Occupational Analyses Series

Automotive Service Technician

2011

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FOREWORD

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this National Occupational Analysis (NOA) as the national standard for the occupation of Automotive Service Technician.

Background

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to cooperate with provincial and territorial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. To this end, Human Resources and Skills Development Canada (HRSDC) sponsors a program, under the guidance of the CCDA, to develop a series of NOAs.

The NOAs have the following objectives:

- to describe and group the tasks performed by skilled workers;
- to identify which tasks are performed in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Red Seal Examinations and curricula for training leading to the certification of skilled workers;
- to facilitate the mobility of apprentices and skilled workers in Canada; and,
- to supply employers, employees, associations, industries, training institutions and governments with analyses of occupations.

ACKNOWLEDGEMENTS

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

Special acknowledgement is extended by HRSDC and the CCDA to the representatives from the trade across Canada who contributed to the development of this document.

This analysis was prepared by the Workplace Partnerships Directorate of HRSDC. The coordinating, facilitating and processing of this analysis were undertaken by employees of the NOA development team of the Trades and Apprenticeship Division. Sid Karlinsky for the host jurisdiction of Ontario also participated in the development of this NOA.

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* National Occupational Classification

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Requests for printed copies of NOAs may be forwarded to:

Trades and Apprenticeship Division
Workplace Partnerships Directorate
Human Resources and Skills Development Canada
140 Promenade du Portage, Phase IV, 5th Floor
Gatineau, Quebec K1A 0J9

These publications can be ordered or downloaded online at: www.red-seal.ca. Links to Essential Skills Profiles for some of these trades are also available on this website.

To facilitate understanding of the occupation, the work performed by tradespersons is divided into the following categories:

Blocks	the largest division within the analysis that is comprised of a distinct set of trade activities
Tasks	distinct actions that describe the activities within a block
Sub-Tasks	distinct actions that describe the activities within a task
Key Competencies	activities that a person should be able to do in order to be called 'competent' in the trade

The analysis also provides the following information:

Context	information to clarify the intent and meaning of tasks
Trends	changes identified that impact or will impact the trade including work practices, technological advances, and new materials and equipment
Related Components	a list of products, items, materials and other elements relevant to the block
Tools and Equipment	categories of tools and equipment used to perform all tasks in the block; these tools and equipment are listed in Appendix A
Required Knowledge	the elements of knowledge that an individual must acquire to adequately perform a task

The appendices located at the end of the analysis are described as follows:

Appendix A — Tools and Equipment	a non-exhaustive list of tools and equipment used in this trade
Appendix B — Glossary	definitions or explanations of selected technical terms used in the analysis
Appendix C — Acronyms	a list of acronyms used in the analysis with their full name
Appendix D — Block and Task Weighting	the block and task percentages submitted by each jurisdiction, and the national averages of these percentages; these national averages determine the number of questions for each block and task in the Interprovincial exam
Appendix E — Pie Chart	a graph which depicts the national percentages of exam questions assigned to blocks
Appendix F — Task Profile Chart	a chart which outlines graphically the blocks, tasks and sub-tasks of this analysis

DEVELOPMENT AND VALIDATION OF ANALYSIS

Development of Analysis

A draft analysis is developed by a committee of industry experts in the field led by a team of facilitators from HRSDC. This draft analysis breaks down all the tasks performed in the occupation and describes the required knowledge and key competencies required for a tradesperson to demonstrate competence in the trade.

Draft Review

The NOA development team then forwards a copy of the analysis and its translation to provincial and territorial authorities for a review of its content and structure. Their recommendations are assessed and incorporated into the analysis.

Validation and Weighting

The analysis is sent to all provinces and territories for validation and weighting. Participating jurisdictions consult with industry to validate and weight the document, examining the blocks, tasks and sub-tasks of the analysis as follows:

BLOCKS	Each jurisdiction assigns a percentage of questions to each block for an examination that would cover the entire trade.
TASKS	Each jurisdiction assigns a percentage of exam questions to each task within a block.
SUB-TASKS	Each jurisdiction indicates, with a YES or a NO, whether or not each sub-task is performed by skilled workers within the occupation in its jurisdiction.

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

This method for the validation of the NOA also identifies common core sub-tasks across Canada for the occupation. If at least 70% of the responding jurisdictions perform a sub-task, it shall be considered common core. Interprovincial Red Seal Examinations are based on the common core sub-tasks identified through this validation process.

Definitions for Validation and Weighting

YES	sub-task performed by qualified workers in the occupation in a specific jurisdiction
NO	sub-task not performed by qualified workers in the occupation in a specific jurisdiction
NV	analysis Not Validated by a province/territory
ND	trade Not Designated in a province/territory
NOT COMMON CORE (NCC)	sub-task, task or block performed by less than 70% of responding jurisdictions; these will not be tested by the Interprovincial Red Seal Examination for the trade
NATIONAL AVERAGE %	average percentage of questions assigned to each block and task in Interprovincial Red Seal Examination for the trade

Provincial/Territorial Abbreviations

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

ANALYSIS

Safe working procedures and conditions, accident prevention, and the preservation of health are of primary importance to industry in Canada. These responsibilities are shared and require the joint efforts of government, employers and employees. It is imperative that all parties are aware of circumstances and conditions that may lead to injury or harm. Safe learning experiences and work environments can be created by controlling the variables and behaviours that may contribute to accidents or injury.

It is generally recognized that safety-conscious attitudes and work practices contribute to a healthy, safe and accident-free work environment.

It is imperative to apply and be familiar with the Occupational Health and Safety (OH&S) Acts and Workplace Hazardous Materials Information System (WHMIS) regulations. As well, it is essential to determine workplace hazards and take measures to protect oneself, co-workers, the public and the environment.

Safety education is an integral part of training in all jurisdictions. As safety is an imperative part of all trades, it is assumed and therefore it is not included as a qualifier of any activities. However, the technical safety tasks and sub-tasks specific to the trade are included in this analysis.

SCOPE OF THE AUTOMOTIVE SERVICE TECHNICIAN TRADE

"Automotive Service Technician" is this trade's official Red Seal occupational title approved by the CCDA. This analysis 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 Technician Level 4										✓			
Motor Vehicle Mechanic							✓						

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, drive trains, suspension, electrical, 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 repair, an increasing number of technicians specialize in specific areas of 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 driving skills and a valid driver's licence.

Experienced automotive service technicians may advance to shop supervisor or service manager positions. Some technicians may open their own garage or automotive specialty shop. With additional training, 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.

There is a push from consumers and governments towards lowering emissions and improving fuel economy. Toward this end, lighter and stronger materials are being used. More complex and powerful vehicle management systems are also being utilized.

Hybrids and electric vehicles are becoming more popular and widely used by consumers. New technology such as fuel cells and hydrogen vehicles may emerge in the coming years. This will have significant effects on repair facilities and safety in the technicians' workplace. This will also lead to an increased requirement for enhanced training in the industry.

In some areas of Canada, alternate fuels are being used in more vehicles, such as fleet vehicles. Technicians must become more aware of these new systems. Some technicians are specializing in these new technologies.

Other new technologies include audio system and vehicle monitoring through satellite communications, automated braking systems and lane changing and parking assistance.

Vehicle management systems that integrate multiple systems such as safety, suspension, and braking systems are becoming standard. These systems utilize safety precautions such as skid control, traction control and supplemental restraint system (SRS) functions.

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 a resource in this trade 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 rebuilt components.

Maintenance of vehicles has changed. Maintenance service requirements have become more stringent. Customers are becoming more aware of the need for the manufacturer's required maintenance services. There is a much greater variety in vehicle-specific products available for maintaining and upgrading vehicles.

BLOCK A OCCUPATIONAL SKILLS

Context	This block includes work practices that automotive service technicians perform throughout their trade.
Trends	There are more specialized tools being used in the trade. Environmental and safety considerations have become more prevalent in this industry.
Related Components	All components apply.
Tools and Equipment	See Appendix A.

Task 1 Uses and maintains tools and equipment.

Required Knowledge

K 1	types of tools and equipment such as hand tools, power tools, welding/cutting devices, shop equipment, and diagnostic and measuring tools
K 2	calibration schedules and requirements for precision equipment
K 3	hoisting and lifting practices and training requirements
K 4	types and applications of personal protective equipment (PPE) and safety equipment
K 5	inspection and maintenance schedules for equipment such as hoists and lifts

Sub-task

A-1.01 Maintains tools and equipment.

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

Key Competencies

A-1.01.01	store and organize tools and equipment
A-1.01.02	inspect tools and equipment regularly to recognize wear, damage or defects
A-1.01.03	lubricate tools and equipment

Sub-task

A-1.02 Uses hoisting and lifting equipment.

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

Key Competencies

A-1.02.01	determine vehicle lifting points and required adapters and extensions in order to balance vehicle on the hoist to prevent damage to the vehicle and to ensure personnel safety
A-1.02.02	determine equipment capacity in relation to the vehicle or item to be lifted
A-1.02.03	apply safety practices specific to hoisting and lifting procedures
A-1.02.04	determine safe working operation and maintenance of hoisting and lifting equipment

Sub-task

A-1.03 Uses personal protective equipment (PPE) and safety equipment.

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

Key Competencies

A-1.03.01	inspect and maintain PPE and safety equipment
A-1.03.02	recognize worksite hazards that require the use of PPE and safety equipment

A-1.03.03	select PPE and safety equipment required for specific tasks
A-1.03.04	apply local, provincial and national safety regulations such as WHMIS

Task 2 Performs common trade activities.

Required Knowledge

K 1	industry specific software
K 2	technical terminology
K 3	sources of technical information such as technical service bulletins (TSB), service manuals and websites
K 4	vehicle identification number (VIN) structure and meaning
K 5	government regulations such as WHMIS
K 6	location of safety equipment such as first aid equipment, fire extinguishers and eye wash stations
K 7	company policies
K 8	costing and estimating procedures

Sub-task

A-2.01 Uses technical information.

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

Key Competencies

A-2.01.01	utilize industry specific software and computer practices to access technical diagnostic and repair information
A-2.01.02	locate required information by category and keyword searches
A-2.01.03	interpret and apply technical information to situation
A-2.01.04	create documents such as repair orders, estimates and maintenance reports

Sub-task

A-2.02 Estimates preliminary job cost.

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

Key Competencies

A-2.02.01	utilize industry specific and proprietary software to determine labour costs and parts costs
A-2.02.02	determine amount of time required to complete a job
A-2.02.03	determine price of parts needed to complete a job
A-2.02.04	calculate total estimated cost
A-2.02.05	coordinate with other staff such as partspersons, suppliers, service advisors and cashiers

Sub-task

A-2.03 Maintains safe work environment.

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

Key Competencies

A-2.03.01	recognize worksite hazards that require the use of PPE and safety equipment
A-2.03.02	recognize potential hazards such as noise level, air quality, and flammable and explosive materials
A-2.03.03	apply local, provincial and national safety regulations such as WHMIS
A-2.03.04	clean, handle, remove and dispose of hazardous materials such as air bags, batteries and shocks according to jurisdictional regulations
A-2.03.05	perform visual inspection of vehicles and surrounding work area

BLOCK B ENGINE AND ENGINE SUPPORT SYSTEMS

Context

Technicians' work on engines and engine subsystems includes mechanical repair of the basic engine and the diagnosis and repair of the support systems to that engine. This section also includes sub-tasks performed by technicians who work with diesel fuel systems.

All diagnostic and repair tasks must be performed according to manufacturers' specifications.

Trends

There are advances in engine design such as variable valve timing, displacement on demand, and variable manifold runners. Advances in diesel and gasoline engine emissions technology are being introduced. Engines and support systems have become considerably lighter using new and advanced materials such as composites, magnesium, aluminium and plastic. There is more variation in cooling and lubrication systems and fluids (oil, coolant, synthetics). Fuel monitoring systems are becoming more efficient, resulting in increased power and lower emissions.

Related Components (including, but not limited to)

Cooling system: water pump, thermostat, expansion tanks, reservoir, belts, hoses, fan, radiator, radiator cap, heater core, control valves, clamps, temperature senders, gauges, warning indicators, heat exchanger.

Lubricating system: oil pumps, filters, hoses, lines, pickup screens, sump, coolers, level indicators, senders, gauges, warning indicators.

Base engine: cylinder block, bearings, crankshaft, connecting rods, pistons, piston rings, camshafts and related timing components, valve trains, cylinder heads, flywheels, balance shafts, gaskets, seals, mounts.

Fuel delivery system (gasoline, ethanol, bio-diesel, flex fuel and diesel): fuel pump, lines, regulators, tanks, filters, water separators, gauges, senders, fuel injectors, injection pump, transfer pump.

