

# CURRICULUM OUTLINE

## Automotive Service Technician

2016



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# **CURRICULUM OUTLINE**

## **AUTOMOTIVE SERVICE TECHNICIAN**



# STRUCTURE OF THE CURRICULUM OUTLINE

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

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

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

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

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

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

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

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

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

**Task Descriptor:** a general description of the task

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

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

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

## Knowledge

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

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

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

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

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

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

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

# DESCRIPTION OF THE AUTOMOTIVE SERVICE TECHNICIAN TRADE

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

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

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

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

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

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

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

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

# ESSENTIAL SKILLS SUMMARY

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

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

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

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

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

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

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## 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.

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## 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.

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## WRITING

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

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## **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.

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## **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.

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## **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.

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## **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.

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## **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.

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## **CONTINUOUS LEARNING**

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

# TRENDS IN THE AUTOMOTIVE SERVICE TECHNICIAN TRADE

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

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

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

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

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

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

# AUTOMOTIVE SERVICE TECHNICIAN

## TASK MATRIX

### A – PERFORMS COMMON OCCUPATIONAL SKILLS

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

## B – DIAGNOSES AND REPAIRS ENGINE AND ENGINE SUPPORT SYSTEMS

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

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

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

## D – DIAGNOSES AND REPAIRS DRIVELINE SYSTEMS

**Task D-12**  
Diagnoses driveline systems

D-12.01 Diagnoses drive shafts and axles <b>1</b>	D-12.02 Diagnoses manual transmissions/transaxles <b>2</b>	D-12.03 Diagnoses automatic transmissions/transaxles <b>4</b>
D-12.04 Diagnoses clutches <b>2</b>	D-12.05 Diagnoses transfer cases <b>3</b>	D-12.06 Diagnoses final drive assemblies <b>2</b>

**Task D-13**  
Repairs driveline systems

D-13.01 Repairs drive shafts and axles <b>1</b>	D-13.02 Repairs manual transmissions/transaxles <b>2</b>	D-13.03 Repairs automatic transmissions/transaxles <b>4</b>
D-13.04 Repairs clutches <b>2</b>	D-13.05 Repairs transfer cases <b>3</b>	D-13.06 Repairs final drive assemblies <b>2</b>

## E – DIAGNOSES AND REPAIRS ELECTRICAL AND COMFORT CONTROL SYSTEMS

<b>Task E-14</b> Diagnoses electrical systems and components	<b>E-14.01 Diagnoses basic wiring and electrical systems</b>  <b>1</b>	<b>E-14.02 Diagnoses starting/charging systems and batteries</b>  <b>1,2</b>	<b>E-14.03 Diagnoses lighting and wiper systems</b>  <b>2</b>
	<b>E-14.04 Diagnoses entertainment systems</b>  <b>4</b>	<b>E-14.05 Diagnoses electrical options</b>  <b>3</b>	<b>E-14.06 Diagnoses instrumentation and information displays</b>  <b>4</b>
	<b>E-14.07 Diagnoses electrical accessories</b>  <b>3</b>		
<b>Task E-15</b> Repairs electrical systems and components	<b>E-15.01 Repairs basic wiring and electrical systems</b>  <b>1</b>	<b>E-15.02 Repairs starting/charging systems and batteries</b>  <b>1,2</b>	<b>E-15.03 Repairs lighting and wiper systems</b>  <b>2</b>
	<b>E-15.04 Repairs entertainment systems</b>  <b>4</b>	<b>E-15.05 Repairs electrical options</b>  <b>3</b>	<b>E-15.06 Repairs instrumentation and information displays</b>  <b>4</b>
	<b>E-15.07 Installs electrical accessories</b>  <b>3</b>	<b>E-15.08 Repairs electrical accessories</b>  <b>2</b>	
<b>Task E-16</b> Diagnoses heating, ventilation and air conditioning (HVAC) and comfort control systems	<b>E-16.01 Diagnoses air flow control systems</b>  <b>4</b>	<b>E-16.02 Diagnoses refrigerant systems</b>  <b>4</b>	<b>E-16.03 Diagnoses heating systems</b>  <b>4</b>
	<b>Task E-17</b> Repairs HVAC and comfort control systems	<b>E-17.01 Repairs air flow control systems</b>  <b>4</b>	<b>E-17.02 Repairs refrigerant systems</b>  <b>1,4</b>

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

<b>Task F-18</b> Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings	<b>F-18.01 Diagnoses steering, suspension and control systems</b>  1,2	<b>F-18.02 Diagnoses braking and control systems</b>  1,2	<b>F-18.03 Diagnoses tires, wheels, hubs and wheel bearings</b>  1
<b>Task F-19</b> Repairs steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings	<b>F-19.01 Repairs steering, suspension and control systems</b>  1,2	<b>F-19.02 Repairs braking and control systems</b>  1,2	<b>F-19.03 Repairs tires, wheels, hubs and wheel bearings</b>  1

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

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

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

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

# ELEMENTS OF HARMONIZATION OF APPRENTICESHIP TRAINING

## **1. Trade name**

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

## **2. Number of Levels of Apprenticeship**

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

## **3. Total Training Hours during Apprenticeship Training**

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

# SEQUENCING OF APPRENTICESHIP TRAINING TOPICS AND RELATED SUBTASKS

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

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

**Level 1****Level 2****Level 3****Level 4****Safety-Related Functions**

1.01 Maintains safe work environment  
1.02 Uses personal protective equipment (PPE) and safety equipment  
17.02 Repairs refrigerant systems  
22.01 Implements specific safety protocols for hybrid and electric vehicles (EV)

**Fundamentals of Tools, Equipment, Materials and Documentation**

2.01 Uses tools and equipment  
2.02 Uses fasteners, tubing, hoses and fittings  
2.03 Uses hoisting and lifting equipment  
2.04 Uses technical information

