response to feedback indicates understanding and corrective measures are taken
A-3.01.04P	explains and provides feedback	explanation and feedback is provided and task is carried out as directed
A-3.01.05P	uses questioning to improve communication	questions enhance understanding, on-the-job training and goal setting
A-3.01.06P	participates in discussions	meetings are attended and information is understood and applied

RANGE OF VARIABLES

active listening includes: hearing, comprehending, interpreting, reflecting, responding, paraphrasing

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.01.01L	demonstrate knowledge of trade terminology	define terminology used in the trade
A-3.01.02L	demonstrate knowledge of effective communication practices	describe the importance of using effective verbal and non-verbal communication with people in the workplace
A-3.01.03L	demonstrate knowledge of technical resources available	identify sources of information to effectively communicate

A-3.01.04L	demonstrate knowledge of various learning styles	identify communication and learning styles
A-3.01.05L	demonstrate the knowledge and benefits of a productive team environment	identify personal responsibilities and attitudes that contribute to on-the-job success
A-3.01.06L	demonstrate knowledge of policies and procedures regarding harassment and discrimination	identify communication that constitutes harassment and discrimination

RANGE OF VARIABLES

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

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

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

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

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

A-3.02 Uses mentoring techniques

Essential Skills Working with Others, Oral Communication, Continuous Learning

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

SKILLS

	Performance Criteria	Evidence of Attainment
A-3.02.01P	identify and communicate learning objective and point of lesson	objective and point of the lesson are explained
A-3.02.02P	link lesson to other lessons and the job	lesson order and unplanned learning opportunities are defined
A-3.02.03P	demonstrates performance of a skill to learner	steps required to demonstrate a skill are performed
A-3.02.04P	set up conditions required for learner to practice a skill	practice conditions are set up so that the skill can be performed
A-3.02.05P	assess ability to perform tasks with increasing independence	performance improves with practice to a point where skill can be done with little supervision

A-3.02.06P	give supportive and corrective feedback	trade practices are adopted after having been given supportive and corrective feedback
A-3.02.07P	support learner in pursuing technical training opportunities	technical training is completed within timeframe prescribed by apprenticeship authority
A-3.02.08P	support equity groups	workplace is harassment and discrimination-free

RANGE OF VARIABLES

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

practice conditions include: guided, limited independence, full independence

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.02.01L	identify, explain and demonstrate strategies for learning skills in the workplace	describe the importance of individual experience
		describe the shared responsibilities for workplace learning
		identify different ways of learning and determine one's own learning preferences and explain how these relate to learning new skills
		describe the importance of different types of skills in the workplace
		describe the importance of essential skills in the workplace
		identify different ways of learning
		identify different learning needs and strategies to meet learning needs
		identify strategies to assist in learning a skill
A-3.02.02L	identify, explain and demonstrate strategies for teaching workplace skills	identify different roles played by a workplace mentor
		describe the steps involved in teaching skills
		explain the importance of identifying the point of a lesson
		identify how to choose the effective time to present a lesson
		explain the importance of linking the lessons
		identify the components of the skill (the context)

	describe considerations in setting up opportunities for skill practice
	explain the importance of providing feedback
	identify techniques for giving effective feedback
	describe a skills assessment
	identify methods of assessing progress
	explain how to adjust a lesson to different situations

RANGE OF VARIABLES

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

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

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

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

MAJOR WORK ACTIVITY B

Diagnoses and repairs engine and engine support systems

TASK B-4 Diagnoses engine systems

TASK DESCRIPTOR

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

B-4.01 Diagnoses cooling systems

Essential Skills Document Use, Thinking, Oral Communication

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' 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' 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' information
B-4.01.07P	check and identify mechanical system faults	mechanical system faults are identified according to manufacturers' 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' information, and required repair is determined

RANGE OF VARIABLES

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

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

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

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 and operation	identify types of cooling systems
		identify cooling system components and describe their purpose and operation
		identify types of coolants and chemical additives and describe their characteristics and applications
		identify types of hoses, tubing, belts, gaskets, seals and sealants and describe their applications
		identify types of fan systems and describe their components and operation
		identify related systems and describe their relationship to cooling systems
B-4.01.02L	demonstrate knowledge of the procedures used to diagnose cooling systems	describe the procedures used to diagnose cooling systems
		identify warning systems and indicators and describe their purpose and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use

RANGE OF VARIABLES

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

fan systems include: mechanical, electric, hydraulic

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

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

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

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

B-4.02 Diagnoses lubricating systems

Essential Skills

Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' 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' information
B-4.02.06P	perform oil pressure tests	oil pressure tests are performed, recorded and compared to manufacturers' 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' information, and required repair is determined

RANGE OF VARIABLES

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

components include: pumps and drives, coolers, lines/hoses, filters, chains, tensioners

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 and operation	identify types of engine lubricants and describe their characteristics and applications
	identify types of oil pumps and describe their purpose and operation
	identify types of oil coolers and describe their purpose and operation
	identify types of hoses, tubing, gaskets, seals and sealants and describe their applications
	describe oil flow, filtration and pressure regulation
	identify testing procedures for checking oil contaminations
	identify types of warning systems and indicators and describe their purpose and operation
B-4.02.02L demonstrate knowledge of the procedures used to diagnose engine lubricating systems	describe the procedures used to diagnose engine lubricating systems

RANGE OF VARIABLES

engine lubricants include: grades and classifications, synthetics, additives

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

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

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

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

B-4.03**Diagnoses engine assembly****Essential Skills**

Document Use, Thinking, Numeracy

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

SKILLS

	Performance Criteria	Evidence of Attainment
B-4.03.01P	verify concern	concern is verified to determine diagnostic strategy
B-4.03.02P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used to isolate concerns
B-4.03.03P	perform tests	tests are performed according to manufacturers' information
B-4.03.04P	inspect engine assembly components	engine assembly components are inspected for wear, damage and defects
B-4.03.05P	inspect valve timing and valve timing components	valve timing and valve timing components are inspected for operation according to manufacturers' information
B-4.03.06P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' information, and required repair is determined

RANGE OF VARIABLES

diagnostic tools and equipment include: scan tools, compression testers, measuring tools, stethoscopes, vibration analyzer

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

tests include: cylinder leak-down, compression, vacuum

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

valve timing components include: timing belt or chain, gears, actuators, tensioners, pulleys, variable valve timing (VVT)

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-4.03.01L	demonstrate knowledge of engine theory	define and explain terminology associated with engines explain internal combustion principles
B-4.03.02L	demonstrate knowledge of engine assemblies, their components and operation	identify types of engine classifications

		identify types of engine configurations and describe their construction
		identify types of valve train configurations and valve timing control systems operations and describe their construction
		identify types of fasteners, gaskets, seals and sealants and describe their applications and procedures for use
		identify engine assembly components and describe their design, purpose and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		describe engine displacement, compression ratios and horsepower
		identify related components and describe their relationship to engine assembly
B-4.03.03L	demonstrate knowledge of the procedures used to diagnose engine assemblies	identify types and sources of engine assembly problems
		describe the procedures used to diagnose engine assembly problems

RANGE OF VARIABLES

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

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

engine configurations include: inline, rotary, opposed, V

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

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

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

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

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

B-4.04**Diagnoses accessory drive systems****Essential Skills**

Document Use, Thinking, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
B-4.04.03P	check and inspect accessory drive pulley alignment	accessory drive pulleys are inspected for alignment according to manufacturers' 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 diagnostic tools and equipment
B-4.04.06P	measure belt tension	belt tension is measured according to manufacturers' information
B-4.04.07P	inspect accessory drive system components	accessory drive system components are inspected for wear, tension and noise according to manufacturers' 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' information, and required repair is determined

RANGE OF VARIABLES

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

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

accessory drive system components include: tensioners, pulleys, belts

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-4.04.01L	demonstrate knowledge of accessory drive systems , their components and operation	identify the types of accessory drive systems , and describe their components and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify related components and describe their relationship to accessory drive systems
B-4.04.02L	demonstrate knowledge of the procedures used to diagnose accessory drive systems	describe the procedures used to diagnose accessory drive systems
		describe the procedures used to diagnose accessory drive system components

RANGE OF VARIABLES

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

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

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

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

TASK B-5 Repairs engine systems

TASK DESCRIPTOR

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

B-5.01 Repairs cooling systems

Essential Skills Document Use, Thinking, Reading

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

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.01.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to repair procedures
B-5.01.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' 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 systems	coolant system is drained, flushed, refilled and bled according to manufacturers' information
B-5.01.06P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

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

KNOWLEDGE

Learning Outcomes	Learning Objectives
B-5.01.01L demonstrate knowledge of cooling systems, their components and operation	identify cooling system components and describe their purpose and operation
	identify types of coolants and chemical additives and describe their characteristics and applications
	identify types of hoses, tubing, belts, gaskets, seals and sealants and describe their applications
	identify types of repair tools and equipment and describe their applications and procedures for use
	identify types of fan systems and describe their components and operation
	identify related systems and describe their relationship to cooling systems
B-5.01.02L demonstrate knowledge of the procedures used to repair cooling systems	identify warning systems and indicators and describe their purpose and operation
	describe the procedures used to repair cooling systems
	describe the procedures used to remove and reinstall cooling system components
	describe the procedures used to flush and recycle or dispose of coolants according to jurisdictional regulations
	describe procedures used to verify repair

RANGE OF VARIABLES

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

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

fan systems and their components include: mechanical, electric

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

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

B-5.02**Repairs lubricating systems****Essential Skills**

Document Use, Thinking, Numeracy

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

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.02.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to repair procedures
B-5.02.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
B-5.02.03P	remove, replace or service lubricating system components	lubricating system components are removed, replaced or serviced according to manufacturers' information
B-5.02.04P	identify and select engine oil	engine oil is identified and selected according to manufacturers' information
B-5.02.05P	perform maintenance procedures	maintenance procedures are performed according to manufacturers' 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' information
B-5.02.07P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, 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 and operation	identify types of engine lubricants and describe their characteristics and applications
		identify types of oil pumps and drives and describe their purpose and operation
		identify types of oil coolers and describe their purpose and operation

		identify types of hoses, tubing, gaskets, seals and sealants and describe their applications
		describe oil flow, filtration and pressure regulation
		identify requirements related to superchargers and turbochargers
		identify related systems and describe the relationship to lubricating systems
		identify types of warning systems and indicators and describe their purpose and operation
B-5.02.02L	demonstrate knowledge of the procedures used to repair engine lubricating systems	describe the procedures used to repair lubrication systems
		describe procedures used to verify repair

RANGE OF VARIABLES

related systems include: engine assembly, oil coolers

B-5.03 Repairs engine assembly

Essential Skills Document Use, Thinking, Numeracy

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

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.03.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to repair procedures
B-5.03.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
B-5.03.03P	remove and reinstall engine assembly	engine assembly is removed and reinstalled according to manufacturers' information
B-5.03.04P	remove, disassemble and inspect engine components	engine components are removed, disassembled according to manufacturers' information and inspected for damage, measured for wear and compared to manufacturers' information
B-5.03.05P	replace or service components	components are replaced or serviced according to manufacturers' 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' information
B-5.03.07P	perform mechanical engine timing procedures	mechanical engine timing procedures are performed according to manufacturers' information
B-5.03.08P	perform pre-lubrication and priming procedures	pre-lubrication and priming procedures are performed according to manufacturers' information
B-5.03.09P	verify repair	repair is verified by system re-test and road test according to manufacturers' information