Ignition system: distributor, cap and rotor, coil, spark plugs, spark plug wires, primary ignition trigger, crankshaft or camshaft position sensor.

Intake/exhaust system: upper and lower intake manifolds, ducting, air cleaners, throttle plates or bodies, crankcase breathers, exhaust manifolds, pipes, mufflers, catalytic converters, turbo and superchargers, intercoolers, exhaust back pressure devices, mounting hardware, diesel particulate filters.

Related Components (including, but not limited to) (cont'd)	**Emission system:** catalytic converter, positive crankcase ventilation (PCV) systems, O_2 sensors, exhaust gas recirculation (EGR) systems, vacuum pump, evaporative emission control (EVAP) systems, closed loop fuel injection system, secondary air injection system. **Accessory drive system and mounting components:** belts, pulleys, tensioners, idlers, brackets, braces, hangers, bearings, mounts. **Diesel engine support system:** glow plugs, air preheaters, engine preheaters, diesel emission systems.
Tools and Equipment	See Appendix A.

Task 3 Diagnoses engine systems.

Required Knowledge

K 1	types of cooling systems such as liquid and air cooled
K 2	cooling system components such as gaskets, thermostats and water pumps
K 3	cooling system integration with other systems such as hybrid systems
K 4	warning systems such as lights, gauges and switches
K 5	fan systems such as mechanical, electric and hydraulic
K 6	types of coolants and chemical additives
K 7	related systems such as HVAC and auxiliary coolers
K 8	composition of lubricants such as grades of oil, synthetics and additives
K 9	types of oil pumps and drives such as gerotor, vane type and gear type
K 10	oil coolers such as oil-to-air and oil-to-coolant
K 11	oil flow and filtration methods
K 12	gaskets, seals and sealants
K 13	types of engine configurations such as inline, rotary, opposed and V-type
K 14	types of valve train configurations such as push rod, overhead cam, multi-valve and variable valve timing
K 15	engine timing components such as timing belts, chains, gear drive and variable valve timing mechanism
K 16	engine component clearances and specifications

Sub-task

B-3.01 Diagnoses cooling systems.

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

Key Competencies

B-3.01.01	inspect components for wear, damage and defects
B-3.01.02	analyze coolant conditions (concentration, chemistry and contamination) using procedures such as acidity test, visual inspection and freeze point test
B-3.01.03	select and use diagnostic tools and equipment such as pressure testers, coolant strength testers and infrared temperature guns
B-3.01.04	identify restrictions in air and coolant flow
B-3.01.05	check for operation of water pump and thermostat
B-3.01.06	check electronically-controlled system operation for conditions such as blown fuses, seized motors, broken wires, and sensors out of range or blown
B-3.01.07	check mechanical system operation for conditions such as malfunctioning fan and belt slippage and incorrect routing
B-3.01.08	pressurize cooling and pressure regulating devices such as radiator pressure cap in order to test their ability to maintain required operating pressures and to locate leaks in system
B-3.01.09	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

B-3.02 Diagnoses lubricating systems.

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

Key Competencies

B-3.02.01	inspect lubricant for contamination and levels
B-3.02.02	inspect components for leaks, and failed gaskets and seals
B-3.02.03	select and use diagnostic tools and equipment such as pressure gauge, and black light and dye

B-3.02.04	take oil pressure readings at different operating temperatures
B-3.02.05	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

B-3.03 Diagnoses base engine.

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

Key Competencies

B-3.03.01	select and use diagnostic tools such as scan tool, compression testers and measuring tools
B-3.03.02	perform tests such as cylinder leak-down, compression and vacuum
B-3.03.03	identify and distinguish sources of noises, vibrations and harshness (NVH) in engine components such as valve train, pistons and crankshaft
B-3.03.04	recognize worn, damaged, and defective components such as worn camshafts, bearings and rings
B-3.03.05	inspect valve timing and adjustment
B-3.03.06	take measurements of base engine components and compare to manufacturers' specifications
B-3.03.07	interpret and analyze results of functional tests and inspections to determine required repair

Task 4 Repairs engine systems.

Required Knowledge

K 1	types of cooling systems such as liquid and air cooled
K 2	cooling system components such as gaskets, thermostats and water pumps
K 3	cooling system integration with other systems such as hybrid systems
K 4	warning systems such as lights, gauges and switches
K 5	fan systems such as mechanical, electric and hydraulic
K 6	types of coolants and chemical additives
K 7	related systems such as HVAC and auxiliary coolers
K 8	water quality suitable for cooling systems

K 9	composition of lubricants such as grades of oil, synthetics and additives
K 10	types of oil pumps and drives such as gerotor, vane type and gear type
K 11	oil coolers such as oil-to-air and oil-to-coolant
K 12	oil flow and filtration methods
K 13	electronic oil level and oil quality monitoring
K 14	gaskets, seals and sealants
K 15	types of engine configurations such as inline, rotary, opposed and V
K 16	types of valve train configurations such as push rod, overhead cam, multi-valve and variable valve timing
K 17	engine timing components such as timing belts, chains and gear drives
K 18	engine component clearances and specifications
K 19	engine hoisting and repair mounting fixtures
K 20	fasteners used in base engine repair
K 21	handling and disposal of hazardous materials such as coolants and lubricants

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Sub-task

B-4.01 Repairs cooling systems.

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

Key Competencies

B-4.01.01	select and use repair tools and equipment such as pressure testers and automated refill devices
B-4.01.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-4.01.03	remove and replace cooling system components such as radiators, hoses, gaskets, thermostats and water pumps
B-4.01.04	distinguish types and characteristics of coolants in order to avoid mixing incompatible types and to ensure required concentrations
B-4.01.05	drain, flush, refill and bleed coolant system
B-4.01.06	complete repair by verifying system's function and performance

Sub-task

B-4.02 Repairs lubricating systems.

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

Key Competencies

B-4.02.01	select and use repair tools and equipment such as plastic gauge, oil pressure gauge and measuring tools
B-4.02.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-4.02.03	remove, replace, recondition or service components as per manufacturers' procedures and specifications
B-4.02.04	identify and select specified lubricants
B-4.02.05	identify and select specified sealants
B-4.02.06	take final base engine measurements to ensure correct oil pressure
B-4.02.07	perform maintenance procedures such as changing oil and filter
B-4.02.08	perform priming and prelubrication of oil pressure system
B-4.02.09	complete repair by verifying system's function and performance

Sub-task

A-4.03 Repairs base engine.

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

Key Competencies

B-4.03.01	select and use repair tools and equipment such as hand tools, plastic gauge, straight edge and micrometer
B-4.03.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-4.03.03	remove, disassemble and inspect engine components for conditions such as damage and wear
B-4.03.04	remove, replace, recondition or service components as per manufacturers' procedures and specifications
B-4.03.05	reassemble engine components and perform measurements
B-4.03.06	torque components according to sequence and specifications

B-4.03.07	perform mechanical engine timing procedures
B-4.03.08	adjust base engine components and parts
B-4.03.09	perform pre-lubrication and priming procedures
B-4.03.10	install engine and engine components
B-4.03.11	complete repair by verifying system's function and performance

Task 5 Diagnoses engine support systems.

Required Knowledge

K 1	types of fuel delivery systems such as returnless, high pressure and low pressure
K 2	types of fuel such as gasoline and diesel
K 3	fuel handling and storage procedures
K 4	types of gasoline fuel injection systems such as direct injection, single-point, multiport and sequential
K 5	types of diesel, ethanol, bio-diesel or flex fuel injection systems such as direct injection, indirect (pre-combustion) injection and common rail systems
K 6	diesel exhaust fluid system operation
K 7	types of ignition systems such as distributor and distributorless
K 8	ignition system components such as wires, coils, spark plugs, distributors, rotor and cap
K 9	electronic circuits such as cam, knock and crank sensors
K 10	types of intake/exhaust systems
K 11	intake air flow control systems and components such as intercoolers
K 12	exhaust components such as catalytic converters, valves and mufflers
K 13	composition of intake/exhaust system components
K 14	types of emission gases such as carbon monoxide (CO), carbon dioxide (CO_2), oxides of nitrogen (NO_x) and hydrocarbons (HC)
K 15	types of control devices such as EGR, EVAP and secondary air injection
K 16	industry standard on-board diagnostics systems such as first generation (OBD I) and second generation (OBD II) on-board diagnostics systems
K 17	types of accessory drive belt systems
K 18	types of accessory drive belt tensioners
K 19	engine, transmission and exhaust mounts
K 20	electronic engine mount operation

Sub-task

B-5.01 Diagnoses fuel delivery systems.

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

Key Competencies

B-5.01.01	select and use tools and equipment such as fuel pressure gauges, scan tool, vacuum gauges and digital voltage ohmmeter (DVOM)
B-5.01.02	identify type of fuel delivery systems such as sequential and non-sequential fuel systems
B-5.01.03	inspect and test fuel properties such as quality, colour and odour
B-5.01.04	perform fuel system tests such as pressure, volume and fuel injector flow
B-5.01.05	isolate fuel system problems such as engine misfires and lack of power
B-5.01.06	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

B-5.02 Diagnoses ignition systems.

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

Key Competencies

B-5.02.01	select and use tools and equipment such as meters, scan tool and spark testers
B-5.02.02	perform ignition measurements such as coil, primary and secondary circuits
B-5.02.03	inspect ignition system components for wear and damage
B-5.02.04	perform ignition system tests such as spark duration and timing
B-5.02.05	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

B-5.03 Diagnoses intake/exhaust systems.

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

Key Competencies

B-5.03.01	select and use tools and equipment such as scan tool, vacuum gauge and exhaust back pressure gauge
B-5.03.02	inspect intake and exhaust systems for leaks or blockages
B-5.03.03	take measurements on turbo and superchargers such as end play and boost
B-5.03.04	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

B-5.04 Diagnoses emission systems.

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

Key Competencies

B-5.04.01	select and use tools and equipment such as scan tool and EVAP leak detectors
B-5.04.02	determine vehicle's type of emission system and components
B-5.04.03	inspect emission system to identify condition and functionality of components
B-5.04.04	test emission control systems such as EGR, EVAP and PCV
B-5.04.05	access fault codes such as OBD I and OBD II diagnostic codes
B-5.04.06	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

B-5.05 Diagnoses accessory drive systems and mounts.

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

Key Competencies

B-5.05.01	select and use tools and equipment such as infrared temperature guns, laser tool and straight edge
B-5.05.02	check accessory drive pulley alignment
B-5.05.03	identify type of drive pulley system such as serpentine and V-belt
B-5.05.04	identify cause of noise and vibration
B-5.05.05	measure belt tension against manufacturers' specifications
B-5.05.06	inspect mounts for damage and wear
B-5.05.07	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

B-5.06 Diagnoses diesel engine support systems.

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

Key Competencies

B-5.06.01	select and use tools and equipment such as fuel pressure gauges, vacuum gauges, scan tool, pyrometer and DVOM
B-5.06.02	identify type of diesel fuel delivery systems such as direct injection, indirect (pre-combustion) injection and common rail systems
B-5.06.03	follow pressure-handling procedures for testing diesel fuel systems in order to attain a safe pressure according to manufacturers' specifications
B-5.06.04	inspect and test diesel fuel properties such as quality, colour and odour
B-5.06.05	perform diesel fuel system tests such as pressure, volume and restriction
B-5.06.06	check diesel system parameters such as timing and fuel rate
B-5.06.07	isolate diesel system problems such as engine misfires and lack of power
B-5.06.08	check condition of pre-heating components such as glow plugs, air heaters and fuel heaters

B-5.06.09	test diesel particulate filters for conditions such as inlet and outlet temperatures and pressures using a scan tool
B-5.06.10	interpret and analyze results of functional tests and inspections to determine required repair

Task 6 Repairs engine support systems.

Required Knowledge

K 1	types of fuel delivery systems such as returnless, high pressure and low pressure
K 2	types of fuel such as gasoline, diesel, ethanol and bio-diesel
K 3	fuel handling and storage procedures
K 4	types of gasoline fuel injection systems such as direct injection, single-point, multiport and sequential
K 5	types of diesel fuel injection systems such as direct injection, indirect (pre-combustion) injection and common rail systems
K 6	jurisdictional regulations and certification requirements such as emission programs
K 7	types of ignition systems such as distributor and distributorless
K 8	ignition system components such as wires, coils, spark plugs and distributors
K 9	electronic circuits
K 10	types of intake/exhaust systems
K 11	intake air flow control systems and components such as intercoolers
K 12	exhaust components such as catalytic converters, valves and mufflers
K 13	composition of intake/exhaust system components
K 14	types of control systems such as EGR, EVAP and secondary air injection
K 15	industry standard on-board diagnostics systems such as OBD I and OBD II
K 16	types of accessory drive belt systems
K 17	types of accessory drive belt tensioners
K 18	engine, transmission and exhaust mounts

Sub-task

B-6.01 Repairs gasoline delivery systems.