**Communication Techniques**

3.01 Uses communication techniques

**Tires, Wheels, Hubs and Wheel Bearings**

18.03 Diagnoses tires, wheels, hubs and wheel bearings  
19.03 Repairs tires, wheels, hubs and wheel bearings

**Body Components, Accessories and Trim**

20.02 Diagnoses wind noises, rattles and water leaks  
20.03 Diagnoses interior and exterior components, accessories and trim  
20.04 Diagnoses latches, locks and movable glass  
21.02 Repairs wind noises, rattles and water leaks  
21.03 Repairs interior and exterior components, accessories and trim  
21.04 Repairs latches, locks and movable glass

**Mentoring Techniques**

3.02 Uses mentoring techniques

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

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

**Level 1**

**Level 2**

**Level 3**

**Level 4**

**HVAC and Comfort Control Systems**

16.01 Diagnoses air flow control systems  
16.02 Diagnoses refrigerant systems  
16.03 Diagnoses heating systems  
17.01 Repairs air flow control systems  
17.02 Repairs refrigerant systems  
17.03 Repairs heating systems

**Hybrid and Electrical Vehicle (EV)**

22.01 Implements specific safety protocols for hybrid and electric vehicles (EV)  
22.02 Diagnoses hybrid and electric vehicle (EV) systems  
23.01 Repairs hybrid vehicle systems  
23.02 Repairs electric vehicles (EV) systems

**Restraint Systems**

20.01 Diagnoses restraint systems  
21.01 Repairs restraint systems

# MAJOR WORK ACTIVITY A

## Performs common occupational skills

### TASK A-1 Performs safety-related functions

#### TASK DESCRIPTOR

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

#### **A-1.01** Maintains safe work environment

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

#### 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 <b>safety regulations</b> to maintain a safe work environment
		identify <b>components of WHMIS/GHS</b>
		identify and describe jurisdictional requirements for handling and disposing of <b>hazardous materials</b>

#### RANGE OF VARIABLES

**safety regulations** include: OH&S, WHMIS/GHS

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

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

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

Apprenticeship Level	1
Essential Skills	Document Use, Thinking, Reading

**KNOWLEDGE**

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

**RANGE OF VARIABLES**

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

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

**TASK A-2 Uses tools, equipment and documentation****TASK DESCRIPTOR**

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

**A-2.01****Uses tools and equipment**

Apprenticeship Level	1
Essential Skills	Numeracy, Thinking, Document Use

**KNOWLEDGE**

	Learning Outcomes	Learning Objectives
A-2.01.01L	demonstrate knowledge of hand and <b>power tools</b> , 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 <b>power tools</b> and describe their applications and procedures for use
		describe the procedures used to store and maintain <b>power tools</b>
		describe safe operating procedures for hand and <b>power tools</b>
A-2.01.02L	demonstrate knowledge of <b>measuring and testing devices</b> , their applications, maintenance and procedures for use	identify types of <b>measuring and testing devices</b> 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 <b>measuring and testing devices</b>
A-2.01.03L	demonstrate knowledge of <b>shop tools and equipment</b> , their applications, maintenance and procedures for use	identify types of <b>shop tools and equipment</b> and describe their applications and procedures for use
		describe the procedures used to store and maintain <b>shop tools and equipment</b>
A-2.01.04L	demonstrate knowledge of <b>welding, cutting and heating equipment</b> and their applications	identify types of <b>welding, cutting and heating equipment</b> and describe their applications

## RANGE OF VARIABLES

**power tools** include: electric, pneumatic, hydraulic

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

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

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

## A-2.02 Uses fasteners, tubing, hoses and fittings

Apprenticeship Level	1
Essential Skills	Numeracy, Thinking, Document Use

### KNOWLEDGE

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

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

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

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## **A-2.03** Uses hoisting and lifting equipment

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**Apprenticeship Level** 1

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**Essential Skills** Document Use, Thinking, Numeracy

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### **KNOWLEDGE**

#### **Learning Outcomes**

#### **Learning Objectives**

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A-2.03.01L	demonstrate knowledge of vehicle hoisting and lifting equipment, their applications and procedures for use	identify <b>safety considerations</b> pertaining to vehicle hoisting and lifting
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identify the types of vehicle hoisting and lifting equipment and accessories and their applications

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describe procedures for use of vehicle hoisting and lifting equipment

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describe the procedures used to inspect, store and maintain vehicle hoisting and lifting equipment

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A-2.03.02L	demonstrate knowledge of <b>shop lifting equipment</b> , their applications and procedures for use	identify <b>safety considerations</b> pertaining to <b>shop lifting equipment</b>
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identify types of **shop lifting equipment** and their applications

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describe procedures for use of **shop lifting equipment**

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describe the procedures used to inspect, store and maintain **shop lifting equipment**

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### **RANGE OF VARIABLES**

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

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

## A-2.04 Uses technical information

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

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

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

## TASK A-3 Uses communication and mentoring techniques

### TASK DESCRIPTOR

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

## A-3.01 Uses communication techniques

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

### KNOWLEDGE

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

A-3.01.02L	demonstrate knowledge of effective communication practices	describe the importance of using effective verbal and non-verbal communication with <b>people in the workplace</b>
A-3.01.03L	demonstrate knowledge of technical resources available	identify <b>sources of information</b> 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 <b>personal responsibilities and attitudes</b> that contribute to on-the-job success
A-3.01.06L	demonstrate knowledge of policies and procedures regarding <b>harassment</b> and <b>discrimination</b>	identify communication that constitutes <b>harassment</b> and <b>discrimination</b>

## RANGE OF VARIABLES

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

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

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

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

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

## A-3.02 Uses mentoring techniques

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

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

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

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

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

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

# MAJOR WORK ACTIVITY B

## Diagnoses and repairs engine and engine support systems

### TASK B-4 Diagnoses engine systems

#### TASK DESCRIPTOR

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

#### **B-4.01** Diagnoses cooling systems

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Oral Communication

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-4.01.01L	demonstrate knowledge of cooling systems, their <b>components</b> and operation	identify types of cooling systems
		identify cooling system <b>components</b> 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 <b>fan systems</b> and describe their components and operation
B-4.01.02L	demonstrate knowledge of the <b>procedures used to diagnose</b> cooling systems	identify <b>related systems</b> and describe their relationship to cooling systems
		describe the <b>procedures used to diagnose</b> cooling systems

identify **warning systems and indicators** and describe their purpose and operation

identify types of **diagnostic tools and equipment** and describe their applications and procedures for use