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

KNOWLEDGE

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

describe the procedures used to adjust, repair and/or replace engine assembly components

describe procedures used to verify repair

RANGE OF VARIABLES

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

engine configurations include: inline, rotary, opposed, V

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

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

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

B-5.04 Repairs accessory drive systems

Essential Skills

Document Use, Thinking, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.04.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to repair procedures
B-5.04.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' 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' information
B-5.04.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

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

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

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

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

TASK B-6 Diagnoses gasoline engine support systems

TASK DESCRIPTOR

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

B-6.01 Diagnoses gasoline fuel delivery and injection systems

Essential Skills Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
B-6.01.03P	identify type of fuel delivery and injection systems	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 components	components are inspected for wear, damage and defects
B-6.01.06P	perform fuel delivery and injection system tests	fuel delivery and injection system tests are performed according to manufacturers' information
B-6.01.07P	identify fuel delivery and injection system faults	fuel delivery and injection system faults are identified
B-6.01.08P	record, interpret and analyse test results	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' information, and required repair is determined

RANGE OF VARIABLES

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

fuel delivery and injection system includes: 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

fuel delivery and injection system tests include: pressure, volume, fuel injector flow

fuel delivery and injection system faults include: engine misfires, lack of power

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

RANGE OF VARIABLES

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

safety precautions include: high pressure, flammability

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

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

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

B-6.02**Diagnoses gasoline ignition systems****Essential Skills**

Document Use, Thinking, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
B-6.02.03P	perform ignition tests	ignition tests are performed
B-6.02.04P	inspect ignition system components	ignition system components are inspected for wear and damage
B-6.02.05P	record, interpret and analyse test results	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' information, and required repair is determined

RANGE OF VARIABLES

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

ignition tests include: coil, primary and secondary circuits, spark duration and timing, road test

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

KNOWLEDGE

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

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

RANGE OF VARIABLES

ignition systems include: distributor, distributor-less

safety considerations include: high voltage

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

ignition circuits include: primary, secondary, control

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

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

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

ignition concerns include: hesitation, misfire, lag, timing

B-6.03 Diagnoses gasoline intake/exhaust systems

Essential Skills Document Use, Thinking, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
B-6.03.03P	inspect intake and exhaust systems	intake and exhaust systems are inspected for function, leaks, restrictions and variable intake manifold operation
B-6.03.04P	perform intake/exhaust system tests	intake/exhaust system tests are performed according to manufacturers' information
B-6.03.05P	inspect components	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' information
B-6.03.07P	record, interpret and analyze test results	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' information, and required repair is determined

RANGE OF VARIABLES

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

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

intake/exhaust system tests include: exhaust back pressure, leak, intake restriction

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

measurements include: end play, boost

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-6.03.01L	demonstrate knowledge of intake and exhaust systems, their components and operation	identify the types of intake systems and describe their components and operation
		identify safety considerations related to intake/exhaust systems
		identify the exhaust systems and describe their components and operation
		identify types and sources of intake / exhaust system problems
		identify the types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify related systems and describe their relationship to intake/exhaust systems
B-6.03.02L	demonstrate knowledge of the procedures used to diagnose intake / exhaust systems	describe the procedures used to diagnose intake / exhaust systems

RANGE OF VARIABLES

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

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

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

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

related systems include: emissions, lubricating, fuel delivery

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

B-6.04 Diagnoses gasoline emission control systems

Essential Skills Document Use, Thinking, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
B-6.04.03P	access DTCs and data from OBD system	DTCs and data from OBD system are accessed
B-6.04.04P	perform gasoline emission control system tests	emission control systems tests are performed according to manufacturers' information
B-6.04.05P	inspect emission control system components	emission control system components are inspected for wear, damage and defects
B-6.04.06P	record, interpret and analyse test results	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' information, and required repair is determined

RANGE OF VARIABLES

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

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

emission control system components include: solenoids, exhaust gas recirculation (EGR) valves, hoses, catalytic converters, positive crankcase ventilation (PCV) valve, canisters

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-6.04.01L	demonstrate knowledge of emission control systems , their components and operation	identify the types of emission gases and how they are formed
		identify emission control systems and describe their components and operation
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify related systems and describe their relationship to emission control systems
		identify warning systems and indicators
B-6.04.02L	demonstrate knowledge of the procedures used to diagnose emission control systems	describe the procedures used to diagnose emission control systems

RANGE OF VARIABLES

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

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

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

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

related systems include: exhaust, intake, fuel

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

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

TASK B-7 Repairs gasoline engine support systems

TASK DESCRIPTOR

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

B-7.01 Repairs gasoline fuel delivery and injection systems

Essential Skills Thinking, Document Use, Digital Technology

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

SKILLS

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

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants and fastening devices

gasoline fuel delivery and injection system components include: fuel filters, injectors, tanks, lines, hoses and pumps, regulators

fuel delivery and injection system 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 and operation	identify safety considerations pertaining to gasoline fuel delivery and injection systems identify the types of gasoline fuel delivery and injection systems and describe their components and operation identify types of tubing, hoses, gaskets, seals and sealants and describe their applications identify types of repair tools and equipment and describe their applications and procedures for use
B-7.01.02L	demonstrate knowledge of the procedures used to repair gasoline fuel delivery and injection systems	describe the procedures used to repair gasoline fuel delivery and injection systems describe the procedures used to remove and reinstall gasoline fuel delivery and injection systems components describe the procedures used to adjust/calibrate repair and/or replace gasoline fuel delivery and injection systems components describe procedures used to verify repair

RANGE OF VARIABLES

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

safety considerations include: high pressure, flammability

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

B-7.02**Repairs gasoline ignition systems****Essential Skills**

Document Use, Thinking, Digital Technology

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

SKILLS

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

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

clearances include: spark plug gap, sensor clearances

KNOWLEDGE

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

describe the procedures used to remove and reinstall **ignition system components**

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

describe procedures used to verify repair

RANGE OF VARIABLES

ignition systems include: distributor, distributor-less

safety considerations include: high voltage, high temperature

ignition circuits include: primary, secondary, control

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

warning systems and indicators include: check engine light, DIC

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

B-7.03 Repairs gasoline intake/exhaust systems

Essential Skills

Document Use, Thinking, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
B-7.03.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to repair procedures
B-7.03.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
B-7.03.03P	remove and replace intake/exhaust system components	intake/exhaust system components are removed and replaced according to manufacturers' information
B-7.03.04P	prime, lubricate and service turbocharger systems and supercharger systems	turbocharger systems and supercharger systems are primed, lubricated and serviced according to manufacturers' information
B-7.03.05P	maintain intake/exhaust system	intake/exhaust system is maintained by cleaning throttle body, replacing air filters and servicing waste gate
B-7.03.06P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

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

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

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

RANGE OF VARIABLES

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

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

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

related systems include: emissions, lubricating, fuel delivery

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

B-7.04 Repairs gasoline emission control systems

Essential Skills Document Use, Thinking, Digital Technology

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

SKILLS

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

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

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

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

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

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

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

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

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

TASK B-8 Diagnoses diesel engine support systems

TASK DESCRIPTOR

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

B-8.01 Diagnoses diesel fuel delivery and injection systems

Essential Skills Document Use, Thinking, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 manufacturers' information
B-8.01.03P	identify type of diesel fuel delivery systems	diesel fuel delivery systems are identified according to type
B-8.01.04P	identify type of diesel fuel injection systems	diesel fuel injection systems are identified according to type
B-8.01.05P	follow safety procedures for testing diesel fuel delivery and injection systems	procedures are followed for testing diesel fuel delivery and injection systems according to manufacturers' information
B-8.01.06P	inspect and test diesel fuel	diesel fuel properties and contaminants are identified
B-8.01.07P	perform diesel fuel delivery and system tests	diesel fuel delivery system tests are performed according to manufacturers' information
B-8.01.08P	perform diesel fuel injection system tests	diesel fuel injection system tests are performed according to manufacturers' information
B-8.01.09P	interpret and analyze results of data and functional tests	results of functional tests and data are interpreted and analyzed to determine required repair for existing faults

RANGE OF VARIABLES

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

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

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

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

diesel fuel delivery system tests include: pressure, volume, restriction

diesel fuel injection system tests include: pressure, volume

data includes: timing, fuel rate, balance rate

faults include: lack of power, smoke, hard start

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.01.01L	demonstrate knowledge of diesel fuel delivery and injection systems , their components and operation	identify safety considerations pertaining to diesel fuel delivery and injection systems
		identify the types of diesel fuel delivery and injection systems and describe their components and operation
		identify types of tubing, hoses, gaskets, seals and sealants and describe their applications
		identify the types of starting aids and describe their purpose and operation
B-8.01.02L	demonstrate knowledge of the procedures used to diagnose diesel fuel delivery and injection systems	identify methods to test fuel quality and describe their associated procedures
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		describe the procedures used to diagnose diesel fuel delivery and injection systems
		describe the procedures used to remove and reinstall diesel fuel delivery and injection system components

RANGE OF VARIABLES

safety considerations include: high pressure fuel, high injection voltage

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

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

starting aids include: glow plugs intake heaters, timers

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

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

B-8.02 Diagnoses diesel intake/exhaust systems

Essential Skills

Thinking, Digital Technology, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
B-8.02.03P	inspect diesel intake/exhaust systems for damage and restrictions	diesel intake/exhaust systems are inspected for damage and restrictions
B-8.02.04P	take measurements on turbocharger systems	measurements are taken on turbocharger systems
B-8.02.05P	inspect turbocharger systems components for damage	turbocharger systems components are inspected for damage
B-8.02.06P	interpret and analyze results of inspections to determine required repair	results of functional tests and data are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

damage includes: broken fins, leaks, noisy bearings

measurements on turbocharger systems include: end play and boost pressure

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.02.01L	demonstrate knowledge of diesel intake/exhaust systems , their components and operation	identify the types of diesel intake systems and describe their components and operation
		identify safety considerations related to diesel intake and exhaust systems
		identify the types of diesel exhaust systems and describe their components and operation
		identify diesel intake systems and describe their components and operation
		identify types and sources of diesel intake/exhaust system problems
		identify the types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
B-8.02.02L	demonstrate knowledge of the procedures used to diagnose diesel intake and exhaust systems	describe the procedures used to diagnose diesel intake and exhaust system components

RANGE OF VARIABLES

diesel intake systems include: turbocharged, supercharged, NA

safety considerations include: extreme temperature, exhaust fumes

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

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

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

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

Document Use, Thinking, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
B-8.03.03P	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-8.03.04P	inspect diesel emission control systems	diesel emission control systems are inspected to identify condition and function of components
B-8.03.05P	test diesel emission control systems	diesel emission control systems are tested according to manufacturers' information
B-8.03.06P	access DTCs and data from on-board diagnostics systems	DTCs and data from OBD systems are accessed
B-8.03.07P	interpret and analyze results of functional tests and inspections	results of functional tests and inspections are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

diesel emission control systems include: EGR, EVAP, PCV, VCT, Selective Catalyst Reduction (SCR), diesel exhaust fluid (DEF), diesel oxidation catalyst (DOC), diesel particulate filter (DPF)

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.03.01L	demonstrate knowledge of diesel emission control systems , their components and operation	identify diesel emissions and how they are formed
		identify safety considerations related to diesel emission control systems
		identify diesel emission control systems and describe their components and operation