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

Key Competencies

B-6.01.01	select and use repair tools and equipment such as fuel pressure gauge, fuel pressure relief device, and fuel transfer and storage equipment
B-6.01.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-6.01.03	remove, clean and replace fuel system components such as fuel filters, injectors and pumps
B-6.01.04	perform fuel system maintenance procedures such as fuel injector flushes
B-6.01.05	complete repair by verifying system's function and performance

Sub-task

B-6.02 Repairs ignition systems.

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

Key Competencies

B-6.02.01	select and use tools and equipment such as scan tool, hand tools, gauges and spark plug gappers
B-6.02.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-6.02.03	remove, replace, recondition or service components as per manufacturers' procedures and specifications
B-6.02.04	measure and adjust clearances such as spark plug gap and sensor clearances
B-6.02.05	complete repair by verifying system's function and performance

Sub-task

B-6.03 Repairs intake/exhaust systems.

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

Key Competencies

B-6.03.01	select and use tools and equipment such as scan tool, hand tools, torches, MIG welders and pressure relief devices
B-6.03.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-6.03.03	remove and replace intake/exhaust systems components such as manifolds, mufflers and intercoolers
B-6.03.04	prime, lubricate and service turbo and superchargers
B-6.03.05	maintain intake system such as cleaning throttle valve, servicing mass airflow sensors and replacing air filter
B-6.03.06	complete repair by verifying system's function and performance

Sub-task

B-6.04 Repairs emission systems.

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

Key Competencies

B-6.04.01	select and use tools and equipment such as hand tools, scan tool and leak detection equipment
B-6.04.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-6.04.03	remove and replace emission system components such as sensors, valves and modules
B-6.04.04	maintain emission system such as cleaning EGR valves/passages and replacing filters
B-6.04.05	complete repair by verifying system's function and performance

Sub-task

B-6.05 Repairs accessory drive systems and mounts.

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

Key Competencies

B-6.05.01	select and use tools and equipment such as scan tool, hand tools, tension relief devices, pullers and installers
B-6.05.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-6.05.03	remove and replace accessory drive system components such as tensioners, belts and pulleys
B-6.05.04	remove and replace mounts
B-6.05.05	adjust accessory system components such as V-belts and serpentine belts
B-6.05.06	complete repair by verifying system's function and performance

Sub-task

B-6.06 Repairs diesel engine support systems.

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

Key Competencies

B-6.06.01	select and use repair tools and equipment such as hand tools, specialized pressure gauges and scan tool
B-6.06.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
B-6.06.03	depressurize diesel system in order to remove and disassemble system
B-6.06.04	remove, disassemble and inspect diesel fuel system for conditions such as damage, wear and contamination
B-6.06.05	clean and repair diesel fuel system components such as high pressure lines
B-6.06.06	fit and replace diesel fuel system components and parts
B-6.06.07	reassemble diesel system components and perform measurements
B-6.06.08	torque components according to sequence and specifications
B-6.06.09	pressurize and bleed system

B-6.06.10	perform diesel fuel system timing procedures
B-6.06.11	complete repair by verifying system's function and performance

BLOCK C VEHICLE MANAGEMENT SYSTEMS

Context	Vehicle management systems control the vehicle by monitoring inputs and outputs to modules in order to make decisions based on preset parameters. Vehicle management systems ensure the efficient operation of major components such as the engine and transmission. All diagnostic and repair tasks must be performed according to manufacturers' specifications.
Trends	There is an increased use of modules and networking resulting in more shared information. Non-direct linked systems such as drive-by wire systems are increasingly being used. More modules have self-diagnostic and communication capabilities. There is a reduction in the size and number of wires. There is a move to more sophisticated scan tools and there is an increase in the amount of information available via the Internet and electronic bulletins.
Related Components (including, but not limited to)	Wiring, connectors, modules, input and output devices.
Tools and Equipment	Standard tool kit, PPE and safety equipment, scan tool, break-out boxes, anti-static devices.

Task 7 Diagnoses vehicle management systems.

Required Knowledge

K 1	diagnostic trouble code (DTC) types and formats such as OBD I and OBD II industry standards
K 2	types of networks such as International Standards Organization (ISO), high-speed (HS), controller area network (CAN) and universal asynchronous receiver transmitter (UART)
K 3	diagnostic code protocols and actions
K 4	types, operation and interrelationship of modules
K 5	types of parameters such as revolutions per minute (RPM), throttle position sensor (TPS) and vehicle speed sensor (VSS)

K 6	relationship of various parameters
K 7	parameter definitions
K 8	network circuitry types
K 9	input and output modules

Sub-task

C-7.01 Reads diagnostic trouble codes (DTCs).

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

Key Competencies

C-7.01.01	distinguish between OBD I and OBD II diagnostic systems to determine tools used, data link connection (DLC) location and system operation
C-7.01.02	select and use scan tool to read codes such as powertrain control module (PCM) and transmission control module (TCM)
C-7.01.03	perform functional tests to find DTCs
C-7.01.04	refer to manufacturers' diagnostic sequence for code definition

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Sub-task

B-7.02 Monitors parameters.

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

Key Competencies

B-7.02.01	select and use scan tool to monitor parameters such as TPS, EGR and intake air temperature (IAT)
B-7.02.02	use DVOM to monitor parameters
B-7.02.03	select and organize relevant parameters to compare results
B-7.02.04	record parameters for playback to aid with diagnosis

Sub-task

C-7.03 Interprets test results.

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

Key Competencies

C-7.03.01	interpret relative parameters to compare results with manufacturers' specifications
C-7.03.02	determine faulty circuitry and components
C-7.03.03	refer to recorded parameters to assist in diagnosis

Sub-task

C-7.04 Tests system circuitry and components.

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

Key Competencies

C-7.04.01	select and use tools such as DVOM, jumper wires, circuit tester and break-out box to test system circuitry and components such as wiring, sensors and modules according to manufacturers' specifications
C-7.04.02	determine faulty circuitry and components

Task 8 Repairs vehicle management systems.

Required Knowledge

K 1	methods of software transfer
K 2	basic computer processes
K 3	types of components such as control module, wire harnesses, input and output devices
K 4	circuit orientation such as twisted pair and shielded wire
K 5	types of wiring repair procedures such as soldering and crimping

K 6	drive cycles using OBD protocols to enable monitors to verify repairs
K 7	methods of verifying repair such as clear codes, retest and road test using drive cycles

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Sub-task

C-8.01 Updates component software.

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

Key Competencies

C-8.01.01	select and use scan tool to update module software
C-8.01.02	program modules using manufacturers' specifications and updated documentation such as service bulletins
C-8.01.03	configure modules according to vehicle requirements and options
C-8.01.04	verify operation of updated modules

Sub-task

C-8.02 Replaces components.

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

Key Competencies

C-8.02.01	select and use tools and equipment such as hand tools, scan tool and specialized tools
C-8.02.02	follow vehicle-specific cautionary procedures such as using anti-static straps and disabling restraint systems
C-8.02.03	transfer module-specific data to component
C-8.02.04	identify and install compatible electronic components according to the vehicle specifications

Sub-task

C-8.03 Verifies vehicle management system repair.

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

Key Competencies

C-8.03.01	perform road test completing drive cycle
C-8.03.02	select and use scan tool to verify and confirm system repair

BLOCK D DRIVE LINE SYSTEMS

Context

Drive line systems provide a means of transmitting energy from the engines/motors to the drive wheels in complex and innovative methods.

All diagnostic and repair tasks must be performed according to manufacturers' specifications.

Trends

In today's automotive industry, there is an increase in electronically-controlled drive line systems that include specialized fluids, innovative transmission/transaxle designs and an increase in selection of gear ranges. There is a variety of transmission designs including those found in hybrid vehicles. Automatic transmissions are evolving into computer controlled automatically shifting manual transmissions.

Related Components (including, but not limited to)

Mounts, brackets, linkages, cables, hydraulic lines, coolers, sensors, modules, actuators, solenoids, flex plates, ring gear, torque converters, heat shields, seals, wiring harnesses, vacuum lines, vibration dampers, shifters, flywheels, transmissions, transaxles, transfer cases, clutches, drive shafts, constant velocity (CV) axle shafts, final drive assemblies.

Tools and Equipment

Standard tool kit, PPE and safety equipment, hoisting and lifting equipment, scan tool, pullers, presses, pressure gauges, spreaders, clutch alignment tools, installers and removers, flushing and bleeding equipment, oxy-acetylene torches, parts washers, hydraulic transmission jack, jack stands and supports, engine and transmission supports, chassis ears, electronic vibration analyzer.

Task 9 Diagnoses drive line systems.

Required Knowledge

K 1	drive shaft types and construction such as single, two-piece and steel, aluminium and composite construction
K 2	types of drive shaft components such as slip yoke, support bearings, single and double cardan joints
K 3	types of axles such as CV axle shafts, solid axles, full-floating and semi-floating
K 4	multiple piece drive shaft phasing/indexing

K 5	safety precautions
K 6	types and operation of manual and automatic transmissions/transaxles
K 7	path of power from engine to wheels
K 8	types of fluids, lubricants and additives
K 9	gear ratios
K 10	transmission cooling systems
K 11	control systems
K 12	hydraulic system components such as pumps, valves, filters and torque converters
K 13	mechanical system components such as clutch packs, shafts and planetary gear sets
K 14	types and operation of clutches/flywheels
K 15	hydraulics/linkage systems
K 16	types and operation of transfer cases such as manual or automatic
K 17	control systems such as vacuum, manual and electronic
K 18	types of final drive assemblies such as integral, removable, locking and limited slip

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Sub-task

D-9.01 Diagnoses drive shafts and axles.

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

Key Competencies

D-9.01.01	perform road test to identify drive shaft and axle concerns such as vibrations and noises
D-9.01.02	select and use diagnostic tools such as sirometer, inclinometer, dial indicator and hand tools
D-9.01.03	identify type of drive shaft and axle system such as single or multiple piece drive shaft, CV, full-floating and semi-floating axles
D-9.01.04	inspect vehicle's drive shaft and axle components in accordance with manufacturers' specifications and inspection procedures
D-9.01.05	perform functional tests as per manufacturers' procedures and specifications
D-9.01.06	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

D-9.02 Diagnoses manual transmissions/transaxles.

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

Key Competencies

D-9.02.01	perform road test to identify manual transmission/transaxle concerns such as vibrations, noises and driveability
D-9.02.02	select and use diagnostic tools such as sirometer, stethoscope and hand tools
D-9.02.03	identify model of manual transmission/transaxle
D-9.02.04	check fluid level and condition, inspect for leaks or damage
D-9.02.05	inspect manual transmission/transaxle components in accordance with manufacturers' specifications and inspection procedures
D-9.02.06	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

D-9.03 Diagnoses automatic transmissions/transaxles.

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

Key Competencies

D-9.03.01	perform road test to identify automatic transmission/transaxle concerns such as vibrations, noises and driveability
D-9.03.02	identify model of automatic transmission/transaxle
D-9.03.03	check fluid level and condition and inspect for leaks or damage
D-9.03.04	select and use diagnostic tools such as pressure gauge, scan tool and hand tools
D-9.03.05	inspect automatic transmission/transaxle components in accordance with manufacturers' specifications and inspection procedures
D-9.03.06	perform functional tests as per manufacturers' procedures and specifications
D-9.03.07	inspect and test electrical components such as solenoid, switches and pressure sensors
D-9.03.08	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

D-9.04 Diagnoses clutches.

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

Key Competencies

D-9.04.01	perform road test to identify clutch concerns such as slippage, vibrations, odour and driveability
D-9.04.02	identify type of clutch control such as manual or hydraulic
D-9.04.03	check fluid level and condition and inspect for leaks or adjustment
D-9.04.04	inspect clutch components in accordance with manufacturers' specifications and inspection procedures
D-9.04.05	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

D-9.05 Diagnoses transfer cases.

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

Key Competencies

D-9.05.01	perform road test to identify transfer case concerns such as vibrations, noises and driveability
D-9.05.02	identify model of transfer case
D-9.05.03	check fluid level and condition and inspect for leaks or damage
D-9.05.04	select and use diagnostic tools such as scan tool and hand tools
D-9.05.05	inspect transfer case components in accordance with manufacturers' specifications and inspection procedures
D-9.05.06	perform functional tests as per manufacturers' procedures and specifications
D-9.05.07	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

D-9.06 Diagnoses final drive assemblies.