## RANGE OF VARIABLES

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

**fan systems** include: mechanical, electric, hydraulic

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

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

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

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

## B-4.02 Diagnoses lubricating systems

Apprenticeship Level 2

Essential Skills Document Use, Thinking, Numeracy

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-4.02.01L	demonstrate knowledge of engine lubricating systems, their components and operation	identify types of <b>engine lubricants</b> and describe their characteristics and applications
		identify types of <b>oil pumps</b> and describe their purpose and operation
		identify types of <b>oil coolers</b> 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 <b>warning systems and indicators</b> and describe their purpose and operation
B-4.02.02L	demonstrate knowledge of the <b>procedures used to diagnose</b> engine lubricating systems	describe the <b>procedures used to diagnose</b> engine lubricating systems

## RANGE OF VARIABLES

**engine lubricants** include: grades and classifications, synthetics, additives

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

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

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

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

## B-4.03 Diagnoses engine assembly

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Numeracy

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-4.03.01L	demonstrate knowledge of engine theory	define and explain terminology associated with engines explain internal combustion principles
B-4.03.02L	demonstrate knowledge of engine assemblies, their <b>components</b> and operation	identify types of <b>engine classifications</b> identify types of <b>engine configurations</b> and describe their construction identify types of <b>valve train configurations</b> 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 <b>engine assembly components</b> and describe their design, purpose and operation identify types of <b>diagnostic tools and equipment</b> and describe their applications and procedures for use

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

## RANGE OF VARIABLES

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

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

**engine configurations** include: inline, rotary, opposed, V

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

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

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

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

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

## B-4.04 Diagnoses accessory drive systems

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

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

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

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

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

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

## TASK B-5 Repairs engine systems

### TASK DESCRIPTOR

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

### B-5.01 Repairs cooling systems

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Reading

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-5.01.01L	demonstrate knowledge of cooling systems, their <b>components</b> and operation	identify <b>cooling system components</b> 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 <b>repair tools and equipment</b> and describe their applications and procedures for use
		identify types of <b>fan systems</b> and describe <b>their components</b> and operation

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

## RANGE OF VARIABLES

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

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

**fan systems and their components** include: mechanical, electric

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

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

## B-5.02 Repairs lubricating systems

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Numeracy

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

**related systems** include: engine assembly, oil coolers

### B-5.03 Repairs engine assembly

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Numeracy

#### KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-5.03.01L	demonstrate knowledge of engine theory	define and explain terminology associated with engines
		explain internal combustion principles
B-5.03.02L	demonstrate knowledge of engines, their components and operation	identify types of <b>engine classifications</b>
		identify types of <b>engine configurations</b> and describe their construction
		identify types of <b>valve train configurations</b> 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 <b>repair tools and equipment</b> 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 <b>types and sources of engine assembly problems</b>

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

## RANGE OF VARIABLES

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

**engine configurations** include: inline, rotary, opposed, V

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

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

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

## B-5.04 Repairs accessory drive systems

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

### KNOWLEDGE

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

## RANGE OF VARIABLES

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

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

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

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

## TASK B-6 Diagnoses gasoline engine support systems

### TASK DESCRIPTOR

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

### B-6.01 Diagnoses gasoline fuel delivery and injection systems

Apprenticeship Level 3

Essential Skills Thinking, Document Use, Digital Technology

#### KNOWLEDGE

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

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

## RANGE OF VARIABLES

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

**safety precautions** include: high pressure, flammability

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

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

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

## B-6.02 Diagnoses gasoline ignition systems

Apprenticeship Level 3

Essential Skills Document Use, Thinking, Digital Technology

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

**ignition systems** include: distributor, distributor-less

**safety considerations** include: high voltage

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

**ignition circuits** include: primary, secondary, control

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

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

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

**ignition concerns** include: hesitation, misfire, lag, timing

## B-6.03 Diagnoses gasoline intake/exhaust systems

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

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

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

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

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

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

**related systems** include: emissions, lubricating, fuel delivery

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

## B-6.04 Diagnoses gasoline emission control systems

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

### KNOWLEDGE

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

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

## 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, CO<sup>2</sup>, NO<sub>x</sub>, HC, O<sup>2</sup>

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

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

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

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

## TASK B-7 Repairs gasoline engine support systems

### TASK DESCRIPTOR

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

### B-7.01 Repairs gasoline fuel delivery and injection systems

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

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

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

**safety considerations** include: high pressure, flammability

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

## B-7.02 Repairs gasoline ignition systems

Apprenticeship Level

3

Essential Skills

Document Use, Thinking, Digital Technology

### KNOWLEDGE

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

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

describe procedures used to verify repair

## RANGE OF VARIABLES

**ignition systems** include: distributor, distributor-less

**safety considerations** include: high voltage, high temperature

**ignition circuits** include: primary, secondary, control

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

**warning systems and indicators** include: check engine light, DIC

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

## B-7.03 Repairs gasoline intake/exhaust systems

Apprenticeship Level 3

Essential Skills Document Use, Thinking, Digital Technology

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

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

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

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

**related systems** include: emissions, lubricating, fuel delivery

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

## B-7.04 Repairs gasoline emission control systems

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

### KNOWLEDGE

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

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, CO<sup>2</sup>, NO<sub>x</sub>, HC, O<sup>2</sup>