		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify warning systems and indicators
B-8.03.02L	demonstrate knowledge of the procedures used to diagnose diesel emission control systems	describe the procedures used to diagnose diesel emission control systems

RANGE OF VARIABLES

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

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

safety considerations include: corrosive diesel exhaust fluid, high temperature

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

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

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

TASK B-9 Repairs diesel engine support systems

TASK DESCRIPTOR

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

B-9.01 Repairs diesel fuel delivery and injection systems

Essential Skills Document Use, Numeracy, Digital Technology

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

SKILLS

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

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

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

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

diesel fuel delivery and injection system maintenance includes: fuel treatment, water removal, filter replacement

diesel fuel injection system components include: injector, high pressure fuel pump, injector rail

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-9.01.01L	demonstrate knowledge of diesel fuel delivery and injection systems , their components and operation	identify safety considerations pertaining to diesel fuel delivery and injection systems
		identify the types of diesel fuel delivery and injection systems and describe their components and operation
		identify types of tubing, hoses, gaskets, seals and sealants and describe their applications
		identify the types of starting aids and describe their purpose and operation
		identify related systems and describe their relationship to diesel fuel delivery and injection systems
B-9.01.02L	demonstrate knowledge of the procedures used to repair diesel fuel delivery and injection systems	identify methods to test fuel quality and describe their associated procedures
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to repair diesel fuel delivery and injection systems
		describe the procedures used to remove and reinstall diesel fuel delivery and injection system components
		describe procedures used to verify repair

RANGE OF VARIABLES

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

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

starting aids include: glow plugs, intake heaters, timers

related systems include: intake/exhaust, emission control

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

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

B-9.02 Repairs diesel intake/exhaust systems

Essential Skills Document Use, Thinking, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
B-9.02.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
B-9.02.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' specifications
B-9.02.03P	remove and replace diesel intake/exhaust system components	diesel intake/exhaust system components are removed and replaced
B-9.02.04P	prime, lubricate and service turbocharger systems	turbocharger systems are primed, lubricated and serviced
B-9.02.05P	maintain diesel intake/exhaust system	diesel intake/exhaust system is maintained by cleaning passages, replacing air filters and servicing waste gate
B-9.02.06P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

diesel intake/exhaust system components include: manifolds, mufflers, intercoolers, turbochargers

KNOWLEDGE

Learning Outcomes	Learning Objectives	
B-9.02.01L	demonstrate knowledge of diesel intake and exhaust systems , their components and operation	identify the types of diesel intake systems and describe their components and operation
		identify the types of diesel exhaust systems and describe their components and operation
		identify types and sources of diesel intake and exhaust system problems
		identify the types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		identify types of repair tools and equipment and describe their applications and procedures for use
B-9.02.02L	demonstrate knowledge of the procedures used to repair diesel intake and exhaust systems	describe the procedures used to repair diesel intake and exhaust systems
		describe the procedures used to remove and reinstall diesel intake and exhaust system components
		describe the procedures used to adjust, repair and/or replace diesel intake and exhaust system components
		describe the procedures used to perform decarbonization of turbocharger systems
		describe procedures used to verify repair

RANGE OF VARIABLES

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

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

Document Use, Digital Technology, Thinking

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

SKILLS

	Performance Criteria	Evidence of Attainment
B-9.03.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
B-9.03.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
B-9.03.03P	remove and replace diesel emission control system components	diesel emission control system components are removed and replaced according to manufacturers' information
B-9.03.04P	maintain diesel emission control systems	diesel emission control systems are maintained by cleaning the EGR system and restricted passages, replacing filters and performing regeneration procedures
B-9.03.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices

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

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-9.03.01L	demonstrate knowledge of diesel emission control systems , their components and operation	identify the types of diesel emissions and how they are formed
		identify diesel emission control systems and describe their components and operation
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications

		identify types of repair tools and equipment and describe their applications and procedures for use
B-9.03.02L	demonstrate knowledge of the procedures used to repair diesel emission control systems	describe the procedures used to repair diesel emission control systems
		describe the procedures used to remove and reinstall diesel emission control system components
		describe the procedures used to service, repair and/or replace diesel emission control system components
		describe procedures used to verify repair

RANGE OF VARIABLES

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

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

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

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

MAJOR WORK ACTIVITY C

Diagnoses and repairs vehicle module communications systems

TASK C-10 Diagnoses vehicle networking systems

TASK DESCRIPTOR

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

C-10.01 Reads diagnostic trouble codes (DTCs)

Essential Skills Document Use, Digital Technology, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	distinguish diagnostic systems	diagnostic systems are distinguished 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 read DTCs from modules
C-10.01.04P	scan all modules	all modules are scanned for related DTCs and latest software
C-10.01.05P	perform functional tests	functional tests are performed to find active DTCs, readiness, freeze frame data, and stored and pending DTCs
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)

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-10.01.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships
		identify types of diagnostic tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use

RANGE OF VARIABLES

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

networking of modules and multiplexing include: wiring designs, wireless

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

C-10.02 Monitors data

Essential Skills Digital Technology, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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' information
C-10.02.04P	record data	data is recorded to aid with diagnosis

RANGE OF VARIABLES

data includes: inputs and outputs

KNOWLEDGE

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

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

data includes: inputs and outputs

C-10.03 Interprets test results

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	compare test values	test values are compared to manufacturers' information

C-10.03.03P	determine faulty circuitry and components	faulty circuitry and components are determined by analyzing test results
C-10.03.04P	refer to recorded data	recorded data is referenced to assist in diagnosis

KNOWLEDGE

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

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

C-10.04 Tests system circuitry and components

Essential Skills Thinking, Digital Technology, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used to test system circuitry and components according to manufacturers' information
C-10.04.03P	determine faulty system circuitry and components	faulty system circuitry and components are determined according to test results

RANGE OF VARIABLES

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

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

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-10.04.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret DTC
		identify the parameters of inputs and outputs and describe their relationships
C-10.04.02L	demonstrate knowledge of the procedures used to diagnose vehicle networking system components	identify types of diagnostic tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use
		describe the procedures used to diagnose vehicle networking systems
C-10.04.03L	demonstrate knowledge of circuits, their components and operation	describe the application of Ohm's law to electrical circuits
		interpret diagnostic flowcharts and schematics
		identify types of wire and describe their characteristics, composition and applications
C-10.04.04L	demonstrate knowledge of the procedures used to diagnose circuits and components	describe the procedures used to diagnose circuits and components

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

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

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

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

TASK C-11 Repairs vehicle networking systems

TASK DESCRIPTOR

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

C-11.01 Updates component software

Essential Skills Digital Technology, Document Use, Thinking

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

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.01.01P	verify manufacturers' information	latest software update is verified through manufacturers' information
C-11.01.02P	select and use Society of Automotive Engineers (SAE) J2534 compliant tools	SAE J2534 compliant tools are selected and used to update module software
C-11.01.03P	program modules	modules are programmed using updated manufacturers' documentation and service bulletins, 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' information

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.01.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of network protocols and describe their purpose
		describe the networking of modules and multiplexing
		identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships

		identify types of repair tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use
C-11.01.02L	demonstrate knowledge of the procedures used to repair vehicle networking system components	describe the procedures used to repair vehicle networking systems
C-11.01.03L	demonstrate knowledge of reprogramming software	identify methods used to access/transfer and reprogram software and describe their associated procedures

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

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

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

C-11.02 Replaces components

Essential Skills Digital Technology, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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' 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 the 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: hand tools, air tools, scan tools and specialized tools (DMM, oscilloscopes, probes, break out boxes, J2534 compliant tools)

vehicle-specific cautionary procedures include: using anti-static straps and disabling restraint systems

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

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

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

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

C-11.03**Verifies vehicle module communications system repair****Essential Skills**

Digital Technology, Thinking, Document Use

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

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.03.01P	select and use diagnostic tools	diagnostic tools are selected and used to verify and confirm system repair
C-11.03.02P	perform verification test	verification test is performed to confirm system repair

RANGE OF VARIABLES

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

KNOWLEDGE

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

RANGE OF VARIABLES

network protocols include: ISO, CAN, LIN, speed

networking of modules and multiplexing include: wiring designs, wireless

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

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

MAJOR WORK ACTIVITY D

Diagnoses and repairs driveline systems

TASK D-12 Diagnoses driveline systems

TASK DESCRIPTOR

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

D-12.01 Diagnoses drive shafts and axles

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
D-12.01.04P	identify type of drive shaft and axle system	type of drive shaft and axle system is identified
D-12.01.05P	inspect vehicle's drive shaft, axle components and tire circumference tolerances	vehicle's drive shaft, axle components and tire circumference tolerances are inspected according to manufacturers' information
D-12.01.06P	perform functional tests	functional tests are performed according to manufacturers' information
D-12.01.07P	interpret and analyze results of functional tests and inspections	results of functional tests and inspections are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

drive shaft and axle concerns include: vibrations, noises

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

drive shaft and axle systems include: single or multiple piece drive shaft, CV, full-floating, semi-floating axles, four wheel drive axle engagement mechanisms

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 and operation	identify types of drive shafts and describe their composition
		identify safety considerations pertaining to drive shafts and axles
		identify types of drive shaft components and describe their purpose and operation
		identify types of axles and describe their components and operation
		describe axle disconnects, locking hubs and their purpose
		describe the importance of multiple piece drive shaft phasing, indexing and angles
D-12.01.02L	demonstrate knowledge of the procedures used to diagnose drive shafts and axles	identify diagnostic tools and equipment and describe their applications and procedures for use
		describe the procedures used to diagnose drive shafts and axle systems

RANGE OF VARIABLES

types of drive shafts include: 1 piece, 2 piece

composition includes: steel, aluminum

safety considerations include: exposed rotating parts, pinch points

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

axles include: half shafts, floating, semi-floating

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

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

D-12.02 Diagnoses manual transmissions/transaxles

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 to identify manual transmission/transaxle concerns	road test are performed to identify manual transmission/transaxle concerns
D-12.02.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
D-12.02.04P	identify model of manual transmission/transaxle	model of manual transmission/transaxle is identified
D-12.02.05P	check fluid level and condition, inspect for leaks or damage	fluid level and conditions are checked, inspected for leaks or damage
D-12.02.06P	inspect manual transmission/transaxle components and controls	manual transmission/transaxle components and controls are inspected according to manufacturers' information
D-12.02.07P	inspect and test electrical components	electrical components are inspected and tested
D-12.02.08P	interpret and analyze results of tests and inspections	results of tests and inspections are interpreted and analyzed to determine required repair
D-12.02.09P	inspect engine and driveline mounts	engine and driveline mounts are inspected for wear and damage

RANGE OF VARIABLES

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

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-12.02.01L	demonstrate knowledge of manual transmissions/transaxles, their components and operation	identify types of manual transmissions/transaxles and describe their components and operation
		identify safety considerations pertaining to manual transmissions/transaxles

		explain manual transmissions/transaxles power flow
		describe gear ratios, their purpose and calculation
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify types of engine and driveline mounts, their construction and application
D-12.02.02L	demonstrate knowledge of the procedures used to diagnose manual transmissions/transaxles	describe the procedures used to diagnose manual transmissions/transaxles

