

Red Seal Occupational Standard

Truck and Transport Mechanic



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Title: Truck and Transport Mechanic

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Foreword

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Red Seal Occupational Standard (RSOS) as the Red Seal standard for the Truck and Transport Mechanic trade.

Background

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

Standards have the following objectives:

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

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

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

Structure of the Occupational Standard

This standard contains the following sections:

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

Description of the Truck and Transport Mechanic Trade: an overview of the trade's duties, work environment, job requirements, similar occupations and career progression

Trends in the Truck and Transport Mechanic Trade: some of the trends identified by industry as being the most important for workers in this trade

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

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

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

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

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

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

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

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

Task Descriptor: a general description of the task

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

Skills:

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

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

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

Knowledge:

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

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

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

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

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

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

Methodology

Development of the Standard

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

Harmonization of Apprenticeship Training

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

Online Survey

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

Draft Review

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

Validation and Weighting

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

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

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

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

Definitions for Validation and Weighting

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

Provincial/Territorial Abbreviations

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

Description of the Truck and Transport Mechanic Trade

“Truck and Transport Mechanic” is this trade’s official Red Seal occupational title approved by the CCDA. This standard covers tasks performed by truck and transport mechanics.

Truck and transport mechanics inspect, diagnose, repair and maintain commercial trucks, emergency vehicles, buses and road transport vehicles. In some jurisdictions, they may also work on commercial trailers and recreation vehicles. Vehicles include electrical (high voltage), hybrid or other fuel alternative vehicles. Truck and transport mechanics work on the structural, mechanical, electrical vehicle systems and components such as engines, cab, chassis and frames, brakes, steering, suspension, drive train, heating, ventilation and air conditioning (HVAC), emissions, fuel systems and hydraulic systems. Many of these systems have electronic controls.

Truck and transport mechanics use specialized tools including hand tools, test meters, hoisting and lifting equipment, staging equipment, welding and cutting equipment, hydraulic equipment, safety equipment, recycle and recovery equipment, and complex electronics and computer diagnostic test equipment.

Truck and transport mechanics are employed in the agricultural, construction, mining, forestry, petrochemical and transportation sectors. They may be employed in small repair shops, motor vehicle dealers, fleet maintenance companies, public transportation companies, government highway departments, railways and construction companies.

Work environments for truck and transport mechanics differ from one job to another. The truck and transport mechanic trade is physically demanding as they frequently work in awkward positions, and must often climb, stoop, crouch and kneel. They also must handle heavy parts and tools. Truck and transport mechanics are sometimes required to work in adverse weather conditions, including extreme cold and heat.

There is some risk of injury involved in working with heavy equipment and power tools. Common occupational hazards are exposure to chemicals and harmful materials, repetitive motion, stored energy releases, high voltages, noises and sharp edges.

Key attributes for individuals entering this trade are mechanical aptitude, manual dexterity, flexibility, good hand-eye coordination and data management (collection, storing and using data securely). With the evolving technology of electrical and hybrid vehicle systems, they must also have a good understanding of computerized machinery, good problem-solving, analytical and computer skills, and the ability to read and understand service manuals. Good communication skills, self learning skills and patience are also important. Other assets include good vision, hearing and sense of smell to diagnose problems.

This standard recognizes similarities or overlaps with the work of automotive service technicians, agricultural equipment technicians, heavy duty equipment technicians, recreation vehicle service technicians and transport trailer technicians.

With experience, truck and transport mechanics act as mentors and trainers to apprentices in the trade. They may also advance to supervisory, service manager and training positions.

In many jurisdictions, truck and transport mechanics require certification to conduct safety inspections on vehicles.

Trends in the Truck and Transport Mechanic Trade

Technology

There is an increase in the use of alternative fuel system trucks, such as electric, hybrid, hydrogen fuel cells, natural gas and propane-powered, requiring truck and transport mechanics to be more knowledgeable of these new systems and have the skill set required for their maintenance and repair. Automated transmissions have become more popular replacing the manual transmission. These recent technological changes require truck and transport mechanics to have more intellectual, digital, computer and problem-solving skills.

Advanced driver-assist technologies such as lane signaling systems, lane departure, collision avoidance, and roll stability are rapidly evolving. Into the future, it is expected that there will be more and more autonomous applications, such as platoons of vehicles with a single driver and fully autonomous vehicles.

Health and Safety

There are advanced health and safety standards in regard to high voltages in electrical and hybrid vehicle systems. There is also potential for increased arc flash hazards that require specialized personal protective equipment (PPE), tools and safety procedures.