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

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

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

## TASK B-8 Diagnoses diesel engine support systems

### TASK DESCRIPTOR

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

### B-8.01 Diagnoses diesel fuel delivery and injection systems

Apprenticeship Level 4

Essential Skills Document Use, Thinking, Digital Technology

#### KNOWLEDGE

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

identify types of **diagnostic tools and equipment** and describe their applications and procedures for use

describe the **procedures used to diagnose** diesel fuel delivery and injection systems

describe the procedures used to remove and reinstall diesel fuel delivery and injection system components

## RANGE OF VARIABLES

**safety considerations** include: high pressure fuel, high injection voltage

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

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

**starting aids** include: glow plugs intake heaters, timers

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

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

## B-8.02 Diagnoses diesel intake/exhaust systems

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

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

**diesel intake systems** include: turbocharged, supercharged, NA

**safety considerations** include: extreme temperature, exhaust fumes

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

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

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

## B-8.03 Diagnoses diesel emission control systems

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

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

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

**diesel emissions** include: CO, CO<sup>2</sup>, NO<sub>x</sub>, HC, O<sub>2</sub>, particulates

**safety considerations** include: corrosive diesel exhaust fluid, high temperature

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

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

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

## TASK B-9 Repairs diesel engine support systems

### TASK DESCRIPTOR

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

### B-9.01 Repairs diesel fuel delivery and injection systems

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

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

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

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

**starting aids** include: glow plugs, intake heaters, timers

**related systems** include: intake/exhaust, emission control

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

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

## B-9.02 Repairs diesel intake/exhaust systems

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

### KNOWLEDGE

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

## RANGE OF VARIABLES

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

## B-9.03 Repairs diesel emission control systems

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

### KNOWLEDGE

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

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describe the procedures used to remove and reinstall **diesel emission control system components**

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

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describe procedures used to verify repair

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## **RANGE OF VARIABLES**

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

**diesel emissions** include: CO, CO<sup>2</sup>, NO<sub>x</sub>, HC, O<sub>2</sub>, particulates

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

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

# MAJOR WORK ACTIVITY C

## Diagnoses and repairs vehicle module communications systems

### TASK C-10 Diagnoses vehicle networking systems

#### TASK DESCRIPTOR

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

#### C-10.01 Reads diagnostic trouble codes (DTCs)

Apprenticeship Level	3
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Essential Skills	Document Use, Digital Technology, Thinking
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#### 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 <b>network protocols</b> and describe their purpose
		describe the <b>networking of modules and multiplexing</b>
		identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships
		identify types of <b>diagnostic tools and equipment</b> 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

Apprenticeship Level 3

Essential Skills Digital Technology, Thinking, Document Use

#### KNOWLEDGE

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

## RANGE OF VARIABLES

**network protocols** include: ISO, CAN, LIN, speed

**networking of modules and multiplexing** include: wiring designs, wireless

**data** includes: inputs and outputs

### C-10.03 Interprets test results

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Numeracy

#### KNOWLEDGE

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

#### RANGE OF VARIABLES

**network protocols** include: ISO, CAN, LIN, speed

**networking of modules and multiplexing** include: wiring designs, wireless

### C-10.04 Tests system circuitry and components

Apprenticeship Level	3
Essential Skills	Thinking, Digital Technology, Numeracy

#### KNOWLEDGE

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

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

## RANGE OF VARIABLES

**network protocols** include: ISO, CAN, LIN, speed

**networking of modules and multiplexing** include: wiring designs, wireless

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

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

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

## TASK C-11 Repairs vehicle networking systems

### TASK DESCRIPTOR

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

#### C-11.01 Updates component software

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

#### KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.01.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of <b>network protocols</b> and describe their purpose
		describe the <b>networking of modules and multiplexing</b>
		identify and interpret DTCs
		identify the parameters of inputs and outputs and describe their relationships
C-11.01.02L	demonstrate knowledge of the procedures used to repair vehicle networking system components	identify types of <b>repair tools and equipment</b> used to diagnose network and electronic circuitry and describe their applications and procedures for use
		describe the procedures used to repair vehicle networking systems
C-11.01.03L	demonstrate knowledge of reprogramming software	identify <b>methods used to access/transfer and reprogram software</b> 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**

<b>Apprenticeship Level</b>	3
<b>Essential Skills</b>	Digital Technology, Thinking, Document Use

**KNOWLEDGE**

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

**RANGE OF VARIABLES**

**network protocols** include: ISO, CAN, LIN, speed

**networking of modules and multiplexing** include: wiring designs, wireless

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

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

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

Apprenticeship Level

3

Essential Skills

Digital Technology, Thinking, Document Use

**KNOWLEDGE**

	Learning Outcomes	Learning Objectives
C-11.03.01L	demonstrate knowledge of vehicle networking systems, their components and operation	explain basic computer operation and its relationship to vehicle networking systems
		identify the types of <b>network protocols</b> and describe their purpose
		describe the <b>networking of modules and multiplexing</b>
		identify and interpret DTCs
C-11.03.02L	demonstrate knowledge of the procedures used to repair vehicle networking system components	identify types of <b>diagnostic tools and equipment</b> 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 <b>methods used to access/transfer and reprogram software</b> and describe their associated procedures

**RANGE OF VARIABLES**

**network protocols** include: ISO, CAN, LIN, speed

**networking of modules and multiplexing** include: wiring designs, wireless

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

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

# MAJOR WORK ACTIVITY D

## Diagnoses and repairs driveline systems

### TASK D-12 Diagnoses driveline systems

#### TASK DESCRIPTOR

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

#### D-12.01 Diagnoses drive shafts and axles

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Numeracy

#### KNOWLEDGE

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

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

## RANGE OF VARIABLES

**types of drive shafts** include: 1 piece, 2 piece

**composition** includes: steel, aluminum

**safety considerations** include: exposed rotating parts, pinch points

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

**axles** include: half shafts, floating, semi-floating

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

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

## D-12.02 Diagnoses manual transmissions/transaxles

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Numeracy

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-12.02.01L	demonstrate knowledge of manual transmissions/transaxles, their components and operation	identify types of manual transmissions/transaxles and describe their components and operation
		identify <b>safety considerations</b> 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 <b>diagnostic tools and equipment</b> 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 <b>procedures used to diagnose</b> manual transmissions/transaxles	describe the <b>procedures used to diagnose</b> manual transmissions/transaxles