RANGE OF VARIABLES

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

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

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

D-12.03 Diagnoses automatic transmissions/transaxles

Essential Skills

Digital Technology, Reading, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 to identify automatic transmission/transaxle concerns	road test is performed to identify automatic transmission/transaxle concerns
D-12.03.03P	identify model and type of automatic transmission/transaxle	model and type of automatic transmission/transaxle is identified
D-12.03.04P	check fluid level and condition and visually inspect automatic transmission/transaxle	fluid level and condition are checked and inspected for leaks or damage
D-12.03.05P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information

D-12.03.06P	inspect automatic transmission/transaxle components and controls	automatic transmission/transaxle components and controls are inspected according to manufacturers' information
D-12.03.07P	perform functional tests	functional tests are performed according to manufacturers' information
D-12.03.08P	inspect and test electrical components	electrical components are inspected and tested
D-12.03.09P	interpret and analyze results of tests and inspections	results of tests and inspections are interpreted and analyzed to determine required repair
D-12.03.10P	inspect engine and driveline mounts	engine and driveline mounts are inspected for wear and damage

RANGE OF VARIABLES

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

automatic transmissions and transaxles include: electrically controlled, hydraulically controlled

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

electrical components include: solenoids, switches, sensors

KNOWLEDGE

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

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

RANGE OF VARIABLES

automatic transmissions and transaxles include: electrically controlled, hydraulically controlled

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

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

hydraulic principles include: Pascal's law, fluid dynamics

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

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

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

D-12.04 Diagnoses clutches

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 to identify clutch concerns	road test is performed to identify clutch concerns
D-12.04.03P	identify type of clutch control	type of clutch control is identified
D-12.04.04P	check fluid level and condition and inspect for leaks	fluid level and condition are checked and inspected for leaks
D-12.04.05P	inspect clutch components	clutch components are inspected according to manufacturers' information
D-12.04.06P	interpret and analyze results of tests and inspections	results of tests and inspections are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

clutch control includes: mechanical, hydraulic, electric

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
12.04.01L	demonstrate knowledge of clutches, their components and operation	identify types of clutches and describe their components and operation
		identify safety considerations pertaining to clutch systems
		identify mechanical and hydraulic clutch actuating systems and describe their components and operation
		identify types of fluids, fasteners, tubing, hoses and seals and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		describe clutch system power flow
		identify related systems and describe their relationship to clutch systems
12.04.02L	demonstrate knowledge of the procedures used to diagnose clutches	describe the procedures used to diagnose clutches

RANGE OF VARIABLES

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

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

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

D-12.05 Diagnoses transfer cases

Essential Skills Digital Technology, Reading, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	identify model and type of transfer case	model and type of transfer cases are identified
D-12.05.04P	identify types of AWD (all-wheel drive) systems	types of AWD systems are identified
D-12.05.05P	check fluid	fluid is checked for leaks, levels, condition and contamination
D-12.05.06P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
D-12.05.07P	inspect transfer case, components and controls	transfer case, components and controls are inspected according to manufacturers' information
D-12.05.08P	inspect AWD components and controls	AWD components and controls are inspected according to manufacturers' information
D-12.05.09P	perform functional tests	functional tests are performed according to manufacturers' information
D-12.05.10P	interpret and analyze results of tests and inspections	results of tests and inspections are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

model and type of transfer case includes: part-time, full-time, automatic, AWD

diagnostic tools and equipment include: hand tools, scan tools

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-12.05.01L	demonstrate knowledge of transfer cases, their components and operation	identify types of transfer cases and describe their components and operation
		identify types of AWD systems, their components and operation
		identify safety considerations pertaining to transfer cases
		identify related systems and describe their relationship to transfer cases
		identify types of control systems and describe their components and operation
		describe transfer case power flow
		describe gear ratios, their purpose and calculations
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
D-12.05.02L	demonstrate knowledge of the procedures used to diagnose	describe the procedures used to diagnose

RANGE OF VARIABLES

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

related systems include: transmissions, drivelines, mounts

control systems include: vacuum, mechanical, electronic

diagnostic tools and equipment include: scan tools, hand tools

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

D-12.06 Diagnoses final drive assemblies

Essential Skills Digital Technology, Reading, Thinking

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

SKILLS

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

RANGE OF VARIABLES

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

model and type of final drive assembly include: all-wheel drive, integral, removable, locking, limited slip, torque distribution

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

KNOWLEDGE

	<i>Learning Outcomes</i>	<i>Learning Objectives</i>
D-12.06.01L	demonstrate knowledge of final drive assemblies, their components and applications	identify final drive assembly components and their application
		identify safety considerations pertaining to final drive assembly
		identify diagnostic tools and equipment pertaining to final drive assembly

		identify related systems and describe their relationship to final drive assembly
		describe final drive assembly power flow
D-12.06.02L	demonstrate knowledge of procedures to diagnose final drive assembly	describe procedures used to diagnose final drive assembly
		identify tests used to diagnose final drive assembly

RANGE OF VARIABLES

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

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

related systems include: transmissions, drivelines, mounts

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

TASK D-13 Repairs driveline systems

TASK DESCRIPTOR

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

D-13.01 Repairs drive shafts and axles

Essential Skills Thinking, Document Use, Numeracy

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

SKILLS

	Performance Criteria	Evidence of Attainment
D-13.01.01P	determine type of drive shafts and axle systems	identify type of drive shafts and axle systems
D-13.01.02P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
D-13.01.03P	select repair materials	repair materials are selected according to repair requirements
D-13.01.04P	remove, replace, recondition or service drive shaft components	drive shaft components are removed, replaced, reconditioned or serviced according to manufacturers' information

D-13.01.05P	verify repair	repair is verified by system re-test and road test
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RANGE OF VARIABLES

drive shafts and axle systems include: U-joint, CV joint, full-floating and semi-floating axle engagement mechanisms

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

repair materials include: gaskets, seals, lubricants

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.01.01L	demonstrate knowledge of drive shafts and axles, their components and operation	identify types of drive shafts and describe their composition
		identify safety considerations pertaining to drive shafts and axles
		identify types of drive shaft components and describe their purpose and operation
		identify types of axles and describe their components and operation
		describe axle disconnects, locking hubs and their purpose
		describe the importance of multiple piece drive shaft phasing, indexing and driveline angles
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
D-13.01.02L	demonstrate knowledge of the procedures used to repair drive shafts and axles	identify repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to adjust, repair and/or replace drive shafts and axles and their related components
		describe procedures used to verify repair

RANGE OF VARIABLES

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

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

axles include: half shafts, floating, semi-floating

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

D-13.02 Repairs manual transmissions/transaxles

Essential Skills Thinking, Document Use, Numeracy

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

SKILLS

	Performance Criteria	Evidence of Attainment
D-13.02.01P	determine model of manual transmission/transaxles	model of manual transmission/transaxles is determined
D-13.02.02P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
D-13.02.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' 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' information
D-13.02.05P	remove and replace mounts	mounts are removed and replaced using adjustable engine support tools
D-13.02.06P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

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 and operation	identify types of manual transmissions and transaxles and describe their components and operation
		identify safety considerations pertaining to manual transmissions/transaxles
		describe manual transmission and transaxle power flow
		describe gear ratios, their purpose and perform calculations
		identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications

D-13.02.02L	demonstrate knowledge of the procedures used to repair manual transmissions and transaxles	identify types of repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to remove and reinstall manual transmissions and transaxles
		describe the procedures used to adjust, repair and/or replace manual transmissions and transaxles and their related components
		describe the procedures used to replace engine and driveline mounts
		describe procedures used to verify repair

RANGE OF VARIABLES

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

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

D-13.03 Repairs automatic transmissions/transaxles

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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/transaxle	model and type of automatic transmission/transaxle are identified according to manufacturers' information
D-13.03.02P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
D-13.03.03P	select repair materials	repair materials are selected according to requirements and manufacturers' 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' information
D-13.03.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

automatic transmissions and transaxles include: electrically controlled and hydraulically controlled

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

repair materials include: gaskets, seals, lubricants, sealants

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

RANGE OF VARIABLES

automatic transmissions and transaxles include: electrically controlled and hydraulically controlled

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

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

hydraulic principles include: Pascal's law, fluid dynamics

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

D-13.04 Repairs clutches

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
D-13.04.03P	select repair materials	repair materials are selected according to requirements and manufacturers' information
D-13.04.04P	remove, replace, recondition or service components	components are removed, replaced, reconditioned or serviced according to manufacturers' information
D-13.04.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

clutches include: single and multi-disc systems

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

repair materials include: fluids, seals, lubricants, sealants

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.04.01L	demonstrate knowledge of clutches , their components and operation	identify types of clutches and describe their components and operation
		identify safety considerations pertaining to clutch systems

		identify types of flywheels and describe their components and operation
		identify mechanical and hydraulic clutch actuating systems and describe their components and operation
		identify types of fluids, fasteners, tubing, hoses and seals, and describe their applications
D-13.04.02L	demonstrate knowledge of the procedures used to repair clutches	identify types of repair tools and equipment and describe their applications and procedures for use
		describe the procedures used to remove and reinstall clutches
		describe the procedures used to adjust, repair and/or replace clutches and flywheels and their related components
		describe procedures used to verify repair

RANGE OF VARIABLES

clutches include: single and multi-disc systems

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

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

D-13.05 Repairs transfer cases

Essential Skills Digital Technology, Reading, Thinking

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

SKILLS

	Performance Criteria	Evidence of Attainment
D-13.05.01P	determine model and type of transfer case	model and type of transfer case are determined
D-13.05.02P	determine type of AWD (all-wheel drive) system	type of AWD system is identified
D-13.05.03P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
D-13.05.04P	select repair materials	repair materials are selected according to requirements and manufacturers' 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' information
D-13.05.06P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

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

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

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

related systems include: transmissions, drivelines, mounts

control systems include: vacuum, mechanical, electronic

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

D-13.06 Repairs final drive assemblies

Essential Skills Numeracy, Reading, Thinking

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

SKILLS

	Performance Criteria	Evidence of Attainment
D-13.06.01P	determine model and type of final drive assemblies	model and type of final drive assemblies are determined
D-13.06.02P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
D-13.06.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
D-13.06.04P	remove, replace, recondition or service components	components are removed, replaced, reconditioned or serviced according to manufacturers' information
D-13.06.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

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

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

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

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

MAJOR WORK ACTIVITY E

Diagnoses and repairs electrical and comfort control systems

TASK E-14 Diagnoses electrical systems and components

TASK DESCRIPTOR

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

E-14.01 Diagnoses basic wiring and electrical systems

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	identify electrical circuit operation and measurements	electrical circuit operation and measurements are identified prior to testing
E-14.01.03P	inspect components and wires	components and wires are inspected for signs of wear, damage or failure
E-14.01.04P	inspect connectors and connections	connectors and connections are inspected for conditions
E-14.01.05P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
E-14.01.06P	perform tests	tests are performed to pinpoint failure
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 the structure of circuits
E-14.01.09P	interpret and analyze test and inspection results	test and inspection results are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

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

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

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

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

RANGE OF VARIABLES

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

basic computer operation includes: inputs and outputs

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

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

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

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

E-14.02 Diagnoses starting/charging systems and batteries

Essential Skills Thinking, Numeracy, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	inspect components	components are inspected for signs of wear, damage or failure
E-14.02.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
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 starting/charging system and battery tests	starting/charging system and battery tests are performed according to manufacturers' information
E-14.02.06P	interpret wiring diagrams	wiring diagrams are interpreted to determine the structure of circuits
E-14.02.07P	interpret and analyze results of tests and inspections	results of tests and inspections are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