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

Key Competencies

D-9.06.01	perform road test to identify final drive concerns such as vibrations, noises and driveability
D-9.06.02	identify type and model of final drive assembly
D-9.06.03	check fluid level and condition, inspect for leaks or damage
D-9.06.04	select and use diagnostic tools such as scan tool, chassis ears and hand tools
D-9.06.05	inspect final drive assembly components in accordance with manufacturers' specifications and inspection procedures
D-9.06.06	perform functional tests as per manufacturers' procedures and specifications
D-9.06.07	interpret and analyze results of functional tests and inspections to determine required repair

Task 10 Repairs drive line systems.

Required Knowledge

K 1	drive shaft types and construction such as single, two-piece and steel, aluminium and composite construction
K 2	types of drive shaft components such as slip yoke, support bearings, single and double cardan joints
K 3	types of axles such as CV axle shafts, solid axles, full-floating and semi-floating
K 4	multiple piece drive shaft phasing/indexing
K 5	safety precautions
K 6	types and operation of manual and automatic transmissions/transaxles
K 7	path of power from engine to wheels
K 8	types of fluids, lubricants and additives
K 9	gear ratios
K 10	transmission cooling systems
K 11	control systems

K 12	hydraulic system components such as pumps, valves, filters and torque converters
K 13	mechanical system components such as clutch packs, shafts and planetary gear sets
K 14	types and operation of clutches/flywheels
K 15	hydraulics/linkage systems
K 16	types and operation of transfer cases such as manual or automatic
K 17	control systems such as vacuum, manual and electronic
K 18	types of final drive assemblies such as integral, removable, locking and limited slip

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Sub-task

D-10.01 Repairs drive shafts and axles.

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

Key Competencies

D-10.01.01	determine type of drive shafts and axle systems such as U-joint, CV joint, full-floating and semi-floating
D-10.01.02	select and use service tools such as measuring tools, presses and hand tools
D-10.01.03	select repair parts and materials such as gaskets, seals and lubricants according to repair requirements and manufacturers' specifications
D-10.01.04	remove, replace, recondition or service components as per manufacturers' procedures and specifications
D-10.01.05	complete repair by verifying system's function and performance

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Sub-task

D-10.02 Repairs manual transmissions/transaxles.

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

Key Competencies

D-10.02.01	determine model of manual transmission/transaxles
D-10.02.02	select and use service tools such as measuring tools, presses and hand tools

D-10.02.03 select repair parts and materials such as gaskets, seals and lubricants according to repair requirements and manufacturers' specifications

D-10.02.04 remove, disassemble, reassemble, replace, recondition or service components as per manufacturers' procedures and specifications

D-10.02.05 complete repair by verifying system's function, driveability and performance

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Sub-task

D-10.03 Repairs automatic transmissions/transaxles.

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

Key Competencies

D-10.03.01 determine type of automatic transmissions/transaxles such as CVT, electronically and manually controlled

D-10.03.02 select and use service tools such as scan tool, pressure gauges, measuring tools, presses and hand tools

D-10.03.03 select repair parts and materials such as gaskets, seals and lubricants according to repair requirements and manufacturers' specifications

D-10.03.04 remove, disassemble, reassemble, replace, recondition or service components as per manufacturers' procedures and specifications

D-10.03.05 complete repair by verifying system's function, driveability and performance

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Sub-task

D-10.04 Repairs clutches.

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

Key Competencies

D-10.04.01 determine type of clutch such as single and multi-disc systems

D-10.04.02 select and use service tools such as measuring tools, presses and hand tools

D-10.04.03 select repair parts and materials such as fluids, seals and lubricants according to repair requirements and manufacturers' specifications

D-10.04.04 remove, replace, recondition or service components as per manufacturers' procedures and specifications

D-10.04.05 complete repair by verifying system's function, driveability and performance

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Sub-task

D-10.05 Repairs transfer cases.

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

Key Competencies

D-10.05.01 determine type of transfer case such as manual and automatic

D-10.05.02 select and use service tools such as scan tool, measuring tools, presses and hand tools

D-10.05.03 select repair parts and materials such as gaskets, fluids, seals and lubricants according to repair requirements and manufacturers' specifications

D-10.05.04 remove, replace, recondition or service components as per manufacturers' procedures and specifications

D-10.05.05 complete repair by verifying system's function, driveability and performance

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Sub-task

D-10.06 Repairs final drive assemblies.

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

Key Competencies

D-10.06.01 determine type of final drive assembly such as integral, removable, locking, limited slip and torque distribution

D-10.06.02 select and use service tools such as scan tool, measuring tools, presses and hand tools

D-10.06.03 select repair parts and materials such as gaskets, fluids, seals and lubricants according to repair requirements and manufacturers' specifications

D-10.06.04 remove, replace, recondition or service components as per manufacturers' procedures and specifications

D-10.06.05 complete repair by verifying system's function, driveability and performance

BLOCK E ELECTRICAL AND COMFORT CONTROL SYSTEMS

Context	Electrical and comfort control systems include accessories, options and entertainment systems as well as the vehicle comfort system. Diagnosis and repair have to be performed according to manufacturers' specifications. Incorrect processes can result in personal injury and environmental damage.
Trends	There is an increased use of non-repairable electrical components and lighter weight materials. There are more consumer-controlled features and personalization of vehicles. New comfort features include instant cabin heat and cooled seats. Increased use of hybrid technology will change the approaches to diagnostics and repair of starting assist and braking systems. Air compressors are increasingly electrically driven instead of mechanically driven. There is an increase in automatic start/stop systems designed to increase fuel economy.
Related Components (including, but not limited to)	Batteries, alternators, starters, wiring, switches, sensors, actuators, modules, solenoids, linkages, motors, light bulbs, receivers, transmitters, heaters, relays, thermostats, hoses, pumps, nozzles, valves, mirrors, glass, displays, gauges, clusters, compressors, pipes, evaporators, condensers, accumulators, restrictors, remote starters, brake controllers, vacuum lines and reservoirs, check valves, fuses and fuse links, heater cores, connectors, terminals, fans, resistors, controllers, filters, entertainment unit.
Tools and Equipment	See Appendix A.

Task 11 Diagnoses electrical systems and components.

Required Knowledge

K 1	types and operation of starting systems
K 2	types and operation of charging systems
K 3	types of batteries such as lead acid, gel and sealed
K 4	basic wiring principles and diagrams
K 5	electrical principles such as Ohm's law and electron theory

K 6	general electrical components such as fuses, ignition switches, relays and circuit breakers
K 7	wire characteristics such as gauge and insulation
K 8	types and operation of lighting systems and components such as incandescent, light emitting diode (LED) and high intensity discharge (HID)
K 9	types and operation of wiper systems and components
K 10	types and operation of entertainment systems such as audio, video, navigation and telematics
K 11	system components such as displays, speakers and power antennae
K 12	service considerations such as temperature and location of components
K 13	types and operation of options such as power windows, parking aids, keyless entry, power seats and theft deterrent systems
K 14	special service considerations such as paint on object sensors and tint on windows
K 15	types of electrical accessories such as remote starters, brake controllers and trailer wiring
K 16	types and operation of instrumentation systems such as gauges, speedometers and tachometers
K 17	types and operation of displays such as temperature, compasses and engine monitoring

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Sub-task

E-11.01 Diagnoses starting/charging systems and batteries.

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

Key Competencies

E-11.01.01	inspect components for signs of wear, damage or failure
E-11.01.02	select and use diagnostic tools and equipment such as AVR meter, DVOM, circuit tester and scan tool
E-11.01.03	interpret and follow wiring diagrams
E-11.01.04	perform starting/charging system and battery tests such as AVR, voltage drop and parasitic draw
E-11.01.05	interpret viewed values and codes to determine condition of systems and components
E-11.01.06	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

E-11.02 Diagnoses basic wiring and electrical systems.

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

Key Competencies

E-11.02.01	inspect components and wires for signs of wear, damage or failure
E-11.02.02	inspect connectors and connections for conditions such as incorrect routing, corrosion, poor contacts and damaged terminals
E-11.02.03	select and use diagnostic tools and equipment such as DVOM, scan tool and circuit tester
E-11.02.04	interpret and follow wiring diagrams
E-11.02.05	determine and perform tests such as voltage drop and resistance check to pinpoint failure
E-11.02.06	interpret viewed values and codes to determine condition of systems and components
E-11.02.07	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

E-11.03 Diagnoses lighting and wiper systems.

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

Key Competencies

E-11.03.01	inspect components and wires for signs of wear, damage or failure
E-11.03.02	inspect connectors for conditions such as corrosion, poor contacts and damaged terminals
E-11.03.03	select and use diagnostic tools and equipment such as DVOM, scan tool and circuit tester
E-11.03.04	interpret and follow wiring diagrams
E-11.03.05	interpret viewed values and codes to determine condition of systems and components

E-11.03.06	determine and perform tests such as voltage drop and resistance check to pinpoint failure
E-11.03.07	interpret and analyze results of functional tests and inspections to determine required repair

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Sub-task

E-11.04 Diagnoses entertainment systems.

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

Key Competencies

E-11.04.01	inspect components and wires for signs of wear, damage or failure
E-11.04.02	inspect connectors for conditions such as corrosion, poor contacts and damaged terminals
E-11.04.03	select and use diagnostic tools and equipment such as DVOM, scan tool and circuit tester
E-11.04.04	interpret and follow wiring diagrams
E-11.04.05	interpret viewed values and codes to determine condition of systems and components
E-11.04.06	determine and perform tests such as voltage drop and resistance check to pinpoint failure
E-11.04.07	identify presence of aftermarket devices and ensure correct operation
E-11.04.08	activate system self-diagnosis function to retrieve trouble codes
E-11.04.09	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

E-11.05 Diagnoses electrical options.

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

Key Competencies

E-11.05.01	inspect components and wires for signs of wear, damage or failure
E-11.05.02	inspect connectors for conditions such as corrosion, poor contacts and damaged terminals
E-11.05.03	select and use diagnostic tools and equipment such as DVOM, scan tool and circuit tester
E-11.05.04	interpret and follow wiring diagrams
E-11.05.05	interpret viewed values and codes to determine condition of systems and components
E-11.05.06	determine and perform tests such as voltage drop and resistance check to pinpoint failure
E-11.05.07	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

E-11.06 Diagnoses instrumentation and information displays.

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

Key Competencies

E-11.06.01	inspect components and wires for signs of wear, damage or failure
E-11.06.02	inspect connectors for conditions such as corrosion, poor contacts and damaged terminals
E-11.06.03	select and use diagnostic tools and equipment such as DVOM, scan tool and circuit tester
E-11.06.04	interpret and follow wiring diagrams
E-11.06.05	interpret viewed values and codes to determine condition of systems and components
E-11.06.06	determine and perform tests such as voltage drop and resistance check to pinpoint failure

E-11.06.07	verify that all vehicle warning indicators such as tire pressure monitoring system (TPMS), seatbelt monitoring system and airbag monitoring system are functioning as intended (self-test and bulb check)
E-11.06.08	verify that the display is functioning as intended
E-11.06.09	identify presence of aftermarket devices and ensure correct operation
E-11.06.10	interpret and analyze results of functional tests and inspections to determine required repair

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Sub-task

E-11.07 Diagnoses electrical accessories.

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

Key Competencies

E-11.07.01	inspect components and wires for signs of wear, damage or failure
E-11.07.02	inspect connectors and harnesses for conditions such as incorrect routing, corrosion, poor contacts and damaged terminals
E-11.07.03	select and use diagnostic tools and equipment such as DVOM and circuit tester
E-11.07.04	interpret and follow wiring diagrams
E-11.07.05	interpret viewed values and codes to determine condition of systems and components
E-11.07.06	determine and perform tests such as voltage drop and resistance check to pinpoint failure
E-11.07.07	identify presence of aftermarket devices and ensure correct operation
E-11.07.08	interpret and analyze results of functional tests and inspections to determine required repair

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Task 12 Repairs electrical systems and components.