## RANGE OF VARIABLES

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

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

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

## D-12.03 Diagnoses automatic transmissions/transaxles

Apprenticeship Level	4
Essential Skills	Digital Technology, Reading, Thinking

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-12.03.01L	demonstrate knowledge of <b>automatic transmissions/transaxles</b> , their components and operation	identify types of <b>automatic transmissions/transaxles</b> and describe their components and operation
		identify <b>safety considerations</b> pertaining to <b>automatic transmissions/transaxles</b>
		identify types of <b>alternate automatic transmissions/transaxle designs</b>
		explain <b>hydraulic principles</b> 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 <b>diagnostic tools and equipment</b> and describe their applications and procedures for use

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

## RANGE OF VARIABLES

**automatic transmissions and transaxles** include: electrically controlled, hydraulically controlled

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

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

**hydraulic principles** include: Pascal's law, fluid dynamics

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

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

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

## D-12.04 Diagnoses clutches

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Numeracy

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
12.04.01L	demonstrate knowledge of clutches, their components and operation	identify types of clutches and describe their components and operation
		identify <b>safety considerations</b> 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 <b>related systems</b> and describe their relationship to clutch systems
12.04.02L	demonstrate knowledge of the <b>procedures used to diagnose</b> clutches	describe the <b>procedures used to diagnose</b> clutches

## RANGE OF VARIABLES

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

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

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

## D-12.05 Diagnoses transfer cases

Apprenticeship Level	3
Essential Skills	Digital Technology, Reading, Thinking

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-12.05.01L	demonstrate knowledge of transfer cases, their components and operation	identify types of transfer cases and describe their components and operation
		identify types of AWD systems, their components and operation
		identify <b>safety considerations</b> pertaining to transfer cases
		identify <b>related systems</b> and describe their relationship to transfer cases
		identify types of <b>control systems</b> 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 <b>diagnostic tools and equipment</b> and describe their applications and procedures for use
D-12.05.02L	demonstrate knowledge of the <b>procedures used to diagnose</b>	describe the <b>procedures used to diagnose</b>

## RANGE OF VARIABLES

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

**related systems** include: transmissions, drivelines, mounts

**control systems** include: vacuum, mechanical, electronic

**diagnostic tools and equipment** include: scan tools, hand tools

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

## D-12.06 Diagnoses final drive assemblies

Apprenticeship Level	2
Essential Skills	Digital Technology, Reading, Thinking

### KNOWLEDGE

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

## RANGE OF VARIABLES

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

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

**related systems** include: transmissions, drivelines, mounts

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

## TASK D-13 Repairs driveline systems

### TASK DESCRIPTOR

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

#### D-13.01 Repairs drive shafts and axles

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Numeracy

#### KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.01.01L	demonstrate knowledge of drive shafts and axles, their <b>components</b> and operation	identify types of drive shafts and describe their composition
		identify <b>safety considerations</b> pertaining to drive shafts and axles
		identify types of <b>drive shaft components</b> and describe their purpose and operation
		identify types of <b>axles</b> 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 <b>axles</b>	identify <b>repair tools and equipment</b> 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

Apprenticeship Level 2

Essential Skills Thinking, Document Use, Numeracy

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.02.01L	demonstrate knowledge of manual transmissions and transaxles, their components and operation	identify types of manual transmissions and transaxles and describe their components and operation
		identify <b>safety considerations</b> pertaining to manual transmissions/transaxles
		describe manual transmission and transaxle power flow
		describe gear ratios, their purpose and perform calculations
D-13.02.02L	demonstrate knowledge of the procedures used to repair manual transmissions and transaxles	identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications
		identify types of <b>repair tools and equipment</b> 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

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describe procedures used to verify repair

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## 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

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### D-13.03 Repairs automatic transmissions/transaxles

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Apprenticeship Level 4

Essential Skills Thinking, Document Use, Numeracy

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#### KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.03.01L	demonstrate knowledge of <b>automatic transmissions and transaxles</b> , their components and operation	identify types of <b>automatic transmissions and transaxles</b> and describe their components and operation
		identify <b>safety considerations</b> pertaining to <b>automatic transmissions/transaxles</b>
		identify types of <b>alternate automatic transmissions and transaxle designs</b>
		explain <b>hydraulic principles</b> related to <b>automatic transmissions and transaxles</b>
		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 <b>automatic transmissions and transaxles</b>	identify types of <b>repair tools and equipment</b> and describe their applications and procedures for use
		describe the procedures used to remove and reinstall <b>automatic transmissions and transaxles</b>
		describe the procedures used to adjust, repair and/or replace <b>automatic transmissions and transaxles</b> and their related components

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describe the procedures used to replace engine and driveline mounts

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describe procedures used to verify repair

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## 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

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### D-13.04 Repairs clutches

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Apprenticeship Level 2

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Essential Skills Thinking, Document Use, Numeracy

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#### 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**

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

describe procedures used to verify repair

## RANGE OF VARIABLES

**clutches** include: single and multi-disc systems

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

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

## D-13.05 Repairs transfer cases

Apprenticeship Level 3

Essential Skills Digital Technology, Reading, Thinking

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-13.05.01L	demonstrate knowledge of <b>transfer cases</b> , their components and operation	identify types of <b>transfer cases</b> and describe their components and operation
		identify types of AWD systems, their components and operation
		identify <b>safety considerations</b> pertaining to transfer cases
		identify <b>related systems</b> and describe their relationship to <b>transfer cases</b>
		identify types of <b>control systems</b> 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 <b>transfer cases</b>	identify types of <b>repair tools and equipment</b> and describe their applications and procedures for use
		describe the procedures used to remove and reinstall <b>transfer cases</b>