Tools and Equipment

In order to maintain, diagnose and repair hybrid and electric vehicles, specialized tools and repair techniques are necessary. Truck and transport mechanics need to be trained to use these tools and equipment and shops that service these vehicles must have the appropriate specialized equipment to work on them safely.

There is an increase in the use of specialized shop tools to reduce heavy lifting.

Products and Materials

There are increasingly expensive materials being used for the production of truck systems. After treatment systems require exotic materials to accomplish the emission reduction.

Environmental

The reduction of harmful exhaust emissions is a priority, which is leading to an increase in the market of alternative fuel system and electric vehicles. Design in vehicles improve their fuel efficiency through improved aerodynamics, reduced weight vehicles, improved tires and tire monitoring systems and electronic control management systems.

There are many hazardous materials used that are detrimental to the environment. Proper protocols for the recycling and disposal of these materials are crucial.

Legislative and Regulatory

There are legislative requirements set out by the provincial/territorial and federal governments that transport truck mechanics need to follow such as exhaust emissions and chemical disposal.

Skills for Success Summary

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

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

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

Reading

Truck and transport mechanics read a variety of paper-based and electronic documents for troubleshooting and servicing, including manufacturers' instructions, technical service bulletins and operating procedures. They read and interpret government regulations that specify vehicle inspection procedures and roadworthiness requirements of trucks and transports. They locate information on labels such as part numbers and serial numbers.

Document Use

Truck and transport mechanics interpret technical drawings and flow charts to understand and troubleshoot systems. They study graphed data generated by diagnostic equipment to locate information such as duration, speed and revolutions per minute. Truck and transport mechanics also complete a variety of forms including truck inspection forms. Documents that are used are both paper and electronic formats. Being able to navigate and locate information in various reference material is an important skill.

Writing

Truck and transport mechanics write remarks on the complaint/issue, the cause of a problem and the work completed to correct a problem. They may leave reminder notes for co-workers including warnings about defective equipment. Truck and transport mechanics complete pre-job safety checklists. They may also write reports for insurance claims or to report workplace accidents.

Oral Communication

Truck and transport mechanics exchange technical repair and troubleshooting information with apprentices, co-workers and manufacturers. They speak with service managers about topics such as work assignments, repair procedures and the condition of tools and equipment. They may speak with customers to respond to questions, gather information about a problem to be fixed or explain the results of inspections and repairs.

Numeracy

Truck and transport mechanics analyze and compare a variety of measurements such as energy, dimension, speed, horsepower, temperature and torque to specifications. They calculate the effect that modifications have on vehicle performance. They may use some measurements to determine approximate service life of components.

Thinking

Truck and transport mechanics evaluate the severity of vehicle defects, assess the conditions of parts and decide what repairs or replacements are to be done. They decide on the most efficient course and sequence of actions to complete a job and ensure the vehicle is safe for operation. An understanding of systems is important in completing the work. Truck and transport mechanics coordinate their work with co-workers if needed.

Working with Others

Truck and transport mechanics may work independently or with others. They are part of a team which includes other mechanics, service managers and parts and warehouse personnel.

Digital Technology

Truck and transport mechanics use diagnostic equipment such as scan tools and analyzers to determine the operational condition of components. They use computer equipment to complete repairs, download data from on-board computers and monitor systems. They may use databases to retrieve repair information and technical drawings or to input information about repairs. Truck and transport mechanics use the Internet to access online manuals, technical service bulletins and recall notices. They also use computers for daily tasks which may include e-mail, file management and using fleet management software.

Continuous Learning

Truck and transport mechanics are continuously learning to keep up with the changes in the industry. They may participate in training seminars to learn about new equipment and how to troubleshoot and perform repairs effectively.