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

starting/charging system and battery tests include: AVR, voltage drop and parasitic draw

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

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

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

warning indicators include: IPC, DIC

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

E-14.03 Diagnoses lighting and wiper systems

Essential Skills Thinking, Numeracy, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	inspect components	components are inspected for signs of wear, damage or failure

E-14.03.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
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 the structure of circuits
E-14.03.06P	perform tests	tests are performed to pinpoint failure
E-14.03.07P	interpret and analyze test and inspection results	test and inspection results are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

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

tests include: functional output, voltage drop, resistance check

KNOWLEDGE

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

RANGE OF VARIABLES

lighting and wiper systems include: electrically controlled, electronically controlled

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

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

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

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

E-14.04 Diagnoses entertainment systems

Essential Skills

Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	perform inspection of components and wires	inspection of components and wires is performed for signs of wear, damage or failure
E-14.04.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
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 the 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	determine and perform tests	tests are determined and performed to pinpoint failure
E-14.04.08P	interpret and analyze test and inspection results	test and inspection results are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

tests include: voltage drop, resistance check, continuity, data

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-14.04.01L	demonstrate knowledge of entertainment systems , their components and operation	identify safety considerations pertaining to entertainment systems
		identify types of entertainment systems and describe their components and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use

		identify the relationship of the entertainment system to the vehicle networking system
E-14.04.02L	demonstrate knowledge of the procedures used to diagnose entertainment systems	describe the procedures used to diagnose entertainment systems

RANGE OF VARIABLES

safety considerations include: accidental restraint system deployment

entertainment systems include: audio, video, wireless/handsfree

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

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

E-14.05 Diagnoses electrical options

Essential Skills Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	perform inspection of components	inspection of components is performed for signs of wear, damage or failure
E-14.05.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
E-14.05.04P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
E-14.05.05P	interpret wiring diagrams	wiring diagrams are interpreted to determine the structure of circuits
E-14.05.06P	perform tests	tests are performed to pinpoint failure
E-14.05.07P	interpret and analyze tests and inspection results	tests and inspection results are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

tests include: functional output, voltage drop, continuity and resistance checks

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

RANGE OF VARIABLES

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

basic computer operation includes: inputs, outputs

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

safety considerations include: accidental restraint system deployment

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

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

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

E-14.06**Diagnoses instrumentation and information displays****Essential Skills**

Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	inspect components	components are inspected for signs of wear, damage or failure
E-14.06.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
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 to pinpoint failure
E-14.06.06P	interpret wiring diagrams	wiring diagrams are interpreted to determine the structure of circuits
E-14.06.07P	verify all vehicle warning indicators	all vehicle warning indicators are verified to ensure that they are functioning as intended (self-test and bulb check)
E-14.06.08P	verify the 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	interpret and analyze test and inspection results	test and inspection results are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

tests include: functional output, voltage drop, resistance check, continuity

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

KNOWLEDGE

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

RANGE OF VARIABLES

safety considerations include: accidental restraint system deployment

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

instrumentation systems include: gauges, warning indicators

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

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

E-14.07 Diagnoses electrical accessories

Essential Skills

Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	no	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	identify presence of aftermarket devices	presence of aftermarket devices is identified and correct operation is ensured
E-14.07.03P	perform inspection of components	inspection of components is performed for signs of wear, damage or failure
E-14.07.04P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
E-14.07.05P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
E-14.07.06P	interpret wiring diagrams	wiring diagrams are interpreted to determine the structure of circuits
E-14.07.07P	perform tests	tests are performed to pinpoint failure
E-14.07.08P	interpret and analyze tests and inspections results	tests and inspections results are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

diagnostic tools and equipment include: DMMs, circuit testers

tests include: functional output, continuity, voltage drop and resistance check

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-14.07.01L	demonstrate knowledge of electrical accessories , their components and operation	identify safety considerations pertaining to electrical accessories
		identify types of electrical accessories and describe their components and operation
		identify types of diagnostic tools and equipment and describe their applications and procedures for use

		describe relationship of electrical accessories to the vehicle networking system
E-14.07.02L	demonstrate knowledge of the procedures used to diagnose electrical accessories	describe the procedures used to diagnose electrical accessories

RANGE OF VARIABLES

safety considerations include: accidental restraint system deployment

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

diagnostic tools and equipment include: DMMs, circuit testers

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

TASK E-15 Repairs electrical systems and components

TASK DESCRIPTOR

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

E-15.01 Repairs basic wiring and electrical systems

Essential Skills Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 repair tools and equipment	repair tools and equipment are selected and used according to application
E-15.01.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
E-15.01.04P	replace or repair components	components are replaced or repaired according to manufacturers' 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

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

materials include: terminals, insulators, fastening devices

methods include: splicing, terminal replacement, soldering, crimping

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
E-15.01.01L	demonstrate knowledge of basic electrical and electronic principles	explain basic electrical theory
		explain basic computer operation
		identify types of electrical components and describe their purpose and operation
E-15.01.02L	demonstrate knowledge of electrical circuits , their components and operation	describe the application of Ohm's law to electrical circuits
		identify types of wire and describe their characteristics, composition and applications
E-15.01.03L	demonstrate knowledge of the procedures used to repair electrical circuits and components	interpret diagnostic flowcharts and schematics
		identify types of repair tools and equipment used to repair electrical circuits and components and describe their applications and procedures for use
		identify methods of wire repair and describe their associated procedures
		describe the procedures used to repair and/or replace electrical circuits and components
		describe procedures used to verify repair

RANGE OF VARIABLES

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

basic computer operation includes: inputs and outputs

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

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

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

methods include: splicing, terminal replacement, soldering, crimping

E-15.02 Repairs starting/charging systems and batteries

Essential Skills

Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-15.02.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-15.02.02P	identify and select repair components	repair components are identified and selected according to repair requirements and manufacturers' information
E-15.02.03P	replace or repair components	components are replaced or repaired according to manufacturers' information
E-15.02.04P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

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

E-15.03 Repairs lighting and wiper systems

Essential Skills Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-15.03.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-15.03.02P	select repair materials	materials are selected according to repair requirements and manufacturers' information
E-15.03.03P	adjust and replace or repair lighting and wiper components	lighting and wiper components are adjusted and replaced or repaired according to manufacturers' information
E-15.03.04P	adjust and aim headlights	headlights are adjusted and aimed according to manufacturers' information
E-15.03.05P	clear DTCs, program and reset adaptation settings	DTCs are cleared and adaptation settings are programmed and reset according to manufacturers' information
E-15.03.06P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

lighting components include: light bulbs, switches, modules

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-15.03.01L	demonstrate knowledge of lighting and wiper systems , their components and operation	identify safety considerations pertaining to lighting and wiper systems
		identify jurisdictional requirements pertaining to lighting and wiper systems

		identify types of lighting and wiper systems and describe their components and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe relationship of lighting and wiper systems to the vehicle networking system
E-15.03.02L	demonstrate knowledge of the procedures to repair lighting and wiper systems	describe the procedures used to adjust, repair and/or replace lighting and wiper system components
		describe procedures used to verify repair

RANGE OF VARIABLES

safety considerations include: HID, pinch points, lamps

lighting and wiper systems include: electrically controlled, electronically controlled

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

lighting components include: light bulbs, switches, modules

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

E-15.04 Repairs entertainment systems

Essential Skills Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-15.04.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-15.04.02P	replace or repair components	components are replaced or repaired according to manufacturers' information
E-15.04.03P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

KNOWLEDGE

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

RANGE OF VARIABLES

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

E-15.05 Repairs electrical options

Essential Skills Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-15.05.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-15.05.02P	replace, repair and program systems and components	systems and components are replaced, repaired and programmed according to manufacturers' information
E-15.05.03P	adjust systems and components	systems and components are adjusted according to manufacturers' information
E-15.05.04P	adjust and calibrate sensors	sensors are adjusted and calibrated according to manufacturers' information
E-15.05.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

repair tools and equipment include: scan tools, hand tools, air tools, reprogramming equipment, DMMs
systems and components include: adaptive cruise module, assisted driving system, collision avoidance system, sunroof, power mirrors, power windows, power seats, heated mirrors, heated/cooled seats
sensors include: collision avoidance sensors, parking aids, back-up cameras

KNOWLEDGE

Learning Outcomes	Learning Objectives	
E-15.05.01L	demonstrate knowledge of basic electrical and electronic principles	explain basic electrical theory
		explain basic computer operation
		describe the application of Ohm's law to electrical circuits
E-15.05.02L	demonstrate knowledge of circuits, their components and operation	interpret diagnostic flowcharts and schematics
		identify types of wire and describe their characteristics, composition and applications
		identify safety considerations pertaining to electrical accessories
		identify types of electrical accessories and describe their components and operation
		identify types of repair tools and equipment used to test electrical options and describe their applications and procedures for use
	describe relationship of electrical accessories to the vehicle networking system	
E-15.05.03L	demonstrate knowledge of the procedures used to repair electrical accessories	describe the procedures used to adjust, calibrate, repair and/or replace electrical accessories
		describe procedures used to verify repair

RANGE OF VARIABLES

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

basic computer operation includes: inputs, outputs

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

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

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

E-15.06**Repairs instrumentation and information displays****Essential Skills**

Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-15.06.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-15.06.02P	replace, calibrate and program components	components are replaced, calibrated and programmed according to manufacturers' information
E-15.06.03P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-15.06.01L	demonstrate knowledge of instrumentation and information displays, their components and operation	identify safety considerations pertaining to instrumentation and information displays
		identify jurisdictional requirements pertaining to instrumentation and information displays
		identify types of instrumentation systems and describe their components and operation
		identify types of information displays and describe their purpose and operation
		identify types of repair tools and equipment and describe their applications and procedures for use
		describe relationship of instrumentation and information displays to the vehicle networking system
E-15.06.02L	demonstrate knowledge of the procedures used to repair instrumentation and information displays	describe the procedures used to adjust, calibrate, repair and/or replace instrumentation and information displays
		describe procedures used to verify repair

RANGE OF VARIABLES

safety considerations include: accidental deployment of restraint systems

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

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

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

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

E-15.07 Installs electrical accessories

Essential Skills

Thinking, Document Use, Digital Technology

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

SKILLS

Performance Criteria

Evidence of Attainment

E-15.07.01P	determine compatibility of components	compatibility of components with vehicle is determined according to manufacturers' information
E-15.07.02P	select materials	materials are selected according to installation requirements and manufacturers' information
E-15.07.03P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-15.07.04P	reconfigure vehicle control modules	vehicle control modules are reconfigured to allow operation of accessories
E-15.07.05P	verify installation	installation is verified by system re-test and road test

RANGE OF VARIABLES

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

KNOWLEDGE

Learning Outcomes

Learning Objectives

E-15.07.01L	demonstrate knowledge of electrical accessories , their components and operation	identify safety considerations pertaining to electrical accessories
		identify types of electrical accessories and describe their components and operation

		identify types of repair tools and equipment and describe their applications and procedures for use
		describe relationship of electrical accessories to the vehicle networking system
E-15.07.02L	demonstrate knowledge of the procedures used to install electrical accessories	describe the procedures used to install electrical accessories
		describe procedures used to verify installation