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

describe procedures used to verify repair

## RANGE OF VARIABLES

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

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

**related systems** include: transmissions, drivelines, mounts

**control systems** include: vacuum, mechanical, electronic

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

## D-13.06 Repairs final drive assemblies

Apprenticeship Level	2
Essential Skills	Numeracy, Reading, Thinking

### KNOWLEDGE

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

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

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describe procedures used to verify repair

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## **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

<b>Apprenticeship Level</b>	1	
<b>Essential Skills</b>	Thinking, Document Use, Numeracy	
<b>KNOWLEDGE</b>		
	<b>Learning Outcomes</b>	<b>Learning Objectives</b>
E-14.01.01L	demonstrate knowledge of <b>basic electrical and electronic principles</b>	explain basic electrical theory
		explain <b>basic computer operation</b>
		identify types of electrical components and describe their <b>purpose and operation</b>
E-14.01.02L	demonstrate knowledge of <b>electrical circuits</b> , their components and operation	describe the application of Ohm's law to <b>electrical circuits</b>
		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 <b>electrical circuits</b> and components	interpret diagnostic flowcharts and schematics

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

describe the **procedures used to diagnose electrical circuits** and components

## RANGE OF VARIABLES

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

**basic computer operation** includes: inputs and outputs

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

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

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

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

## E-14.02 Diagnoses starting/charging systems and batteries

Apprenticeship Level 1,2

Essential Skills Thinking, Numeracy, Document Use

### KNOWLEDGE

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

## RANGE OF VARIABLES

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

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

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

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

**warning indicators** include: IPC, DIC

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

## E-14.03 Diagnoses lighting and wiper systems

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

### KNOWLEDGE

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

## RANGE OF VARIABLES

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

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

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

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

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

## E-14.04 Diagnoses entertainment systems

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

**safety considerations** include: accidental restraint system deployment

**entertainment systems** include: audio, video, wireless/handsfree

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

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

## E-14.05 Diagnoses electrical options

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

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

**basic computer operation** includes: inputs, outputs

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

**safety considerations** include: accidental restraint system deployment

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

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

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

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

Apprenticeship Level

4

Essential Skills

Thinking, Document Use, Digital Technology

**KNOWLEDGE**

	Learning Outcomes	Learning Objectives
E-14.06.01L	demonstrate knowledge of instrumentation and information displays, their components and operation	identify <b>safety considerations</b> pertaining to instrumentation and information displays identify <b>jurisdictional requirements pertaining to instrumentation and information displays</b> identify types of <b>instrumentation systems</b> and describe their components and operation identify types of information displays and describe their purpose and operation identify types of <b>diagnostic tools and equipment</b> 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 <b>procedures used to diagnose</b> instrumentation and information displays	describe the <b>procedures used to diagnose</b> instrumentation and information displays

**RANGE OF VARIABLES**

**safety considerations** include: accidental restraint system deployment

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

**instrumentation systems** include: gauges, warning indicators

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

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

## E-14.07 Diagnoses electrical accessories

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

**safety considerations** include: accidental restraint system deployment

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

**diagnostic tools and equipment** include: DMMS, circuit testers

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

## TASK E-15 Repairs electrical systems and components

### TASK DESCRIPTOR

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

#### E-15.01 Repairs basic wiring and electrical systems

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

#### KNOWLEDGE

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

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

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describe procedures used to verify repair

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## 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

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## E-15.02 Repairs starting/charging systems and batteries

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Apprenticeship Level 1,2

Essential Skills Thinking, Document Use, Digital Technology

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### 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 <b>safety considerations</b>
		identify types of <b>control systems</b> and describe their components and operation
		identify types of <b>repair tools and equipment</b> 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

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

**safety considerations** include: HID, pinch points, lamps

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

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

**lighting components** include: light bulbs, switches, modules

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

## E-15.04 Repairs entertainment systems

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

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

## E-15.05 Repairs electrical options

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

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-15.05.01L	demonstrate knowledge of <b>basic electrical and electronic principles</b>	explain basic electrical theory
		explain <b>basic computer operation</b>
		describe the application of Ohm's law to <b>electrical circuits</b>
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 <b>electrical accessories</b>
		identify types of <b>electrical accessories</b> and describe their components and operation

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

## RANGE OF VARIABLES

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

**basic computer operation** includes: inputs, outputs

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

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

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

## E-15.06 Repairs instrumentation and information displays

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

### KNOWLEDGE

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

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

## RANGE OF VARIABLES

**safety considerations** include: accidental deployment of restraint systems

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

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

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

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

## E-15.07 Installs electrical accessories

Apprenticeship Level 3

Essential Skills Thinking, Document Use, Digital Technology

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-15.07.01L	demonstrate knowledge of <b>electrical accessories</b> , their components and operation	identify <b>safety considerations</b> pertaining to <b>electrical accessories</b>
		identify types of <b>electrical accessories</b> and describe their components and operation
		identify types of <b>repair tools and equipment</b> 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 <b>electrical accessories</b>	describe the procedures used to install <b>electrical accessories</b>
		describe procedures used to verify installation

## RANGE OF VARIABLES

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

**safety considerations** include: accidental deployment of restraint systems

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

## E-15.08 Repairs electrical accessories

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

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

**safety considerations** include: accidental deployment of restraint systems

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

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

### TASK DESCRIPTOR

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

#### E-16.01 Diagnoses air flow control systems

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

#### KNOWLEDGE

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

### RANGE OF VARIABLES

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

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

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

## E-16.02 Diagnoses refrigerant systems

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

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-16.02.01L	demonstrate knowledge of refrigerant systems, their components and operation	identify <b>safety considerations</b> pertaining to refrigerant systems identify <b>refrigerant system components</b> , their components and operation identify types of refrigerants and lubricants and describe their applications and procedures for use identify <b>jurisdictional requirements</b> 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 <b>diagnostic tools and equipment</b> and describe their applications and procedures for use identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications identify <b>related systems</b> and describe their relationship to refrigerant systems describe refrigerant systems specific to hybrid and electric vehicles
E-16.02.02L	demonstrate knowledge of the <b>procedures used to diagnose</b> refrigerant systems	describe the <b>procedures used to diagnose</b> refrigerant systems