Required Knowledge

K 1	types and operation of starting systems
K 2	types and operation of charging systems
K 3	types of batteries such as lead acid, gel and sealed

K 4	electrical principles such as Ohm's law and electron theory
K 5	wiring, connectors and terminals
K 6	wire characteristics such as gauge and insulation
K 7	types and operation of lighting systems
K 8	types and operation of wiper systems
K 9	articulating headlight operation
K 10	service procedures for bulbs such as incandescent, LED and HID
K 11	governmental regulations regarding lighting
K 12	types and operation of entertainment systems such as audio, video and navigation
K 13	components of entertainment systems
K 14	location considerations such as temperature and moving parts
K 15	anti-theft features
K 16	types and operation of electrical options such as sensors, programmable keys and key fobs
K 17	repair procedures such as calibration and configuration
K 18	special service considerations such as paint on object sensors and tint on windows
K 19	types of electrical accessories such as remote starters, brake controllers and trailer wiring
K 20	requirements for accessories such as bracing, additional wiring and heavy duty flashers
K 21	types and operation of instrumentation and displays
K 22	legislation regarding odometer servicing
K 23	safety concerns related to components such as gas tank, fuel gauge and airbags

Sub-task

E-12.01 Repairs starting/charging systems and batteries.

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

Key Competencies

E-12.01.01	select and use tools and equipment such as scan tool, hand tools, DVOM and specialized tools
E-12.01.02	select repair parts and materials such as lubricants and fastening devices according to repair requirements and manufacturers' specifications
E-12.01.03	remove components to access defective parts such as alternators, starters and batteries
E-12.01.04	replace or repair components according to manufacturers' specifications and recommendations
E-12.01.05	determine component serviceability according to parts availability and cost effectiveness
E-12.01.06	complete repair by verifying system's function and performance

Sub-task

E-12.02 Repairs basic wiring and electrical systems.

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

Key Competencies

E-12.02.01	select and use tools and equipment such as hand tools and soldering equipment
E-12.02.02	select repair parts and materials such as terminals, insulators and fastening devices according to repair requirements and manufacturers' specifications
E-12.02.03	remove components to access defective parts such as wiring harnesses, connectors, relays and fusible links
E-12.02.04	replace or repair components according to manufacturers' specifications and recommendations
E-12.02.05	determine component serviceability according to parts availability and cost effectiveness

E-12.02.06 repair wiring using methods such as splicing, terminal replacement, soldering and crimping

E-12.02.07 complete repair by verifying system's function and performance

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Sub-task

E-12.03 Repairs lighting and wiper systems.

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

Key Competencies

E-12.03.01 select and use tools and equipment such as hand tools, specialized tools and DVOM

E-12.03.02 select repair parts and materials such as gaskets, insulators and fastening devices according to repair requirements and manufacturers' specifications

E-12.03.03 replace or repair components according to manufacturers' specifications and recommendations

E-12.03.04 repair wiring using methods such as splicing, terminal replacement, soldering and crimping

E-12.03.05 adjust and replace wiper components such as linkages and controls

E-12.03.06 adjust and aim headlights

E-12.03.07 complete repair by verifying system's function and performance

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Sub-task

E-12.04 Repairs entertainment systems.

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

Key Competencies

E-12.04.01 select and use tools and equipment such as scan tool and specialized tools

E-12.04.02 select repair parts and materials according to repair requirements and manufacturers' specifications

E-12.04.03 replace or repair components according to manufacturers' specifications and recommendations

E-12.04.04 repair wiring using methods such as splicing, terminal replacement, soldering and crimping

E-12.04.05 complete repair by verifying system's function and performance

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Sub-task

E-12.05 Repairs electrical options.

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

Key Competencies

E-12.05.01 select and use tools and equipment such as specialized tools and DVOM

E-12.05.02 select repair parts and materials according to repair requirements and manufacturers' specifications

E-12.05.03 replace, repair and program components according to manufacturers' specifications and recommendations

E-12.05.04 adjust components such as sunroof, power mirrors, power windows, power seats, and heated mirrors and seats

E-12.05.05 repair wiring using methods such as splicing, terminal replacement, soldering and crimping

E-12.05.06 adjust sensors such as park aids and back-up cameras

E-12.05.07 complete repair by verifying system's function and performance

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Sub-task

E-12.06 Repairs electrical accessories.

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

Key Competencies

E-12.06.01 select and use tools and equipment such as hand tools, specialized tools and DVOM

E-12.06.02 select repair parts and materials according to repair requirements and manufacturers' specifications

E-12.06.03 replace, repair and program components according to manufacturers' specifications and recommendations

E-12.06.04 repair wiring using methods such as splicing, terminal replacement, soldering and crimping

E-12.06.05 complete repair by verifying system's function and performance

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Sub-task

E-12.07 Installs electrical accessories.

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

Key Competencies

E-12.07.01 select and use tools and equipment such as hand tools, specialized tools and DVOM

E-12.07.02 determine compatibility of component with vehicle

E-12.07.03 select parts and materials such as according to installation requirements and manufacturers' specifications

E-12.07.04 reconfigure vehicle control module to allow operation of accessories

E-12.07.05 verify installed components' operation

E-12.07.06 complete installation by verifying system's function and performance

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Sub-task

E-12.08 Repairs instrumentation and information displays.

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

Key Competencies

E-12.08.01 select and use tools and equipment such as scan tool, hand tools and DVOM

E-12.08.02 select repair parts and materials according to repair requirements and manufacturers' specifications

E-12.08.03 replace or repair components according to manufacturers' specifications and recommendations

E-12.08.04 repair wiring using methods such as splicing, terminal replacement, soldering and crimping

E-12.08.05 program modules to vehicle's calibration

E-12.08.06	recalibrate compass
E-12.08.07	complete repair by verifying system's function and performance

Task 13 Diagnoses heating, ventilation and cooling (HVAC) and comfort control systems.

Required Knowledge

K 1	types and operation of air flow control systems such as manual, electrical and vacuum
K 2	operation of components such as fans, blend doors, levers, actuators and auxiliary vacuum pumps
K 3	causes of odours
K 4	types and operation of refrigerant systems
K 5	principles of refrigeration
K 6	refrigerants, lubricants and consequences of improper mixing
K 7	electronic control systems
K 8	types and operation of heating systems
K 9	operation of components such as heater core, thermostats, coolant pumps and restrictors
K 10	coolant types and characteristics
K 11	cabin filters and their locations

Sub-task

E-13.01 Diagnoses air flow control systems.

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

Key Competencies

E-13.01.01	inspect components for wear, damage and defects
E-13.01.02	inspect connectors for conditions such as corrosion, poor contacts and damaged terminals
E-13.01.03	select and use diagnostic tools and equipment such as DVOM, scan tool, circuit tester and vacuum pumps
E-13.01.04	interpret and follow wiring diagrams and vacuum and air flow schematics

E-13.01.05	interpret viewed values and codes to determine condition of systems and components
E-13.01.06	activate system self-diagnosis function to retrieve trouble codes
E-13.01.07	check electronically-controlled system operation for conditions such as blown fuses, seized motors and broken wires
E-13.01.08	determine and perform tests such as voltage drop and resistance check to pinpoint failure
E-13.01.09	inspect air flow circulation to identify problems such as partially open/closed doors, restricted cabin filters and dead animals
E-13.01.10	verify full range of fan operation
E-13.01.11	interpret and analyze results of functional tests and inspections to determine required repair

---

Sub-task

E-13.02 Diagnoses refrigerant systems.

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

Key Competencies

E-13.02.01	inspect components for wear, damage and defects
E-13.02.02	select and use diagnostic tools and equipment such as Freon leak detector, DVOM, circuit tester, AC machine and black lights
E-13.02.03	interpret pressure gauge readings
E-13.02.04	inspect connectors for conditions such as corrosion, poor contacts and damaged terminals
E-13.02.05	interpret and follow wiring diagrams
E-13.02.06	check electronically-controlled system operation for conditions such as blown fuses and broken wires
E-13.02.07	determine and perform tests such as voltage drop and resistance check to pinpoint failure
E-13.02.08	perform Freon leak detection and determine source of leakage
E-13.02.09	identify compatibility of refrigerant with systems and tools
E-13.02.10	pressurize systems with nitrogen to locate leaks
E-13.02.11	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

E-13.03 Diagnoses heating systems.

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

Key Competencies

E-13.03.01	verify customer complaint such as no heat, erratic idling and odours to guide the diagnostic process
E-13.03.02	determine diagnostic sequence as per manufacturers' specifications
E-13.03.03	depressurize cooling system before removing radiator cap to avoid personal injury
E-13.03.04	determine and perform diagnostic tests such as checking coolant level, pressure, flow and temperature
E-13.03.05	identify faulty system such as base engine or HVAC
E-13.03.06	interpret and analyze findings of tests such as low coolant level, inoperative blend doors and insufficient air flow to identify defective components and determine required repair

Task 14 Repairs heating, ventilation and cooling (HVAC) and comfort control systems.

Required Knowledge

K 1	types and operation of air flow control systems
K 2	procedures to correct problems such as odours, air flow restrictions and noises
K 3	types and operation of refrigerant systems
K 4	refrigerant system hazards
K 5	types and operation of components such as compressors, clutches and receiver dryers
K 6	metering devices such as orifice tubes and expansion valves
K 7	types of refrigerants and oils
K 8	legislation regarding licensing requirements, use, handling and disposal of refrigerants
K 9	electronic control systems
K 10	types and operation of heating systems

K 11	types of coolants and chemical additives
K 12	water quality suitable for heating systems

Sub-task

E-14.01 Repairs air flow control systems.

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

Key Competencies

E-14.01.01	select and use tools and equipment such as hand tools, scan tool, and specialized tools
E-14.01.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
E-14.01.03	follow repair sequence as per manufacturers' specifications
E-14.01.04	recover refrigerant and evacuate air conditioning system according to jurisdictional regulations
E-14.01.05	access faulty components such as blend doors, blower motors and cabin filters
E-14.01.06	remove, repair and replace faulty components such as control units, connectors, blend door motors and blower motor resistors
E-14.01.07	clean and deodorize air flow systems with materials such as compressed air and pressurized deodorizers
E-14.01.08	complete repair by verifying system's function and performance

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Sub-task

E-14.02 Repairs refrigerant systems.

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

Key Competencies

E-14.02.01	select and use tools and equipment to evacuate and recharge system and to identify and recover types of refrigerant
E-14.02.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications

E-14.02.03	follow repair sequence as per manufacturers' specifications
E-14.02.04	recover refrigerant and evacuate air conditioning system according to jurisdictional regulations
E-14.02.05	remove and replace faulty components such as switches, hoses and expansion valves
E-14.02.06	recharge system to recommended amounts of refrigerant oils and refrigerants
E-14.02.07	clean and deodorize air flow systems with materials such as compressed air and pressurized deodorizers
E-14.02.08	convert systems to run on other refrigerants as per manufacturers' requirements by performing tasks such as replacing fittings and adding refrigerant oil
E-14.02.09	complete repair by verifying system's function and performance

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Sub-task

E-14.03 Repairs heating systems.

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

Key Competencies

E-14.03.01	select and use tools and equipment such as hand tools, scan tool and DVOM
E-14.03.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
E-14.03.03	follow repair sequence as per manufacturers' specifications
E-14.03.04	depressurize cooling system before removing radiator cap to avoid personal injury
E-14.03.05	fill and bleed cooling system using vacuum fill equipment
E-14.03.06	remove and replace faulty components such as blend doors and control valves
E-14.03.07	clean and deodorize air flow systems with materials such as compressed air and pressurized deodorizers
E-14.03.08	complete repair by verifying system's function and performance

BLOCK F STEERING AND SUSPENSION, BRAKING, CONTROL SYSTEMS, TIRES, HUBS AND WHEEL BEARINGS

Context

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 to permit precise control of the vehicle.

Suspension systems are use to support and cushion the vehicle, absorbing road surface irregularities and smoothing the vehicle ride. The suspension is designed to permit 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 to various components such as calipers, wheel cylinders and actuators. Antilock braking systems (ABS), 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 and serviced by automotive service technicians in order to ensure the safe and correct operation of the vehicle such as wheel balance and wheel alignment.

Trends

In today's vehicles, there is a greater use of handling and control systems such as run flat tires and tire pressure monitoring systems. There is also an increased use of traction control, four-wheel steering, active handling/ride control systems and electric-hydraulic systems.

Related Components (including, but not limited to)

Steering system: steering wheel, steering knuckle, steering column, mounts, control arms, linkages, idler arms, pitman arms, steering boxes and rack-and-pinion, coolers, pumps, electric motors, actuators, sensors.

Suspension system: shocks, struts, springs, airbags, upper and lower control arms, torsion bars, sway bars, ball joints, active ride control.

Braking system: rotors, drums, master cylinders, wheel cylinders and calipers, hoses, pipes, bushings, valves, power assist, springs, retainers, control modules, wiring harnesses, sensors, actuators, ABS pump, modulators, brake linings, brake pads, TCS components (traction control pump, actuators, switches and throttle retarding devices).