RANGE OF VARIABLES

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

safety considerations include: accidental deployment of restraint systems

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

E-15.08 Repairs electrical accessories

Essential Skills Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-15.08.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-15.08.02P	replace, repair, calibrate or reprogram components	components are replaced, repaired, calibrated or reprogrammed according to manufacturers' information
E-15.08.03P	program modules	modules are programmed to vehicle's configuration
E-15.08.04P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

KNOWLEDGE

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

RANGE OF VARIABLES

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

safety considerations include: accidental deployment of restraint systems

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

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

TASK DESCRIPTOR

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

E-16.01 Diagnoses air flow control systems

Essential Skills Document Use, Thinking, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	perform sensory inspection of components	sensory inspection of components is performed to identify wear, damage, defects and foreign materials
E-16.01.03P	inspect air flow circulation	air flow circulation is inspected and problems are identified
E-16.01.04P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
E-16.01.05P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
E-16.01.06P	verify electronically-controlled system operation	electronically-controlled system is verified for operating conditions
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 the structure of the circuit
E-16.01.08P	perform tests	tests are performed to determine the cause of failure
E-16.01.09P	interpret and analyze test and inspection results	test and inspection results are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

problems include: partially open/closed doors, restricted cabin filters, foreign materials, debris

diagnostic tools and equipment include: DMMs, scan tools, circuit testers, vacuum pumps, inspection camera

operating conditions include: blown fuses, seized motors and actuators, broken wires, disconnected ductwork

tests include: functional output, voltage drop, vacuum tests, continuity and resistance check

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-16.01.01L	demonstrate knowledge of air flow control systems, their components and operation	identify air flow control systems, their components and operation
		identify safety considerations pertaining to air flow control systems
		identify types of specialized tools and equipment and describe their applications and procedures for use
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
E-16.01.02L	demonstrate knowledge of the procedures used to diagnose air flow control systems	describe the procedures used to diagnose air flow control systems

RANGE OF VARIABLES

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

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

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

E-16.02**Diagnoses refrigerant systems****Essential Skills**

Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	perform sensory inspection	components are inspected for wear, damage and defects
E-16.02.03P	identify compatibility of refrigerant	compatibility of refrigerant with systems and equipment is identified
E-16.02.04P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
E-16.02.05P	interpret pressure gauge readings, viewed values and DTCs	pressure gauge readings, viewed values and DTCs are interpreted 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 to pinpoint failure according to manufacturers' information
E-16.02.08P	interpret wiring diagrams	wiring diagrams are interpreted to determine structure of circuit
E-16.02.09P	verify operation conditions of electronically-controlled system	operation conditions of electronically-controlled system are verified
E-16.02.10P	interpret and analyze tests and inspection results	tests and inspection results are interpreted and analyzed to determine required repair

RANGE OF VARIABLES

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

tests include: voltage drop, resistance check, pressure test, vacuum test

jurisdictional requirements include: handling and disposal, storing and recycling, Heating, Refrigeration and Air conditioning Institute of Canada (HRAI) licensing and certification

operation conditions include: blown fuses, broken wires, low refrigerant (leak)

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

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

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

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

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

E-16.03**Diagnoses heating systems****Essential Skills**

Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	perform sensory inspection of components	components are inspected for wear, damage and defects
E-16.03.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to application
E-16.03.04P	perform diagnostic tests	diagnostic tests are performed according to manufacturers' information to identify faults
E-16.03.05P	identify faults in system	system faults are identified
E-16.03.06P	interpret and analyze results of tests	test results are interpreted and analyzed, defective components are identified and required repair is determined

RANGE OF VARIABLES

components include: cabin filters, blower motors, actuators, heater core, thermostats, fans, controls, sensors

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

diagnostic tests include: checking coolant level, pressure, circulation, temperature

faults in system include: leaks in cooling system, thermostat failure, air flow restrictions

results include: low coolant level, plugged heater core, insufficient air flow

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-16.03.01L	demonstrate knowledge of heating systems, their components and operation	identify types of heating systems and describe their components and operation
		identify safety considerations pertaining to heating systems
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications

		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify related systems and describe their relationship to heating systems
E-16.03.02L	demonstrate knowledge of the procedures used to diagnose heating systems	describe the procedures used to diagnose heating systems

RANGE OF VARIABLES

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

considerations include: airborne contaminants, mould spores, pinch points

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

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

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

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

TASK DESCRIPTOR

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

E-17.01 Repairs air flow control systems

Essential Skills Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-17.01.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-17.01.02P	select repair components and materials	repair components and materials are selected according to repair requirements and manufacturers' information

E-17.01.03P	follow repair sequence	repair sequence is followed according to manufacturers' information
E-17.01.04P	remove, repair and replace faulty components	faulty components are removed, repaired and replaced
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	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

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

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 and operation	identify air flow control systems, their components and operation
		identify safety considerations pertaining to air flow control systems
		identify types of repair tools and equipment and describe their applications and procedures for use
		identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
E-17.01.02L	demonstrate knowledge of the procedures used to repair air flow control systems	describe the procedures used to repair air flow control systems
		describe the 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

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

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

E-17.02 Repairs refrigerant systems

Essential Skills

Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-17.02.01P	select and use repair tools and equipment	repair tools and equipment are selected and used to evacuate and recharge system and to identify and recover types of refrigerant
E-17.02.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
E-17.02.03P	follow repair sequence	repair sequence is followed according to manufacturers' 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 jurisdictional regulations
E-17.02.05P	remove and replace faulty components	faulty components are removed and replaced according to manufacturers' information
E-17.02.06P	recharge system	system is recharged to recommended amounts and types of refrigerant oils and refrigerants according to manufacturers' information
E-17.02.07P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

materials include: gaskets, sealants, fastening devices

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-17.02.01L	demonstrate knowledge of refrigerant systems, their components and operation	identify safety considerations pertaining to refrigerant systems
		identify refrigerant systems, their components and operation

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

RANGE OF VARIABLES

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

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

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

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

E-17.03 Repairs heating systems

Essential Skills

Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
E-17.03.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to application
E-17.03.02P	select repair components	repair components are selected according to repair requirements and manufacturers' information
E-17.03.03P	follow repair sequence	repair sequence is followed according to manufacturers' information
E-17.03.04P	remove and replace faulty components	faulty components are removed and replaced
E-17.03.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

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

KNOWLEDGE

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

describe the procedures used to fill and bleed heating systems

describe procedures used to verify repair

RANGE OF VARIABLES

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

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

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

MAJOR WORK ACTIVITY F

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

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

TASK DESCRIPTOR

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

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

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

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

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

F-18.01 Diagnoses steering, suspension and control systems

Essential Skills Thinking, Reading, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' 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' information
F-18.01.05P	determine type of suspension system	type of suspension system is determined by visual inspection and manufacturers' 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' information
F-18.01.07P	inspect steering, suspension and control components	steering, suspension and control components are inspected according to manufacturers' information and inspection procedures
F-18.01.08P	perform tests	tests are performed according to manufacturers' information
F-18.01.09P	interpret and analyze results of tests and inspections	required repair is determined according to interpretation and analysis of results of tests and inspections

RANGE OF VARIABLES

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

concerns include: vibrations, noises, pulls, tire wear, misalignment

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

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

tests include: clearances, ride height, leaks

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-18.01.01L	demonstrate knowledge of suspension systems , their components and operation	identify types of suspension systems and describe their components and operation
		identify types of springs and describe their purpose and operation
		identify types of dampers and describe their components and operation
		describe suspension geometry
F-18.01.02L	demonstrate knowledge of the procedures used to diagnose suspension systems	describe the procedures used to diagnose suspension systems

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

RANGE OF VARIABLES

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

springs include: coil, leaf, torsion bar, air

dampers include: struts, shocks

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

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

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

steering columns include: tilt, telescopic

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

related systems include: lane departures, active park assist

steering assist systems include: electric, hydraulic, variable

power steering pumps include: hydraulic, gear, vane

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

F-18.02 Diagnoses braking and control systems

Essential Skills Document Use, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' 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' information
F-18.02.06P	identify ABS/TCS and stability control system components	ABS/TCS and stability control system components are identified and their operation is related to the vehicle and other systems

F-18.02.07P	perform tests	tests are performed according to manufacturers' information
F-18.02.08P	interpret and analyze results of tests and inspections	required repair is determined according to interpretation and analysis of results of tests and inspections

RANGE OF VARIABLES

braking concerns include: vibrations, noises, lack of brake assist, pulls, soft or low pedal

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

braking systems include: hydraulic, electric, park brake

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-18.02.01L	demonstrate knowledge of braking systems, their components and operation	identify safety considerations pertaining to braking systems
		explain hydraulic principles related to braking systems
		identify types of braking systems and describe their components and operation
		identify types of braking systems in hybrid and EVs
		identify types of power assists and describe their components and operation
		identify types of control systems and describe their components and operation
		identify types of brake fluids and describe their applications and procedures for use
		identify types of fittings, flaring, tubing and hoses and describe their applications and procedures for use
		identify types of diagnostic tools and equipment and describe their applications and procedures for use
		identify types of trailer brakes and controls and describe their components and operation
F-18.02.02L	demonstrate knowledge of the procedures used to diagnose braking systems	describe the procedures used to diagnose braking systems
F-18.02.03L	demonstrate knowledge of the procedures used to diagnose control systems	describe the procedures used to diagnose control systems

RANGE OF VARIABLES

safety considerations include: hydraulic pressure, airborne contaminants

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

power assists include: vacuum, hydraulic, electric

control systems include: TCS, ABS, stability control

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

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

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

Essential Skills Numeracy, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 to identify tire, wheel, hub and wheel bearing concerns	road test is performed and tire, wheel, hubs and wheel bearings concerns are identified
F-18.03.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' 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' information
F-18.03.07P	interpret and analyze results of tests and inspections	required repair is determined according to interpretation and analysis of results of tests and inspections

RANGE OF VARIABLES

concerns include: vibrations, noises (growl, rumble, whine), pulls, irregular wear, failure, age

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

tests include: wheel balance, runout, TPMS

KNOWLEDGE

Learning Outcomes	Learning Objectives
F-18.03.01L demonstrate knowledge of tires, wheels, hubs, bearings, their components and operation	identify safety considerations pertaining to tires, wheels, hubs and wheel bearings, their components and operation
	identify types of tires and describe their construction
	interpret tire codes and sidewall markings
	describe the importance of tire pressure and rotation
	identify types of wheels and describe their components and construction
	identify types of hubs and bearing assemblies and describe their components and operation
	identify types of tire pressure monitoring systems and describe their applications
	identify types of lubricants and describe their applications and procedures for use
	describe the relationship between the steering, suspension and wheel assemblies
	identify types of diagnostic tools and equipment and describe their applications and procedures for use
F-18.03.02L demonstrate knowledge of the procedures used to diagnose tires, wheels, bearings and hubs	describe the procedures used to diagnose tires, wheels, bearings and hubs

RANGE OF VARIABLES

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

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

types of wheels include: steel alloy

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

types of hubs include: pressed in, integral, tapered roller

types of tire pressure monitoring systems include: passive, active

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

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

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

TASK DESCRIPTOR

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

F-19.01 Repairs steering, suspension and control systems

Essential Skills Document Use, Numeracy, Thinking

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

SKILLS

	Performance Criteria	Evidence of Attainment
F-19.01.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to vehicle specifications and manufacturers' information
F-19.01.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
F-19.01.03P	remove, replace and service steering and suspension system components	steering and suspension system components are replaced or serviced according to manufacturers' 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' information and procedures
F-19.01.06P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

repair tools and equipment include: hand tools, air tools, scan tools, pullers, presses, reprogramming equipment, alignment machine