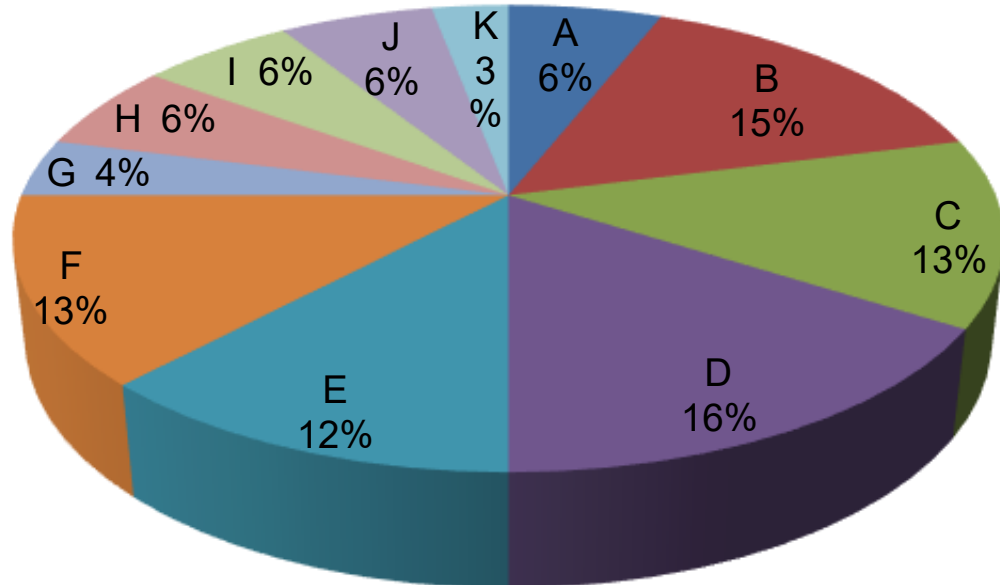
Industry Expected Performance

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

Language Requirements

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

Pie Chart of Red Seal Examination Weightings



MWA A	Performs common occupational skills	6%
MWA B	Services, diagnoses and repairs engines and supporting systems	15%
MWA C	Services, diagnoses and repairs air systems and brake systems	13%
MWA D	Services, diagnoses and repairs electrical and electronic systems	16%
MWA E	Services, diagnoses and repairs drive trains	12%
MWA F	Services, diagnoses and repairs steering, chassis/frames, suspensions, tires, wheels and hubs	13%
MWA G	Services, diagnoses and repairs cabs	4%
MWA H	Services, diagnoses and repairs trailers	6%
MWA I	Services, diagnoses and repairs climate control systems	6%
MWA J	Services, diagnoses and repairs hydraulic systems	6%
MWA K	Services, diagnoses and repairs hybrid and electric vehicles (EV)	3%

This pie chart represents a breakdown of the interprovincial Red Seal examination. Percentages are based on the collective input from workers from the trade from across Canada. The Task Matrix on the next pages indicates the breakdown of tasks and sub-tasks within each Major Work Activity and the breakdown of questions assigned to the Tasks. The Interprovincial examination for this trade has 150 questions.

Truck and Transport Mechanic

Task Matrix and Weightings

A – Performs common occupational skills

6%

Task A-1 Performs safety-related functions 28%	A-1.01 Maintains safe work environment	A-1.02 Uses personal protective equipment (PPE) and safety equipment	A-1.03 Implements specific safety protocols for hybrid electric vehicles (EV)
Task A-2 Uses and maintains tools and equipment 32%	A-2.01 Uses hand, power, measuring, testing, and diagnostic tools	A-2.02 Uses shop equipment	A-2.03 Uses hoisting, lifting and staging equipment
Task A-3 Performs routine work practices 28%	A-2.04 Uses welding and cutting equipment	A-2.05 Uses electronic devices and systems for diagnostics and programming	
	A-3.01 Uses documentation and reference materials	A-3.02 Maintains fluids and lubricants	A-3.03 Services hoses, tubing and fittings
Task A-4 Uses communication and mentoring techniques 12%	A-3.04 Services filters	A-3.05 Services bearings and seals	A-3.06 Uses fasteners and sealing devices
	A-4.01 Uses communication techniques	A-4.02 Uses mentoring techniques	