### RANGE OF VARIABLES

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

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

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

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

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

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

## E-16.03 Diagnoses heating systems

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

**components** include: cabin filters, blower motors, actuators, heater core, thermostats, fans **safety considerations** include: airborne contaminants, mould spores, pinch points

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

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

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

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

### TASK DESCRIPTOR

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

#### E-17.01 Repairs air flow control systems

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

#### KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-17.01.01L	demonstrate knowledge of air flow control systems, their <b>components</b> and operation	identify air flow control systems, their <b>components</b> and operation
		identify <b>safety considerations</b> pertaining to air flow control systems
		identify types of <b>repair tools and equipment</b> and describe their applications and procedures for use
E-17.01.02L	demonstrate knowledge of the procedures used to repair air flow control systems	identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications
		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

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

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-17.02.01L	demonstrate knowledge of refrigerant systems, their <b>components</b> and operation	identify <b>safety considerations</b> pertaining to refrigerant systems identify refrigerant systems, their <b>components</b> and operation identify types of refrigerants and lubricants and describe their applications and procedures for use identify <b>jurisdictional requirements</b> 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 <b>repair tools and equipment</b> 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 <b>components</b> describe procedures used to verify repair

### RANGE OF VARIABLES

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

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

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

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

## E-17.03 Repairs heating systems

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

### KNOWLEDGE

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

### RANGE OF VARIABLES

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

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

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

# MAJOR WORK ACTIVITY F

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

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

#### TASK DESCRIPTOR

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

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

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

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

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

#### F-18.01 Diagnoses steering, suspension and control systems

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

#### KNOWLEDGE

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

F-18.01.02L	demonstrate knowledge of the <b>procedures used to diagnose</b> suspension systems	describe the <b>procedures used to diagnose</b> suspension systems
F-18.01.03L	demonstrate knowledge of <b>steering systems</b> , their components and operation	identify <b>safety considerations</b> pertaining to steering systems
		identify types of <b>steering columns</b> and describe their components and operation
		identify types of <b>steering systems</b> and describe their <b>components</b> and operation
		identify <b>related systems</b> and describe their relationship to steering systems
		identify types of <b>steering assist systems</b> and describe their components and operation
		identify types of <b>power steering pumps</b> 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 <b>diagnostic tools and equipment</b> and describe their applications and procedures for use
		describe the procedures used to disarm passive restraints
		describe steering geometry
F-18.01.04L	demonstrate knowledge of the <b>procedures used to diagnose</b> steering systems	describe the <b>procedures used to diagnose</b> 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 <b>procedures used to diagnose</b> electronically controlled suspension systems
F-18.01.06L	demonstrate knowledge of the <b>procedures used to diagnose</b> and perform wheel alignments	describe the <b>procedures used to diagnose</b> 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

<b>Apprenticeship Level</b>	1,2
<b>Essential Skills</b>	Document Use, Numeracy, Thinking

<b>KNOWLEDGE</b>		
	<b>Learning Outcomes</b>	<b>Learning Objectives</b>
F-18.02.01L	demonstrate knowledge of braking systems, their <b>components</b> and operation	identify <b>safety considerations</b> pertaining to braking systems
		explain hydraulic principles related to braking systems
		identify types of <b>braking systems</b> and describe their <b>components</b> and operation
		identify types of braking systems in hybrid and EVs
		identify types of <b>power assists</b> and describe their components and operation
		identify types of <b>control systems</b> 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 <b>diagnostic tools and equipment</b> 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 <b>procedures used to diagnose</b> braking systems	describe the <b>procedures used to diagnose</b> braking systems
F-18.02.03L	demonstrate knowledge of the <b>procedures used to diagnose</b> control systems	describe the <b>procedures used to diagnose</b> control systems

## RANGE OF VARIABLES

**safety considerations** include: hydraulic pressure, airborne contaminants

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

**power assists** include: vacuum, hydraulic, electric

**control systems** include: TCS, ABS, stability control

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

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

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

Apprenticeship Level	1
Essential Skills	Numeracy, Document Use, Thinking

### KNOWLEDGE

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

## RANGE OF VARIABLES

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

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

**types of wheels** include: steel alloy

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

**hubs** include: pressed in, integral, tapered roller

**types of tire pressure monitoring systems** include: passive, active

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

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

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

## TASK DESCRIPTOR

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

### F-19.01 Repairs steering, suspension and control systems

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

#### KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-19.01.01L	demonstrate knowledge of <b>suspension systems</b> , their components and operation	identify types of <b>suspension systems</b> and describe their components and operation
		identify <b>safety considerations</b> pertaining to <b>suspension systems</b>
		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 <b>suspension systems</b>	describe the procedures used to repair <b>suspension systems</b>
		describe the procedures used to remove and reinstall <b>suspension system components</b>
		describe the procedures used to adjust, repair and/or replace <b>suspension system components</b>
F-19.01.03L	demonstrate knowledge of the procedures used to repair <b>steering systems</b>	describe the procedures used to remove and reinstall <b>steering system components</b>
		describe the procedures used to adjust, repair and/or replace <b>steering system components</b>
		identify <b>related systems</b> 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

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

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-19.02.01L	demonstrate knowledge of <b>braking systems</b> , their <b>components</b> and operation	explain hydraulic principles related to <b>braking systems</b>
		identify <b>safety considerations</b> pertaining to <b>braking system</b> repairs
		identify types of <b>braking systems</b> and describe their <b>components</b> and operation
		identify types of <b>power assists</b> and describe their components and operation
		identify types of <b>control systems</b> 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 <b>repair tools and equipment</b> and describe their applications and procedures for use
		identify types of trailer brakes and controls and describe their components and operation
		identify types of <b>braking systems</b> in hybrid and EVs
F-19.02.02L	demonstrate knowledge of the procedures used to repair <b>braking systems</b>	describe the procedures used to repair <b>braking systems</b>
		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 <b>braking system components</b>
		describe procedures used to verify repair
F-19.02.03L	demonstrate knowledge of the procedures used to repair <b>control systems</b>	describe procedures used to repair <b>control systems</b>