Tires, wheels, hubs and wheel bearings: wheel studs, valve stems, TPMS, runflat tires.

Tools and Equipment	Standard tool kit, PPE and safety equipment, hoisting and lifting equipment, scan tool, pullers, presses, micrometers, wheel balancer, brake drum gauge, brake lathe, tire changing, tire repair, wheel alignment and leak detection equipment, ball joint press and adapters, coil spring compressor, flushing and bleeding equipment, pressure gauges.

Task 15 Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings.

Required Knowledge

K 1	types of steering systems such as rack-and-pinion, recirculating ball and power assist
K 2	types of power assist systems such as electric and hydraulic
K 3	related steering components such as tie rods, ball joints and pitman arms
K 4	steering columns and their components such as tilt mechanism and steering locks
K 5	relationship between suspension and components
K 6	steering geometry and alignment
K 7	types of suspension system assist pumps
K 8	types of suspension systems such as independent, monobeam, double wishbone and active
K 9	types of springs such as coil, leaf, torsion bar and airbag
K 10	types of ride height controls such as airbags and air suspension
K 11	types of dampers such as struts and shocks
K 12	types of braking systems
K 13	types of control systems such as ABS, TCS and stability control systems
K 14	types of brake assist such as vacuum and hydraulic
K 15	hydraulic principles such as Pascal's law
K 16	specialized tools such as scan tool, brake lathes, bleeders and flaring tools
K 17	different types of friction materials such as metallic, semi-metallic and ceramic
K 18	braking system components such as rotors, calipers and master cylinders
K 19	parking brake system
K 20	methods of tire repairs
K 21	types of hubs

K 22	types of wheel bearings such as tapered roller and ball
K 23	types and operation of TPMS
K 24	types of tires such as directional, conventional and runflat
K 25	types of rims such as steel and aluminium
K 26	spare components and systems
K 27	tire construction such as bias and radial
K 28	nitrogen as air replacement in tires
K 29	electrical theory
K 30	safety concerns such as deactivation of passive restraints, tire inflation safety procedures, high pressure fluid systems and brake dust
K 31	control systems such as variable assist and four-wheel steering
K 32	types of fluids and lubricants

Sub-task

F-15.01 Diagnoses steering, suspension and control systems.

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

Key Competencies

F-15.01.01	perform road test to identify steering or suspension concerns such as pull, vibrations and extent of assist
F-15.01.02	determine type of steering and control system such as rack-and-pinion, recirculating ball, hydraulic, electric and four-wheel steer
F-15.01.03	determine type of suspension and control system such as MacPherson strut, leaf spring, standard and active
F-15.01.04	select and use diagnostic tools such as scan tool, pressure gauge and measuring tools
F-15.01.05	inspect vehicle's steering, suspension and control components in accordance with manufacturers' specifications and inspection procedures
F-15.01.06	perform functional tests as per manufacturers' procedures and specifications
F-15.01.07	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

F-15.02 Diagnoses braking and control systems.

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

Key Competencies

F-15.02.01	perform road test to identify braking concerns such as vibrations, noises and lack of brake assist
F-15.02.02	determine type of braking and control system such as hydro-boost, vacuum assist, ABS/TCS, self-regulating and regenerating (hybrid)
F-15.02.03	identify ABS, TCS and stability control system components and relate the operation of those system components to the vehicle and other systems
F-15.02.04	select and use diagnostic tools such as measuring tools, scan tool and pressure gauge
F-15.02.05	inspect vehicle's braking and control components and fluids in accordance with manufacturers' specifications and inspection procedures
F-15.02.06	perform functional tests as per manufacturers' procedures and specifications
F-15.02.07	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

F-15.03 Diagnoses tires, wheels, hubs and wheel bearings.

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

Key Competencies

F-15.03.01	perform road test to identify tire, wheel, hubs or wheel bearings concerns such as vibrations, noises and pulls
F-15.03.02	select and use diagnostic tools such as measuring tools, pressure gauge, chassis ears and stethoscope
F-15.03.03	inspect tires, wheels and hubs for damage, defects, irregular wear, and correct application and size
F-15.03.04	listen for abnormal noises such as growl, rumble or whine and interpret source and cause of these noises
F-15.03.05	inspect hubs or wheel bearings for excessive play or noise

F-15.03.06	perform functional tests as per manufacturers' procedures and specifications
F-15.03.07	interpret and analyze results of functional tests and inspections to determine required repair

Task 16 Repairs steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings.

Required Knowledge

K 1	types of steering systems such as rack-and-pinion, recirculating ball and power assist
K 2	types of power assist systems such as electric and hydraulic
K 3	related steering components such as tie rods, ball joints and pitman arms
K 4	steering columns and their components such as tilt mechanism, steering locks and airbag clock spring
K 5	relationship between suspension and components
K 6	steering geometry and alignment
K 7	types of suspension system assist pumps
K 8	types of suspension systems such as independent, monobeam, double wishbone, I-beam and active
K 9	types of springs such as coil, leaf, torsion bar and airbag
K 10	types of ride height controls such as airbags and air suspension
K 11	types of dampers such as struts and shocks
K 12	types of braking systems
K 13	types of control systems such as ABS, TCS and stability control systems
K 14	types of brake assist such as vacuum and hydraulic
K 15	hydraulic principles such as Pascal's law
K 16	specialized tools such as scan tool, brake lathes, bleeders and flaring tools
K 17	different types of friction materials such as metallics, semi-metallics and ceramics
K 18	braking system components such as rotors, calipers and master cylinders
K 19	types of parking brake system
K 20	methods of tire repairs
K 21	types of hubs
K 22	types of wheel bearings such as tapered roller and ball bearing
K 23	types and operation of TPMS
K 24	types of tires such as directional, conventional and runflat

K 25	types of rims such as steel and aluminium
K 26	spare tire components and systems
K 27	tire construction such as bias and radial
K 28	electrical theory
K 29	safety concerns such as deactivation of passive restraints, tire inflation safety procedures, high pressure fluid systems and brake dust
K 30	control systems such as variable assist and four-wheel steering
K 31	types of fluids and lubricants

Sub-task

F-16.01 Repairs steering, suspension and control systems.

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

Key Competencies

F-16.01.01	select and use service tools such as scan tool, pullers, presses and hand tools
F-16.01.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
F-16.01.03	remove, replace, recondition or service components as per manufacturers' procedures and specifications
F-16.01.04	perform adjustments such as wheel alignment, tire pressure and ride height adjustment
F-16.01.05	complete repair by verifying system's function and performance

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Sub-task

F-16.02 Repairs braking and control systems.

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

Key Competencies

F-16.02.01	determine type of braking and control system such as hydro-boost, vacuum assist, ABS/TCS, self-regulating and regenerating (hybrid)
F-16.02.02	select and use service tools such as scan tool, pressure gauges, measuring tools and hand tools

F-16.02.03	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
F-16.02.04	remove, replace, recondition or service components as per manufacturers' procedures and specifications
F-16.02.05	complete repair by verifying system's function and performance

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Sub-task

F-16.03 Repairs tires, wheels, hubs and wheel bearings.

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

Key Competencies

F-16.03.01	select and use service tools such as scan tool, wheel balancers, tire changing machines and tire pressure monitoring tools
F-16.03.02	inspect and perform manufacturer-approved procedures such as dismounting and patching
F-16.03.03	reset, reprogram and calibrate tire pressure monitor systems
F-16.03.04	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
F-16.03.05	remove, replace and service wheels, hubs and wheel bearings as per manufacturers' procedures and specifications
F-16.03.06	complete repair by verifying system's function and performance

BLOCK G BODY COMPONENTS, TRIM AND RESTRAINT SYSTEMS

Context	**Body components and trim** are designed to enhance structural integrity, vehicle appearance and aerodynamics. They secure the occupants and storage compartments of a vehicle as well as enhance vehicle safety. **Restraint systems** are designed to provide additional protection for the occupants of the vehicle.
Trends	Restraint systems have become increasingly complex with features such as multiple airbag locations, seatbelt pretensioners, weight sensitive and staged deployment. There is more adjustability of seats and pedals. Components are constructed to be lighter weight, using materials such as composites, plastics and aluminium. There have been advances in vehicles' aerodynamic designs, as well as their ergonomics and space utilization. Restraint systems are being tied into all the other vehicle management systems for the purpose of safety management such as automatic braking, drive assist, global positioning system (GPS) tracking and fuel shut off functions.
Related Components (including, but not limited to)	**Restraint systems:** seatbelts, airbags, airbag diagnostic module, warning indicators, impact sensors. **Body components:** seats, upholstery, adhesives, fasteners, latches, locks, regulators, weather stripping, glass channels, mirrors, bumpers, trim, hinges, antenna, fixed and movable glass, headlights, accessories such as trailer hitches, roof racks, running boards and box liners.
Tools and Equipment	Standard tool kit, PPE and safety equipment, airbag removal tools, airbag simulators, chassis ears, electronic vibration analyzer, scan tool, water hose, smoke machine, upholstery tools.

Task 17 Diagnoses body components, trim and restraint systems.

Required Knowledge

K 1	seatbelt mounting and operation
K 2	seatbelt warning system

K 3	types of passive restraint systems such as front impact airbags, curtain airbags and seatbelt pre-tensioners
K 4	airbag mounting and locations
K 5	impediments to air bag operation such as glass and trim items, seat covers and placement of child seats
K 6	airbag monitoring systems
K 7	progressive airbag deployment and operation
K 8	lubricants, adhesives and sealing materials
K 9	basic aerodynamics
K 10	vibration emitters, conductors, generators and resonators
K 11	trim hardware, fasteners, adhesives and materials used to dampen or interrupt vibration such as tapes and dampers
K 12	upholstery, carpet and roof lining
K 13	door components such as latches, locks and linkages
K 14	movable glass components such as channels, regulators and weather stripping
K 15	electrical/electronic systems associated with doors, windows and seats
K 16	basic electrical circuitry
K 17	hardware and fasteners
K 18	safety procedures
K 19	regulations and safety standards
K 20	vehicle design and construction

Sub-task

G-17.01 Diagnoses restraint systems.

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

Key Competencies

G-17.01.01	follow manufacturers' stated safety precautions and protocols
G-17.01.02	identify type of occupant restraint systems such as seatbelts (passive or active) and single or multiple airbag systems
G-17.01.03	inspect vehicle's restraint monitoring and warning systems
G-17.01.04	inspect vehicle's restraint systems for defects such as tears, frays and improper modifications

G-17.01.05	inspect vehicle's restraint systems for impediments to airbag systems such as seat covers and incorrect accessory placement
G-17.01.06	select and use diagnostic tools such as scan tool, hand tools and simulators
G-17.01.07	perform functional tests as per manufacturers' procedures and specifications
G-17.01.08	interpret and analyze results of functional tests and inspections to determine required repair

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Sub-task

G-17.02 Diagnoses wind noise, rattles and water leaks.

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

Key Competencies

G-17.02.01	perform road test to identify and locate wind noise or rattles
G-17.02.02	select and use diagnostic tools such as smoke machine, chassis ears and water hose
G-17.02.03	perform tests such as smoke test, interior pressure test or water test to isolate or locate cause of concern
G-17.02.04	interpret and analyze results of functional tests and inspections to determine required repair

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Sub-task

G-17.03 Diagnoses interior and exterior components and trim.

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

Key Competencies

G-17.03.01	inspect interior and exterior components for flaws in areas such as fit, finish and function
G-17.03.02	interpret and analyze results of inspections to determine required repair

Sub-task

G-17.04 Diagnoses latches, locks and movable glass.

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

Key Competencies

G-17.04.01	inspect latches, locks and movable glass for form, fit and function
G-17.04.02	select and use diagnostic tools such as scan tool, DVOM, trim panel tools and hand tools
G-17.04.03	perform electrical functional tests
G-17.04.04	interpret and analyze results of inspections and functional tests to determine required repair

Task 18 Repairs body components, trim, restraint systems and installed accessories.

Required Knowledge

K 1	seatbelt mounting and operation
K 2	seatbelt warning system
K 3	types of passive restraint systems such as front impact airbags, curtain airbags and seatbelt pre-tensioners
K 4	airbag mounting and locations
K 5	impediments to air bag operation such as glass and trim items, seat covers and placement of child seats
K 6	airbag monitoring systems
K 7	progressive airbag deployment and operation
K 8	lubricants, adhesives and sealing materials
K 9	basic aerodynamics
K 10	vibration emitters, conductors, generators and resonators
K 11	trim hardware, fasteners, adhesives and materials used to dampen or interrupt vibration such as tapes and dampers
K 12	upholstery, carpet and roof lining
K 13	door components such as latches, locks and linkages
K 14	movable glass components such as channels, regulators and weather stripping

K 15	electrical/electronic systems associated with doors, windows and seats
K 16	basic electrical circuitry
K 17	hardware and fasteners
K 18	safety procedures
K 19	regulations and safety standards
K 20	vehicle design and construction

Sub-task

G-18.01 Repairs restraint systems.