B – Services, diagnoses and repairs engines and supporting systems

15%

<p>Task B-5 Services, diagnoses and repairs base engines 15%</p>	<p>B-5.01 Services base engines</p>	<p>B-5.02 Diagnoses base engines</p>	<p>B-5.03 Repairs base engines</p>
<p>Task B-6 Services, diagnoses and repairs lubrication systems 10%</p>	<p>B-6.01 Services lubrication systems</p>	<p>B-6.02 Diagnoses lubrication systems</p>	<p>B-6.03 Repairs lubrication systems</p>
<p>Task B-7 Services, diagnoses and repairs intake systems 13%</p>	<p>B-7.01 Services intake systems</p>	<p>B-7.02 Diagnoses intake systems</p>	<p>B-7.03 Repairs intake systems</p>
<p>Task B-8 Services, diagnoses and repairs exhaust systems 14%</p>	<p>B-8.01 Services exhaust systems</p>	<p>B-8.02 Diagnoses exhaust systems</p>	<p>B-8.03 Repairs exhaust systems</p>
<p>Task B-9 Services, diagnoses and repairs engine management systems 17%</p>	<p>B-9.01 Services engine management systems</p>	<p>B-9.02 Diagnoses engine management systems</p>	<p>B-9.03 Repairs engine management systems</p>
<p>Task B-10 Services, diagnoses and repairs fuel delivery systems 13%</p>	<p>B-10.01 Services fuel delivery systems</p>	<p>B-10.02 Diagnoses fuel delivery systems</p>	<p>B-10.03 Repairs fuel delivery systems</p>
<p>Task B-11 Services, diagnoses and repairs engine retarder systems 3%</p>	<p>B-11.01 Services engine retarder systems</p>	<p>B-11.02 Diagnoses engine retarder systems</p>	<p>B-11.03 Repairs engine retarder systems</p>
<p>Task B-12 Services, diagnoses and repairs cooling systems 10%</p>	<p>B-12.01 Services cooling systems</p>	<p>B-12.02 Diagnoses cooling systems</p>	<p>B-12.03 Repairs cooling systems</p>

C – Services, diagnoses and repairs air systems and brake systems

13%

Task C-13 Services, diagnoses and repairs air systems 51%	C-13.01 Services air systems	C-13.02 Diagnoses air systems	C-13.03 Repairs air systems
Task C-14 Services, diagnoses and repairs brake systems 49%	C-14.01 Services brake systems	C-14.02 Diagnoses brake systems	C-14.03 Repairs brake systems

D – Services, diagnoses and repairs electrical and electronic systems

16%

Task D-15 Services, diagnoses and repairs battery systems 13%	D-15.01 Services battery systems	D-15.02 Diagnoses battery systems	D-15.03 Repairs battery systems
Task D-16 Services, diagnoses and repairs charging systems 19%	D-16.01 Services charging systems	D-16.02 Diagnoses charging systems	D-16.03 Repairs charging systems
Task D-17 Services, diagnoses and repairs spark ignition systems 8%	D-17.01 Services spark ignition systems	D-17.02 Diagnoses spark ignition systems	D-17.03 Repairs spark ignition systems
Task D-18 Services, diagnoses and repairs starting systems 19%	D-18.01 Services starting systems	D-18.02 Diagnoses starting systems	D-18.03 Repairs starting systems
Task D-19 Services, diagnoses and repairs electrical components and accessories 21%	D-19.01 Services electrical components and accessories	D-19.02 Diagnoses electrical components and accessories	D-19.03 Repairs electrical components and accessories
Task D-20 Services, diagnoses and repairs vehicle management systems and electronic components 20%	D-20.01 Services vehicle management systems and electronic components	D-20.02 Diagnoses vehicle management systems and electronic components	D-20.03 Repairs vehicle management systems and electronic components

E – Services, diagnoses and repairs drive trains

12%

<p>Task E-21 Services, diagnoses and repairs clutches 13%</p>	<p>E-21.01 Services clutches</p>	<p>E-21.02 Diagnoses clutches</p>	<p>E-21.03 Repairs clutches</p>
<p>Task E-22 Services, diagnoses and repairs manual transmissions and transfer cases 17%</p>	<p>E-22.01 Services manual transmissions and transfer cases</p>	<p>E-22.02 Diagnoses manual transmissions and transfer cases</p>	<p>E-22.03 Repairs manual transmissions and transfer cases</p>
<p>Task E-23 Services, diagnoses and repairs automatic transmissions 15%</p>	<p>E-23.01 Services automatic transmissions</p>	<p>E-23.02 Diagnoses automatic transmissions</p>	<p>E-23.03 Repairs automatic transmissions</p>
<p>Task E-24 Services, diagnoses and repairs automated transmissions 20%</p>	<p>E-24.01 Services automated transmissions</p>	<p>E-24.02 Diagnoses automated transmissions</p>	<p>E-24.03 Repairs automated transmissions</p>
<p>Task E-25 Services, diagnoses and repairs driveline systems 12%</p>	<p>E-25.01 Services driveline systems</p>	<p>E-25.02 Diagnoses driveline systems</p>	<p>E-25.03 Repairs driveline systems</p>
<p>Task E-26 Services, diagnoses and repairs drive axle assemblies 16%</p>	<p>E-26.01 Services drive axle assemblies</p>	<p>E-26.02 Diagnoses drive axle assemblies</p>	<p>E-26.03 Repairs drive axle assemblies</p>
<p>Task E-27 Services, diagnoses and repairs drive train retarders 7%</p>	<p>E-27.01 Services drive train retarders</p>	<p>E-27.02 Diagnoses drive train retarders</p>	<p>E-27.03 Repairs drive train retarders</p>