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

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

KNOWLEDGE

Learning Outcomes	Learning Objectives
F-19.01.01L demonstrate knowledge of suspension systems , their components and operation	identify types of suspension systems and describe their components and operation
	identify safety considerations pertaining to suspension systems
	identify types of springs and describe their purpose and operation
	identify types of dampers and describe their components and operation
F-19.01.02L demonstrate knowledge of the procedures used to repair suspension systems	describe the procedures used to repair suspension systems
	describe the procedures used to remove and reinstall suspension system components
	describe the procedures used to adjust, repair and/or replace suspension system components
F-19.01.03L demonstrate knowledge of the procedures used to repair steering systems	describe the procedures used to remove and reinstall steering system components
	describe the procedures used to adjust, repair and/or replace steering system components
	identify related systems and describe their relationship to steering systems
F-19.01.04L demonstrate knowledge of the procedures used to repair wheel alignment and electronically-controlled suspension systems	describe the procedures used to remove and reinstall electronically-controlled suspension systems components
	describe the procedures used to adjust, repair and/or replace electronically-controlled suspension systems components
	describe the procedures to perform wheel alignment
	describe the procedures to reset steering sensors
	describe procedures used to verify repair

RANGE OF VARIABLES

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

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

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

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

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

related systems include: lane departures, active park assist

F-19.02 Repairs braking and control systems

Essential Skills Numeracy, Document Use, Thinking

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

SKILLS

	Performance Criteria	Evidence of Attainment
F-19.02.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
F-19.02.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
F-19.02.03P	remove, replace or service components	components are removed, replaced or serviced according to manufacturers' information
F-19.02.04P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

materials include: gaskets, fastening devices, lubricants

KNOWLEDGE

Learning Outcomes	Learning Objectives
F-19.02.01L demonstrate knowledge of braking systems , their components and operation	explain hydraulic principles related to braking systems
	identify safety considerations pertaining to braking system repairs
	identify types of braking systems and describe their components and operation
	identify types of power assists and describe their components and operation
	identify types of control systems and describe their components and operation
	identify types of brake fluids and describe their applications and procedures for use
	identify types of fittings, flaring, tubing and hoses and describe their applications and procedures for use
	identify types of repair tools and equipment and describe their applications and procedures for use
	identify types of trailer brakes and controls and describe their components and operation
F-19.02.02L demonstrate knowledge of the procedures used to repair braking systems	identify types of braking systems in hybrid and EVs
	describe the procedures used to repair braking systems
	describe the procedures used to flush and bleed hydraulic and anti-lock brakes
	describe the procedures used to measure and machine components
	describe the procedures used to adjust, repair and replace braking system components
F-19.02.03L demonstrate knowledge of the procedures used to repair control systems	describe procedures used to verify repair
	describe procedures used to repair control systems

RANGE OF VARIABLES

braking systems include: hydraulic, electric, park brake

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

safety considerations include: hydraulic pressure, airborne contaminants

power assists include: vacuum, hydraulic, electric

control systems include: TCS, ABS, stability control

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

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

Essential Skills Document Use, Digital Technology, Thinking

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

SKILLS

	Performance Criteria	Evidence of Attainment
F-19.03.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
F-19.03.02P	perform manufacturer and jurisdiction-approved procedures	procedures are performed according to manufacturers' information and jurisdictional specifications
F-19.03.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
F-19.03.04P	mount tire on wheel and balance wheel assemblies	wheel assembly is balanced and tire pressure is set according to manufacturers' information
F-19.03.05P	reset, reprogram and calibrate tire pressure monitoring systems	tire pressure monitoring system is reset, reprogrammed and calibrated
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' information
F-19.03.07P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

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

materials include: gaskets, sealants, fastening devices, lubricants

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-19.03.01L	demonstrate knowledge of tires, wheels, hubs, wheel bearings, their components and operation	identify types of tires and describe their construction
		identify safety considerations pertaining to tires, wheels, hubs and wheel bearings repair
		interpret tire codes and sidewall markings
		describe the importance of tire rotation, balance and pressure
		identify types of wheels and describe their components and operation
		identify types of hubs and bearing assemblies and describe their components and operation
		identify types of tire pressure monitoring systems and describe their applications
		identify types of lubricants and describe their applications and procedures for use
		describe the relationship between the steering, suspension and wheel assemblies
		identify types of repair tools and equipment and describe their applications and procedures for use
F-19.03.02L	demonstrate knowledge of the procedures used to repair tires, wheels, hubs and wheel bearings	describe the procedures used to repair tires, wheels, hubs and wheel bearings
		describe the procedures used to remove and reinstall tires, wheels, hubs and wheel bearings
		describe the procedures used to repair and replace tires, wheels, hubs and wheel bearings
		describe procedures used to verify repair

RANGE OF VARIABLES

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

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

types of wheels include: steel alloy

types of tire pressure monitoring systems include: passive, active

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

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

MAJOR WORK ACTIVITY G

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

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

TASK DESCRIPTOR

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

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

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

G-20.01 Diagnoses restraint systems

Essential Skills Document Use, Thinking, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 systems	type of restraint systems are identified according to manufacturers' information
G-20.01.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
G-20.01.04P	identify restraint system components	restraint system components are identified according to manufacturers' information
G-20.01.05P	inspect restraint system components	restraint system 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 systems	restraint system monitoring and warning systems are inspected according to manufacturers' information
G-20.01.07P	identify restraint system DTCs	restraint system DTCs are identified according to manufacturers' information
G-20.01.08P	perform tests	tests are performed according to manufacturers' 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' information, and required repair is determined

RANGE OF VARIABLES

restraint systems include: active and passive

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

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
G-20.01.01L	demonstrate knowledge of restraint systems , their components and operation	identify types of restraint systems and describe their operation identify restraint system components and describe their purpose and operation identify jurisdictional requirements pertaining to restraint systems identify safety considerations related to restraint systems identify types of restraint system monitoring and warning systems and describe their purpose
G-20.01.02L	demonstrate knowledge of the procedures used to diagnose restraint systems	describe the procedures used to diagnose restraint systems identify types of diagnostic tools and equipment and describe their applications and procedures for use

RANGE OF VARIABLES

restraint systems include: active and passive

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

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

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

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

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

G-20.02 Diagnoses wind noises, rattles and water leaks

Essential Skills

Thinking, Document Use, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	perform tests to identify, verify and locate wind noises, rattles and water leaks	wind noises, rattles and water leaks are identified and located during tests
G-20.02.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
G-20.02.04P	perform sensory inspections to determine, isolate or locate wind noises, rattles or water leaks	wind noises, rattles or water leaks are identified
G-20.02.05P	inspect suspected area for apparent related damage	all related damage is identified
G-20.02.06P	perform tests	tests are performed to determine cause of wind noises, rattles and water leaks
G-20.02.07P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted and analyzed, and required repair is determined

RANGE OF VARIABLES

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

tests include: interior pressure test, water test, road test, visual inspection, mechanical inspections, drag test

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

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

Essential Skills Thinking, Document Use, Reading

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
G-20.03.03P	inspect interior and exterior components, accessories and trim for flaws	flaws are identified
G-20.03.04P	perform tests	tests are performed to determine the cause of the flaws of interior and exterior components, accessories and trim

G-20.03.05P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted and analyzed, and required repair is determined
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RANGE OF VARIABLES

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

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 and their applications	identify safety considerations related to interior and exterior components, accessories and trim
		identify interior and exterior components, accessories and trim and describe their purpose and operation
		identify flaws related to interior and exterior components, accessories and trim
G-20.03.02L	demonstrate knowledge of the procedures used to diagnose interior and exterior components, accessories and trim	describe the procedures used to diagnose interior and exterior components, accessories and trim
		identify diagnostic tools and equipment and describe their applications and procedures for use

RANGE OF VARIABLES

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

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

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

flaws include: fit, finish, form, function

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

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

G-20.04 Diagnoses latches, locks and movable glass

Essential Skills Thinking, Document Use, Reading

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	identify types of latches, locks, and movable glass	types of latches, locks and movable glass are identified according to manufacturers' information
G-20.04.03P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
G-20.04.04P	identify latches, locks and movable glass components	latches, locks and movable glass components are identified according to manufacturers' information
G-20.04.05P	inspect components of latches, locks and movable glass	components of latches, locks and movable glass are inspected for fit, function and proper operation
G-20.04.06P	inspect warning systems	warning systems are inspected according to manufacturers' information
G-20.04.07P	identify latches, locks and movable glass faults	latches, locks and movable glass faults are identified according to manufacturers' information
G-20.04.08P	perform mechanical tests	mechanical tests are performed according to manufacturers' information
G-20.04.09P	record, interpret and analyze results of tests and inspections	results of tests and inspections are recorded, interpreted, analyzed and compared to manufacturers' information, and required repair is determined

RANGE OF VARIABLES

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

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

warning systems include: chimes, bells, lights

KNOWLEDGE

	Learning Outcomes	Learning Objectives
G-20.04.01L	demonstrate knowledge of latches, locks and movable glass and their application	identify types of latches, locks and movable glass and their application distinguish between electrical and mechanical components identify safety considerations related to latches, locks and movable glass
G-20.04.02L	demonstrate knowledge of procedures used to diagnose latches, locks and movable glass	identify procedures used to diagnose latches, locks and movable glass identify diagnostic tools and equipment used to diagnose latches, locks and movable glass and describe their application and procedures for use

RANGE OF VARIABLES

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

safety considerations include: pinch points, handling of glass

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

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

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

TASK DESCRIPTOR

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

G-21.01 Repairs restraint systems

Essential Skills Document Use, Thinking, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
G-21.01.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' specifications
G-21.01.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
G-21.01.03P	remove, service and replace restraint system components	restraint system components are removed, serviced and replaced according to manufacturers' information
G-21.01.04P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

repair materials include: connectors, fasteners, shrink tubes, wire repair kits

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

KNOWLEDGE

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

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

RANGE OF VARIABLES

restraint systems include: active and passive

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

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

jurisdictional requirements include: disposal, repair, motor vehicle inspection

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

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

G-21.02 Repairs wind noises, rattles and water leaks

Essential Skills

Thinking, Document Use, Digital Technology

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

SKILLS

	Performance Criteria	Evidence of Attainment
G-21.02.01P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information
G-21.02.02P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
G-21.02.03P	remove, service, adjust and replace components	components are removed, serviced, adjusted and replaced according to manufacturers' information
G-21.02.04P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

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

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 the principles of basic aerodynamics related to body design
		identify types of repair materials and describe their applications and procedures for use
G-21.02.02L	demonstrate knowledge of the procedures used to repair wind noises, rattles and water leaks	identify types of body components and accessories
		describe the procedures used to repair wind noises, rattles and water leaks according to task being performed

identify **repair tools and equipment** and describe their applications and procedures for use to repair wind noises, rattles and water leaks

identify procedures used to verify repair

RANGE OF VARIABLES

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

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

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

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

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

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

Essential Skills

Thinking, Document Use, Reading

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

SKILLS

	Performance Criteria	Evidence of Attainment
G-21.03.01P	follow manufacturers' stated safety precautions and protocols	manufacturers' stated safety precautions and protocols are followed
G-21.03.02P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information and repair to be performed
G-21.03.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
G-21.03.04P	remove, service, adjust and replace components	components are removed, serviced, adjusted and replaced according to manufacturers' information
G-21.03.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