## RANGE OF VARIABLES

**braking systems** include: hydraulic, electric, park brake

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

**safety considerations** include: hydraulic pressure, airborne contaminants

**power assists** include: vacuum, hydraulic, electric

**control systems** include: TCS, ABS, stability control

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

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

Apprenticeship Level

1

Essential Skills

Document Use, Digital Technology, Thinking

### KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-19.03.01L	demonstrate knowledge of tires, wheels, hubs, wheel bearings, their components and operation	identify <b>types of tires</b> and describe their construction
		identify <b>safety considerations</b> 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 <b>types of wheels</b> and describe their components and operation
		identify types of hubs and bearing assemblies and describe their components and operation
		identify <b>types of tire pressure monitoring systems</b> 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 <b>repair tools and equipment</b> and describe their applications and procedures for use
F-19.03.02L	demonstrate knowledge of the <b>procedures</b> used to repair tires, wheels, hubs and wheel bearings	describe the <b>procedures</b> used to repair tires, wheels, hubs and wheel bearings
		describe the <b>procedures</b> used to remove and reinstall tires, wheels, hubs and wheel bearings
		describe the <b>procedures</b> used to repair and replace tires, wheels, hubs and wheel bearings
		describe <b>procedures</b> used to verify repair

## RANGE OF VARIABLES

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

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

**types of wheels** include: steel alloy

**types of tire pressure monitoring systems** include: passive, active

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

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

# MAJOR WORK ACTIVITY G

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

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

#### TASK DESCRIPTOR

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

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

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

#### G-20.01 Diagnoses restraint systems

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

#### KNOWLEDGE

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

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

## RANGE OF VARIABLES

**restraint systems** include: active and passive

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

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

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

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

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

## G-20.02 Diagnoses wind noises, rattles and water leaks

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

### KNOWLEDGE

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

## RANGE OF VARIABLES

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

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

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

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Reading

**KNOWLEDGE**

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

**RANGE OF VARIABLES**

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

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

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

*flaws* include: fit, finish, form, function

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

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

**G-20.04****Diagnoses latches, locks and movable glass**

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Reading

**KNOWLEDGE**

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

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

## RANGE OF VARIABLES

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

**safety considerations** include: pinch points, handling of glass

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

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

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

### TASK DESCRIPTOR

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

### G-21.01 Repairs restraint systems

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

### KNOWLEDGE

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

		identify <b>jurisdictional requirements</b> pertaining to <b>restraint systems</b>
		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 <b>restraint systems</b>	describe the procedures used to repair <b>restraint systems</b>
		identify types of <b>repair tools and equipment</b> and describe their applications and procedures for use
		describe the procedures used to remove, repair, replace, adjust and reinstall electrical or <b>restraint system mechanical components</b>
		describe the procedures used to recycle or dispose of <b>restraint systems components</b> according to jurisdictional regulations
		describe proper care, handling and storage procedures of <b>restraint system components</b>
		identify procedures used to verify repair

## RANGE OF VARIABLES

**restraint systems** include: active and passive

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

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

**jurisdictional requirements** include: disposal, repair, motor vehicle inspection

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

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

## G-21.02 Repairs wind noises, rattles and water leaks

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

### KNOWLEDGE

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

<b>Apprenticeship Level</b>	1
<b>Essential Skills</b>	Thinking, Document Use, Reading

**KNOWLEDGE**

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

**RANGE OF VARIABLES**

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

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

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

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

## G-21.04 Repairs latches, locks and movable glass

Apprenticeship Level	1
Essential Skills	Thinking, Document Use, Reading

### KNOWLEDGE

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

### RANGE OF VARIABLES

**safety considerations** include: pinch points, handling of glass

**warning systems** include: chimes, bells, lights

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

# MAJOR WORK ACTIVITY H

## Diagnoses and repairs hybrid and electric vehicles (EV)

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

#### TASK DESCRIPTOR

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

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

Apprenticeship Level	1,4
Essential Skills	Thinking, Document Use, Reading

#### KNOWLEDGE

	Learning Outcomes	Learning Objectives
H-22.01.01L	demonstrate knowledge of <i>safety protocols for hybrid and EV systems</i>	identify <i>safety protocols pertaining to hybrid and EV systems</i>

#### RANGE OF VARIABLES

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

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

Apprenticeship Level	4
Essential Skills	Thinking, Reading, Digital Technology

#### KNOWLEDGE

	Learning Outcomes	Learning Objectives
H-22.02.01L	demonstrate knowledge of operations of hybrid and EV systems	identify the function of hybrid and EV systems
H-22.02.02L	demonstrate knowledge of diagnosing hybrid and EV systems	identify methods for diagnosing hybrid and EV systems

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

### TASK DESCRIPTOR

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

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#### **H-23.01** Repairs hybrid vehicle systems

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<b>Apprenticeship Level</b>	4
<b>Essential Skills</b>	Thinking, Digital Technology, Reading

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#### **KNOWLEDGE**

	<b>Learning Outcomes</b>	<b>Learning Objectives</b>
H-23.01.01L	demonstrates knowledge of repairing hybrid vehicle systems	identify methods for repair of hybrid vehicle systems

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#### **H-23.02** Repairs electric vehicle (EV) systems

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<b>Apprenticeship Level</b>	4
<b>Essential Skills</b>	Thinking, Digital Technology, Reading

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#### **KNOWLEDGE**

	<b>Learning Outcomes</b>	<b>Learning Objectives</b>
H-23.02.01L	demonstrates knowledge of repairing EV systems	identify methods for repairing EV systems

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# 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

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