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

Key Competencies

G-18.01.01	follow manufacturers' stated safety precautions and protocols
G-18.01.02	identify type of occupant restraint systems such as seatbelts (passive or active) and single or multiple airbag systems
G-18.01.03	select and use tools such as scan tool and hand tools
G-18.01.04	select repair parts and materials such as connectors and fasteners according to repair requirements and manufacturers' specifications
G-18.01.05	remove and replace components as per manufacturers' procedures and specifications
G-18.01.06	complete repair by verifying system self-test

Sub-task

G-18.02 Repairs problems with wind noise, rattles and water leaks.

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

Key Competencies

G-18.02.01	follow manufacturers' stated safety precautions and protocols
G-18.02.02	select repair parts and materials such as lubricants, sealants, adhesives and fastening devices according to repair requirements and manufacturers' specifications
G-18.02.03	select and use tools such as trim tool and hand tools

G-18.02.04	remove, replace or adjust components as per manufacturers' procedures and specifications
G-18.02.05	complete repair by verifying fit, function and performance

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Sub-task

G-18.03 Repairs interior and exterior components and trim.

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

Key Competencies

G-18.03.01	follow manufacturers' stated safety precautions and protocols
G-18.03.02	select repair parts and materials such as adhesives, gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
G-18.03.03	select and use tools such as trim tools and hand tools
G-18.03.04	remove, replace or adjust components as per manufacturers' procedures and specifications
G-18.03.05	complete repair by verifying fit, function and performance

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Sub-task

G-18.04 Repairs latches, locks and movable glass.

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

Key Competencies

G-18.04.01	follow manufacturers' stated safety precautions and protocols
G-18.04.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
G-18.04.03	select and use tools such as trim tools and hand tools
G-18.04.04	remove, replace or adjust components as per manufacturers' procedures and specifications
G-18.04.05	complete repair by verifying fit, function and performance

Sub-task

G-18.05 Installs interior and exterior accessories.

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

Key Competencies

G-18.05.01	follow manufacturers' stated safety precautions and protocols
G-18.05.02	select installation parts and materials such as adhesives, sealants and fastening devices according to repair requirements and manufacturers' specifications
G-18.05.03	select and use tools such as power tools, trim tools and hand tools
G-18.05.04	remove, replace or adjust components as per manufacturers' procedures and specifications
G-18.05.05	complete installation by verifying fit, function and performance

BLOCK H HYBRID AND ALTERNATE FUEL SYSTEMS

Context	Hybrid systems have unique risks associated with them because of the high voltages required. Technicians need to possess the knowledge and skills of system operation and safety. Proper procedures are paramount to success in repairs of the hybrid systems. High voltage PPE such as linesman gloves and grounding mats must be used. Technicians should not work on hybrid systems without specialized training. Alternate fuels include propane and natural gas. Jurisdictional certification may be required to work on these systems. Alternate fuel systems have unique risks associated with them because of pressurized gasses.
Trends	As hybrids become more common, technicians will require new skills, equipment and training to perform the diagnosis, service and repair. New alternate fuel technologies are emerging and may be introduced to the market in the coming years. Sales of full electric vehicles are increasing.
Related Components (including, but not limited to)	**Hybrid systems:** inverter, high-voltage battery pack, high-voltage AC compressor, generator transmission assembly, cooling modules, starter alternator assembly, cables, control modules. **Alternate fuel systems:** tanks, valves, lines, mixers, regulators, injectors, control modules, sensors.
Tools and Equipment	Standard tool kit, PPE and safety equipment, shop tools, specialized hybrid system tools.

Task 19 Diagnoses hybrid and alternate fuel systems.

Required Knowledge

K 1	safety procedures specific to working on hybrid systems
K 2	high voltage cables used in hybrid operating system
K 3	manufacturers' specifications for hybrid systems
K 4	hybrid storage and control systems and their components such as high voltage battery pack, power inverter and control modules

K 5	hybrid charging and propulsion systems and their components such as generator motor units
K 6	hybrid accessory systems and their components such as AC compressors
K 7	hybrid cooling systems and their components such as inverter coolers and coolant pumps
K 8	high voltage disconnect devices
K 9	alternate fuels such as natural gas and propane
K 10	types of alternate fuel systems
K 11	jurisdictional regulations and certification requirements such as emissions and alternate fuel requirements
K 12	safety procedures specific to working on alternate fuel systems
K 13	alternate fuel controls such as regulators and mixers

Sub-task

H-19.01 Implements hybrid safety protocols.

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

Key Competencies

H-19.01.01	prepare vehicle for service of system by isolating high voltage system according to manufacturers' directions
H-19.01.02	select and use PPE and safety equipment specific to hybrid systems such as insulated gloves and pylons
H-19.01.03	select and use tools and equipment required to complete safety preparation
H-19.01.04	recognize safety hazards specific to working on hybrid vehicles such as wet floors and high voltages
H-19.01.05	restrict access to work area using pylons

Sub-task

H-19.02 Diagnoses hybrid systems.

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

Key Competencies

H-19.02.01	identify type of hybrid system
H-19.02.02	select and use diagnostic tools and equipment such as scan tool, specialized voltmeter and laptop
H-19.02.03	visually inspect hybrid system components for wear, damage and defects
H-19.02.04	retrieve diagnostic trouble codes
H-19.02.05	ensure that safety protocols have been implemented
H-19.02.06	isolate problem as per manufacturers' instructions
H-19.02.07	interpret and analyze results of functional tests and inspections to determine required repair

Sub-task

H-19.03 Diagnoses alternate fuel systems.

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

Key Competencies

H-19.03.01	select and use tools and equipment such as fuel pressure gauges, vacuum gauges, scan tool, DVOM and laptops
H-19.03.02	identify type of alternate fuel delivery systems such as injection and feedback, and external mixer systems
H-19.03.03	check for leaks in system using methods such as soap and water, odour and gas detecting meter
H-19.03.04	perform alternate fuel system pressure and restriction tests
H-19.03.05	check alternate fuel system parameters such as timing and fuel rate
H-19.03.06	isolate alternate fuel system problems such as engine misfires and lack of power
H-19.03.07	inspect alternate fuel system storage vessel mounts and ventilation

H-19.03.08	follow pressure-handling procedures for testing alternate fuel systems in order to attain a safe pressure according to manufacturers' specifications
H-19.03.09	interpret and analyze results of functional tests and inspections to determine required repair

Task 20 Repairs hybrid and alternate fuel systems.

Required Knowledge

K 1	safety procedures specific to working on hybrid systems
K 2	high voltage cables used in hybrid operating system
K 3	manufacturers' specifications for hybrid systems
K 4	hybrid storage and control systems and their components such as high voltage battery pack, power inverter and control modules
K 5	hybrid charging and propulsion systems and their components such as generator motor units
K 6	hybrid accessory systems and their components such as AC compressors
K 7	hybrid cooling systems and their components such as inverter coolers and coolant pumps
K 8	high voltage disconnect devices
K 9	alternate fuels such as natural gas and propane
K 10	types of alternate fuel systems
K 11	jurisdictional regulations and certification requirements such as emissions and alternate fuel requirements
K 12	safety procedures specific to working on alternate fuel systems
K 13	alternate fuel controls such as regulators and mixers

Sub-task

H-20.01 Repairs hybrid systems.

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

Key Competencies

H-20.01.01	select and use tools and equipment such as PPE, safety devices, specialized voltmeter, scan tool and hand tools
H-20.01.02	determine manufacturers' specifications and repair procedures for specific storage and control system
H-20.01.03	deactivate electrical system according to manufacturers' specifications and procedures
H-20.01.04	select repair parts and materials such as wiring, fuses and fastening devices according to repair requirements and manufacturers' specifications
H-20.01.05	remove and inspect hybrid system components such as modules and inverters
H-20.01.06	replace components according to manufacturers' specifications
H-20.01.07	complete repair by verifying system's function and performance

Sub-task

H-20.02 Repairs alternate fuel systems.

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

Key Competencies

H-20.02.01	select and use tools and equipment such as hand tools, specialized pressure gauges, scan tool and laptop
H-20.02.02	select repair parts and materials such as gaskets, sealants and fastening devices according to repair requirements and manufacturers' specifications
H-20.02.03	depressurize alternate fuel system in order to remove and disassemble system
H-20.02.04	remove, disassemble and inspect alternate fuel systems for conditions such as damage and wear
H-20.02.05	clean and repair alternate fuel system components and parts

H-20.02.06	fit and replace alternate fuel system components and parts
H-20.02.07	reassemble alternate fuel system components and perform measurements
H-20.02.08	torque components according to sequence and specifications
H-20.02.09	pressurize, bleed and purge system
H-20.02.10	perform alternate fuel system timing procedures
H-20.02.11	complete repair by verifying system's function and performance

APPENDICES

APPENDIX A 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/fender covers
crowfoot wrenches
dial indicator set
drill and bits
drill gauge
feeler gauges – SAE and metric
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
multimeter (DVOM)
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
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
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

Standard Tool Kit (continued)

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)
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
break-out boxes
camshaft bearing tools (removal and installation)
CAT-IV meter (for hybrid vehicles)
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 analyzer (oscilloscope)
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
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
parts washers/steam cleaners and blaster
piston ring compressor
piston ring installer
power steering pressure tester
pressure washer
propane enrichment tools

Shop Tools and Equipment (continued)

recalibration tool
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
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 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
plastic gauge
power steering pressure tester
pressure gauges
pyrometer
refractor
scan tool
sirometer (RPM measuring device)
spring scale
torque angle meter/indicator

Personal Protective Equipment (PPE) and Safety 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)
hearing protection – ear muffs, ear plugs
respiratory protection – dust and particle masks, chemical filtered mask
safety hook (for hybrid vehicles)
safety pylons (for hybrid vehicles)

APPENDIX B GLOSSARY

ammeter	instrument used to measure electrical current flow in a circuit
AVR	alternator voltage regulator; refers to a device that is used to test generators/alternators for electrical output, voltage and amperage
CAN	controller area network; a protocol for communication between electronic/computer modules
condenser (A/C)	device used in an air conditioning system to allow the dissipation of heat
condenser (electrical)	electrical device that acts to store an electrical charge preventing voltage surges
DVOM	digital voltage ohmmeter; meter for measuring voltage, amperage, resistance (ohms) and is digital in its operation
gerotor	a positive displacement pump which utilizes a drive shaft with an inner and outer rotor
inclinometer	device used to measure the incline of an object, measured in degrees
jounce	the motion of a wheel that compresses its suspension. Full jounce refers to a wheel that is at the upper limits of its travel. Jounce is the opposite of rebound
manometer	a graduated tube containing water which measures pressure/vacuum in units of water column
micrometer	a precision measuring device for small distances
O2 Sensor	device used to measure the oxygen content of exhaust gases
OBD I and OBD II	on board diagnostics are part of a vehicle's engine management software used to monitor system performance. OBD II is a second generation program that performs as dictated by standards established by the Society of Automotive Engineers
Ohm's Law	the relationship between current, resistance and voltage in any electrical circuit
pneumatic	operated by compressed air
pyrometer	instrument used to measure temperatures

refractor	test instrument used to measure the strength of antifreeze or specific gravity of electrolyte in a cell of a lead/acid battery
sirometer	test instrument used to measure RPM of an engine or frequency of a vibration with great accuracy
UART	universal asynchronous receive transmit ; a protocol for communication between computer modules

APPENDIX C ACRONYMS

ABS	antilock braking systems
A/C	air conditioning
AVR	alternator voltage regulator
CAN	controller area network
CO	carbon monoxide
CO_2	carbon dioxide
CSA	Canadian Standards Association
CV	constant velocity
CVT	continuously variable transmission
DLC	data link connection
DSC	dynamic stability control
DTC	diagnostic trouble code
DVOM	digital voltage ohmmeter
EGR	exhaust gas recirculation
EVAP	evaporative emission control systems
GMAW	gas metal arc welding
GPS	global positioning system
GTAW	gas tungsten arc welding
HC	hydrocarbons
HID	high intensity discharge
HS	high speed
HVAC	heating, ventilation and air conditioning
IAT	intake air temperature