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

KNOWLEDGE

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

RANGE OF VARIABLES

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

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

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

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

G-21.04 Repairs latches, locks and movable glass

Essential Skills Thinking, Document Use, Reading

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

SKILLS

	Performance Criteria	Evidence of Attainment
G-21.04.01P	follow manufacturers' stated safety precautions and protocols	manufacturers' stated safety precautions and protocols are followed
G-21.04.02P	select and use repair tools and equipment	repair tools and equipment are selected and used according to manufacturers' information and repair to be performed

G-21.04.03P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information
G-21.04.04P	remove, service, adjust and replace components	components are removed, serviced, adjusted and replaced according to manufacturers' information
G-21.04.05P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

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

repair materials include: gaskets, sealants, fastening devices, lubricants

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

KNOWLEDGE

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

RANGE OF VARIABLES

safety considerations include: pinch points, handling of glass

warning systems include: chimes, bells, lights

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

MAJOR WORK ACTIVITY H

Diagnoses and repairs hybrid and electric vehicles (EV)

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

TASK DESCRIPTOR

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

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

Essential Skills Thinking, Document Use, Reading

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

SKILLS

	Performance Criteria	Evidence of Attainment
H-22.01.01P	select and use <i>PPE and safety equipment specific to hybrid and EV systems</i>	<i>PPE and safety equipment specific to hybrid and EV systems</i> is selected and used according to manufacturers' information
H-22.01.02P	select and use tools and equipment required to complete safety preparation	tools and equipment required to complete safety preparation are selected and used according to manufacturers' information
H-22.01.03P	recognize <i>safety hazards specific to working on hybrid vehicles and EVs</i>	<i>safety hazards specific to working on hybrid vehicles and EVs</i> are identified
H-22.01.04P	ensure that safety protocols have been implemented	safety protocols have been implemented according to manufacturers' information

RANGE OF VARIABLES

PPE and safety equipment specific to hybrid and EV systems include: insulated gloves, pylons, high voltage specific tools, safety hook

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

KNOWLEDGE

	Learning Outcomes	Learning Objectives
H-22.01.01L	demonstrate knowledge of safety protocols for hybrid and EV systems	identify safety protocols pertaining to hybrid and EV systems

RANGE OF VARIABLES

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

H-22.02

Diagnoses hybrid and electric vehicle (EV) systems

Essential Skills Thinking, Reading, Digital Technology

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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	identify type of hybrid and EV system	type of hybrid and EV system is identified
H-22.02.03P	inspect hybrid and EV system components	hybrid and EV system components are inspected for wear, damage and defects
H-22.02.04P	select and use diagnostic tools and equipment	diagnostic tools and equipment are selected and used according to manufacturers' information
H-22.02.05P	retrieve DTCs	DTCs are retrieved
H-22.02.06P	determine and perform tests	tests are determined and performed to pinpoint failure
H-22.02.07P	interpret viewed values and DTCs	viewed values and DTCs are interpreted to determine condition of systems and components
H-22.02.08P	interpret and analyze results of tests and inspections	results of tests and inspections are interpreted and analyzed to determine required repair
H-22.02.09P	isolate problem	problem is isolated according to manufacturers' information

RANGE OF VARIABLES

hybrid and EV system includes: series, parallel, combination, plug-in, extended range

hybrid and EV system components include: modules, inverters, high voltage batteries, drive motors

diagnostic tools and equipment include: scan tools, specialized DMMs, service information

tests include: active tests, voltage and amperage tests, resistance check, voltage isolation tests, live/dead/live test

KNOWLEDGE

	Learning Outcomes	Learning Objectives
H-22.02.01L	demonstrate knowledge of operations of hybrid and EV systems	identify the function of hybrid and EV systems
H-22.02.02L	demonstrate knowledge of diagnosing hybrid and EV systems	identify methods for diagnosing hybrid and EV systems

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

TASK DESCRIPTOR

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

H-23.01 Repairs hybrid vehicle systems

Essential Skills Thinking, Digital Technology, Reading

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 manufacturers' information
H-23.01.02P	deactivate electrical and engine operating system	electrical and engine operating system are deactivated according to manufacturers' information
H-23.01.03P	remove and inspect hybrid system components	hybrid system components are removed and inspected
H-23.01.04P	select repair materials	repair materials are selected according to repair requirements and manufacturers' information

H-23.01.05P	replace hybrid system components	hybrid system components are replaced according to manufacturers' information
H-23.01.06P	verify repair	repair is verified by system re-test and road test

RANGE OF VARIABLES

tools and equipment include: PPE, safety devices, specialized DMMs, scan tools, reprogramming equipment, hand tools

hybrid system components include: modules, inverters, high voltage batteries, drive motors

repair materials include: gaskets, sealants, lubricants

KNOWLEDGE

	Learning Outcomes	Learning Objectives
H-23.01.01L	demonstrates knowledge of repairing hybrid vehicle systems	identify methods for repair of hybrid vehicle systems

H-23.02 Repairs electric vehicle (EV) systems

Essential Skills Thinking, Digital Technology, Reading

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	yes	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 manufacturers' service information
H-23.02.02P	deactivate high voltage electrical system	high voltage electrical system is deactivated according to manufacturers' service information
H-23.02.03P	remove and inspect EV system components	EV system components are removed and inspected
H-23.02.04P	select repair materials	repair materials are selected according to manufacturers' service information
H-23.02.05P	replace EV system components	EV system components are replaced 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: PPE, safety devices, specialized DMMs, scan tools, reprogramming equipment, hand tools

EV system components include: modules, inverters, high-voltage batteries, drive motors

repair materials include: gaskets, sealants, lubricants

KNOWLEDGE

	Learning Outcomes	Learning Objectives
H-23.02.01L	demonstrates knowledge of repairing EV systems	identify methods for repairing EV systems

APPENDIX A

ACRONYMS

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

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

APPENDIX B

TOOLS AND EQUIPMENT

Standard Tool Kit

air die grinder
air hammer/chisel
air ratchet
antifreeze tester
axle boot clamp tools
battery post service and reshape tool
belt tension release tool
blow gun
bolt and nut extractor set (easy-outs)
brake service tools (adjusters, spring removal and installation tools, caliper tools)

caulking gun
compression testers

creeper
crowfoot wrenches

dial indicator set
drill and bits
drill gauge
feeler gauges – SAE and metric
fender covers
filter wrenches
flare nut wrenches – SAE and metric
flaring tool (SAE, metric and ISO)
flashlights
fuel injector noid lights
fuel/transmission/air conditioning line disconnect set
hacksaw
hammers – ball peen, dead blow, rubber mallet, softface
hex keys and sockets – SAE and metric
impact driver and bits
impact wrench and impact socket set – SAE and metric

inspection mirror
jumper lead
locking pliers
magnetic pick-up tool
mechanic's pick set
metal files
micrometer – SAE and metric
digital multimeter (DMM)
nut driver set – SAE and metric
pliers – slip joint, needle nose, multipurpose adjustable, side cutter, snap ring, inside pliers
pry bars
pullers – gear, pulley, battery terminal and steering wheel
punches and chisels
ratchet and sockets – SAE and metric, swivel, spark plug, extensions and adapters
refractometer
rivet gun
scraper (gasket and carbon)
screwdriver set
seal drivers and extractors
soldering tools
spark plug gapper
spark tester
standard test leads and probes
stethoscope
straight edge
stud extractor
tap and die set – SAE, metric and pipe thread
tape and ruler
terminal remover tools
test lamp

Standard Tool Kit (continued)

thermometer

thread files

timing light

tin snips – centre, left and right cut

tire pressure gauge

torque angle meter/indicator

torque limited sockets (torque sticks)

torque wrenches – various sizes and ranges

torx bits and sockets

tread depth gauge (for tires and brakes)

trouble light

tube bending tool

tube cutters

upholstery tools – trim panel tools, hog ring pliers

utility knife

vacuum pump

vacuum/pressure gauge

vernier caliper – SAE and metric

wire brush

wire stripper/crimping tool

wrench set – SAE and metric/various designs

Shop Tools and Equipment

acetylene torches

air compressor – hoses, inline filter and water separators

air conditioning flushing equipment

air conditioning leak detection and inspection equipment

air conditioning recovery/recycle/recharge station

air conditioning service and repair tools

airbag removal tools

airbag simulators

anti-static devices

ball joint press and adapters

battery chargers/boosting equipment

battery, alternator and starter tester (AVR)

battery power supply

bearing remover

belt tension gauge

bench grinders

bench vises

black light

borescope

brake cylinder hone

brake drum gauge

brake lathe

brake pressure tester

brake rotor gauge

brake system bleeder

CAT-IV meter (for hybrid vehicles)

camshaft bearing tools (removal and installation)

chassis ears

clutch alignment tools

clutch installers and removers

compression leak-down tester

computer – laptop, PC

coolant drain pans

cooling system pressure tester

cooling system recovery and flushing station

core plug/expansion plug installation tool

cylinder ridge reamer

drill press

electrical short detector

engine and transmission supports

engine cylinder hone

engine hanging supports; engine hoisting equipment

engine stand – portable

EVAP test equipment (smoke generator)

exhaust fan, ventilation hoses

exhaust pipe bender

Shop Tools and Equipment (continued)

floor jack
fuel injector flushing kit
fuel quality tester
fuel recovery and storage station
funnels
gear puller set

grease gun – oil dispensing system, fluid suction pump
hydraulic press
hydraulic transmission jack
insulated tools (for hybrid vehicles)
jack stands and supports
leak detection tank (tires)
lock pick set – lock out tools
manometer
oil drain barrels and disposal system
opacity meter
oscilloscope
parts washers/steam cleaners and blaster
piston ring compressor

piston ring installer
power steering pressure tester
pressure washer
propane enrichment tools

shop vacuum
slide hammer
specialized tools for air conditioning systems
specialized tools for engines and transmission
spreaders
spring compressors – coil spring and strut spring
tire changing machine

tire pressure monitoring systems (TPMS)
tire repair equipment
transmission fixtures
transmission flushing equipment
transmission pressure test kit
vacuum fill tools
valve grinding equipment
valve spring compressor
vehicle hoist
vehicle service information system
water hose
welding equipment – TIG, GMAW, GTAW, MIG welder and oxy-fuel
wheel alignment equipment
wheel balancer
wheel chocks
wheel ramps

Measuring Tools and Equipment

air conditioning pressure gauge
ammeter
AVR (alternator voltage regulator)
back pressure gauge
ball joint dial indicator set
battery load tester
coolant system pressure tester
cylinder bore gauges – small bore gauge, telescoping gauge
electronic vibration analyzer
fuel pressure gauges
headlight aiming equipment
hole gauge

inclinometer
infrared temperature gun
micrometer – SAE and metric
oil pressure gauge set – engine/transmission
opacity meter
plastic precision clearance gauge
power steering pressure tester
pyrometer

refractometer
refractor
scan tools
spring scale

Safety and Personal Protective Equipment

body protection – shop apron/heat resistant arm protectors

CSA approved safety foot wear

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

eye wash station

fire extinguisher

first aid kits and station

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

hearing protection – ear muffs, ear plugs

respiratory protection – dust and particle masks, chemical filtered mask

safety hook (for hybrid and electric vehicles)

safety pylons (for hybrid and electric vehicles)

APPENDIX C

GLOSSARY

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