ISO	International Standards Organization
LED	light emitting diode
NOx	oxides of nitrogen
NVH	noises, vibrations and harshness
OBD I	On board diagnostics (first generation)
OBD II	On board diagnostics (second generation)
PCM	power train control module
PCV	positive crankcase ventilation
PPE	personal protective equipment
RPM	revolutions per minute
SAE	Society of Automotive Engineers
SRS	supplemental restraint system
TCM	transmission control module
TCS	traction control system
TPMS	tire pressure monitoring system
TPS	throttle position sensor
TSB	technical service bulletins
UART	universal asynchronous receive transmit
VIN	vehicle identification number
VSS	vehicle speed sensor
WHMIS	Workplace Hazardous Materials Information System

APPENDIX D BLOCK AND TASK WEIGHTING

BLOCK A OCCUPATIONAL SKILLS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	5	3	5	6	ND	2	9	2	5	5	NV	NV	NV	5%

Task 1 Uses and maintains tools and equipment.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	45	55	45	ND	50	50	50	45	75	NV	NV	NV	52%

Task 2 Performs common trade activities.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	55	45	55	ND	50	50	50	55	25	NV	NV	NV	48%

BLOCK B ENGINE AND ENGINE SUPPORT SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	25	14	16	14	ND	23	17	18	15	15	NV	NV	NV	17%

Task 3 Diagnoses engine systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	30	30	25	ND	31	30	20	23	25	NV	NV	NV	25%

Task 4 Repairs engine systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	20	28	24	ND	25	20	15	25	15	NV	NV	NV	20%

Task 5 Diagnoses engine support systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	30	25	27	ND	27	30	50	28	30	NV	NV	NV	32%

Task 6 Repairs engine support systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	20	17	24	ND	17	20	15	24	30	NV	NV	NV	23%

BLOCK C VEHICLE MANAGEMENT SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	10	20	17	17	ND	13	19	12	21	20	NV	NV	NV	16%

Task 7 Diagnoses vehicle management systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	80	60	58	ND	60	60	70	70	60	NV	NV	NV	63%

Task 8 Repairs vehicle management systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	20	40	42	ND	40	40	30	30	40	NV	NV	NV	37%

BLOCK D DRIVE LINE SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	10	16	15	12	ND	19	13	15	16	15	NV	NV	NV	15%

Task 9 Diagnoses drive line systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	70	52	55	ND	55	40	60	61	60	NV	NV	NV	56%

Task 10 Repairs drive line systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	30	48	45	ND	45	60	40	39	40	NV	NV	NV	44%

BLOCK E ELECTRICAL AND COMFORT CONTROL SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	20	20	14	19	ND	17	17	22	12	13	NV	NV	NV	17%

Task 11 Diagnoses electrical systems and components.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	40	38	36	ND	38	35	50	40	35	NV	NV	NV	39%

Task 12 Repairs electrical systems and components.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	15	27	23	ND	29	15	10	21	30	NV	NV	NV	23%

Task 13 Diagnoses heating, ventilation and cooling (HVAC) and comfort control systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	30	20	23	ND	20	35	30	24	20	NV	NV	NV	24%

Task 14 Repairs heating, ventilation and cooling (HVAC) and comfort control systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	15	15	18	ND	13	15	10	15	15	NV	NV	NV	14%

BLOCK F STEERING AND SUSPENSION, BRAKING, CONTROL SYSTEMS, TIRES, HUBS AND WHEEL BEARINGS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	20	18	22	18	ND	21	15	18	16	20	NV	NV	NV	19%

Task 15 Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	80	55	56	ND	60	45	60	65	70	NV	NV	NV	60%

Task 16 Repairs steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	20	45	44	ND	40	55	40	35	30	NV	NV	NV	40%

BLOCK G BODY COMPONENTS, TRIM AND RESTRAINT SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	5	3	6	10	ND	3	5	8	10	7	NV	NV	NV	6%

Task 17 Diagnoses body components, trim and restraint systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	60	50	45	56	ND	50	60	60	60	50	NV	NV	NV	55%

Task 18 Repairs body components, trim, restraint systems and installed accessories.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	40	50	55	44	ND	50	40	40	40	50	NV	NV	NV	45%

BLOCK H HYBRID AND ALTERNATE FUEL SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	5	6	5	4	ND	2	5	5	5	5	NV	NV	NV	5%

Task 19 Diagnoses hybrid and alternate fuel systems.

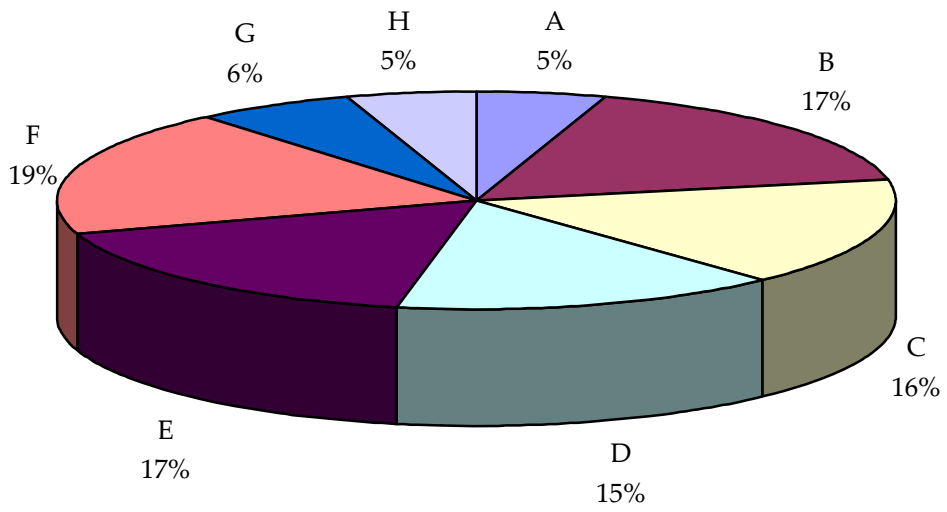
	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	70	50	52	ND	100	40	65	54	50	NV	NV	NV	59%

Task 20 Repairs hybrid and alternate fuel systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	30	50	48	ND	0	60	35	46	50	NV	NV	NV	41%

APPENDIX E

PIE CHART*



TITLES OF BLOCKS

BLOCK A	Occupational Skills	BLOCK E	Electrical and Comfort Control Systems
BLOCK B	Engine and Engine Support Systems	BLOCK F	Steering and Suspension, Braking, Control Systems, Tires, Hubs, and Wheel Bearings
BLOCK C	Vehicle Management Systems	BLOCK G	Body Components, Trim and Restraint Systems
BLOCK D	Drive Line Systems	BLOCK H	Hybrid and Alternate Fuel Systems

*Average percentage of the total number of questions on an interprovincial examination, assigned to assess each block of the analysis, as derived from the collective input from workers within the occupation from all areas of Canada. Interprovincial examinations typically have from 100 to 150 multiple-choice questions.

APPENDIX F

TASK PROFILE CHART — AUTOMOTIVE SERVICE TECHNICIAN

BLOCKS	TASKS	SUB-TASKS				
A - OCCUPATIONAL SKILLS	1. Uses and maintains tools and equipment.	1.01 Maintains tools and equipment.	1.02 Uses hoisting and lifting equipment.	1.03 Uses personal protective equipment (PPE) and safety equipment.		
	2. Performs common trade activities.	2.01 Uses technical information.	2.02 Estimates preliminary job cost.	2.03 Maintains safe work environment.		
B - ENGINE AND ENGINE SUPPORT SYSTEMS	3. Diagnoses engine systems.	3.01 Diagnoses cooling systems.	3.02 Diagnoses lubricating systems.	3.03 Diagnoses base engine.		
	4. Repairs engine systems.	4.01 Repairs cooling systems.	4.02 Repairs lubricating systems.	4.03 Repairs base engine.		
	5. Diagnoses engine support systems.	5.01 Diagnoses fuel delivery systems.	5.02 Diagnoses ignition systems.	5.03 Diagnoses intake/exhaust systems.	5.04 Diagnoses emission systems.	5.05 Diagnoses accessory drive systems and mounts.
		5.06 Diagnoses diesel engine support systems.				

BLOCKS	TASKS	SUB-TASKS				
	6. Repairs engine support systems.	6.01 Repairs gasoline delivery systems.	6.02 Repairs ignition systems.	6.03 Repairs intake/exhaust systems.	6.04 Repairs emission systems.	6.05 Repairs accessory drive systems and mounts.
		6.06 Repairs diesel engine support systems.				
C - VEHICLE MANAGEMENT SYSTEMS	7. Diagnoses vehicle management systems.	7.01 Reads diagnostic trouble codes (DTCs).	7.02 Monitors parameters.	7.03 Interprets test results.	7.04 Tests system circuitry and components.	
	8. Repairs vehicle management systems.	8.01 Updates component software.	8.02 Replaces components.	8.03 Verifies vehicle management system repair.		
D - DRIVE LINE SYSTEMS	9. Diagnoses drive line systems.	9.01 Diagnoses drive shafts and axles.	9.02 Diagnoses manual transmissions/ transaxles.	9.03 Diagnoses automatic transmissions/ transaxles.	9.04 Diagnoses clutches.	9.05 Diagnoses transfer cases.
		9.06 Diagnoses final drive assemblies.				
	10. Repairs drive line systems.	10.01 Repairs drive shafts and axles.	10.02 Repairs manual transmissions/ transaxles.	10.03 Repairs automatic transmissions/ transaxles.	10.04 Repairs clutches.	10.05 Repairs transfer cases.
		10.06 Repairs final drive assemblies.				

BLOCKS	TASKS	SUB-TASKS				
E - ELECTRICAL AND COMFORT CONTROL SYSTEMS	11. Diagnoses electrical systems and components.	11.01 Diagnoses starting/charging systems and batteries.	11.02 Diagnoses basic wiring and electrical systems.	11.03 Diagnoses lighting and wiper systems.	11.04 Diagnoses entertainment systems.	11.05 Diagnoses electrical options.
		11.06 Diagnoses instrumentation and information displays.	11.07 Diagnoses electrical accessories.			
	12. Repairs electrical systems and components.	12.01 Repairs starting/charging systems and batteries.	12.02 Repairs basic wiring and electrical systems.	12.03 Repairs lighting and wiper systems.	12.04 Repairs entertainment systems.	12.05 Repairs electrical options.
		12.06 Repairs electrical accessories.	12.07 Installs electrical accessories.	12.08 Repairs instrumentation and information displays.		
	13. Diagnoses heating, ventilation and cooling (HVAC) and comfort control systems.	13.01 Diagnoses air flow control systems.	13.02 Diagnoses refrigerant systems.	13.03 Diagnoses heating systems.		
	14. Repairs heating, ventilation and cooling (HVAC) and comfort control systems.	14.01 Repairs air flow control systems.	14.02 Repairs refrigerant systems.	14.03 Repairs heating systems.		
F - STEERING AND SUSPENSION, BRAKING, CONTROL SYSTEMS, TIRES, HUBS AND WHEEL BEARINGS	15. Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings.	15.01 Diagnoses steering, suspension and control systems.	15.02 Diagnoses braking and control systems.	15.03 Diagnoses tires, wheels, hubs and wheel bearings.		
	16. Repairs steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings.	16.01 Repairs steering, suspension and control systems.	16.02 Repairs braking and control systems.	16.03 Repairs tires, wheels, hubs and wheel bearings.		

BLOCKS	TASKS	SUB-TASKS				
G - BODY COMPONENTS, TRIM AND RESTRAINT SYSTEMS	17. Diagnoses body components, trim and restraint systems.	17.01 Diagnoses restraint systems.	17.02 Diagnoses wind noise, rattles and water leaks.	17.03 Diagnoses interior and exterior components and trim.	17.04 Diagnoses latches, locks and movable glass.	
	18. Repairs body components, trim, restraint systems and installed accessories.	18.01 Repairs restraint systems.	18.02 Repairs problems with wind noise, rattles and water leaks.	18.03 Repairs interior and exterior components and trim.	18.04 Repairs latches, locks and movable glass.	18.05 Installs interior and exterior accessories.
H - HYBRID AND ALTERNATE FUEL SYSTEMS	19. Diagnoses hybrid and alternate fuel systems.	19.01 Implements hybrid safety protocols.	19.02 Diagnoses hybrid systems.	19.03 Diagnoses alternate fuel systems.		
	20. Repairs hybrid and alternate fuel systems.	20.01 Repairs hybrid systems.	20.02 Repairs alternate fuel systems.			