F – Services, diagnoses and repairs steering, chassis/frames, suspensions, tires, wheels and hubs

13%

Task F-28 Services, diagnoses and repairs steering systems 26%	F-28.01 Services steering systems	F-28.02 Diagnoses steering systems	F-28.03 Repairs steering systems
Task F-29 Services, diagnoses and repairs chassis/frames 14%	F-29.01 Services chassis/frames	F-29.02 Diagnoses chassis/frames	F-29.03 Repairs chassis/frames
Task F-30 Services, diagnoses and repairs suspensions 23%	F-30.01 Services suspensions	F-30.02 Diagnoses suspensions	F-30.03 Repairs suspensions
Task F-31 Services, diagnoses and repairs hitches and couplers 15%	F-31.01 Services hitches and couplers	F-31.02 Diagnoses hitches and couplers	F-31.03 Repairs hitches and couplers
Task F-32 Services, diagnoses and repairs tires, wheels and hubs 22%	F-32.01 Services tires, wheels and hubs	F-32.02 Diagnoses tires, wheels and hubs	F-32.03 Repairs tires, wheels and hubs

G – Services, diagnoses and repairs cabs

4%

Task G-33 Services, diagnoses and repairs interior cab components 56%	G-33.01 Services interior cab components	G-33.02 Diagnoses interior cab components	G-33.03 Repairs interior cab components
Task G-34 Services, diagnoses and repairs exterior cab components 44%	G-34.01 Services exterior cab components	G-34.02 Diagnoses exterior cab components	G-34.03 Repairs exterior cab components

H – Services, diagnoses and repairs trailers

6%

Task H-35 Services, diagnoses and repairs trailer components and accessories 59%	H-35.01 Services trailer components and accessories	H-35.02 Diagnoses trailer components and accessories	H-35.03 Repairs trailer components and accessories
Task H-36 Services, diagnoses and repairs heating and refrigeration systems 41%	H-36.01 Services heating and refrigeration systems	H-36.02 Diagnoses heating and refrigeration systems	H-36.03 Repairs heating and refrigeration systems

I – Services, diagnoses and repairs climate control systems

6%

Task I-37 Services, diagnoses and repairs heating and ventilation systems 46%	I-37.01 Services heating and ventilation systems	I-37.02 Diagnoses heating and ventilation systems	I-37.03 Repairs heating and ventilation systems
Task I-38 Services, diagnoses and repairs air conditioning systems 54%	I-38.01 Services air conditioning systems	I-38.02 Diagnoses air conditioning systems	I-38.03 Repairs air conditioning systems

J – Services, diagnoses and repairs hydraulic systems

6%

Task J-39 Services, diagnoses and repairs hydraulic systems 100%	J-39.01 Services hydraulic systems	J-39.02 Diagnoses hydraulic systems	J-39.03 Repairs hydraulic systems
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K – Services, diagnoses and repairs hybrid and electric vehicles (EV)

3%

Task K-40 Services, diagnoses and repairs hybrid vehicles 51%	K-40.01 Services hybrid vehicles	K-40.02 Diagnoses hybrid vehicles	K-40.03 Repairs hybrid vehicles
Task K-41 Services, diagnoses and repairs electric vehicles (EV) 49%	K-41.01 Services electric vehicles (EV)	K-41.02 Diagnoses electric vehicles (EV)	K-41.03 Repairs electric vehicles (EV)

Harmonization of Apprenticeship Training

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

1. Trade name

The official Red Seal name for this trade is Truck and Transport Mechanic.

2. Number of Levels of Apprenticeship

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

3. Total Training Hours during Apprenticeship Training

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

4. Sequencing Topics and Related Sub-tasks

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

Level 1	Level 2	Level 3	Level 4
Context	Context	Context	Context
Routine Trade Activities	Routine Trade Activities	Routine Trade Activities	Routine Trade Activities
Hybrid Vehicles	Hybrid Vehicles	Hybrid Vehicles	
Electric Vehicles (EV)	Electric Vehicles (EV)	Electric Vehicles (EV)	

Safety-Related Functions

1.01 Maintains safe work environment

1.02 Uses personal protective equipment (PPE) and safety equipment

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

Level 1	Level 2	Level 3	Level 4
<p>Tools and Equipment</p> <p>2.01 Uses hand, power, measuring, testing, and diagnostic tools</p> <p>2.02 Uses shop equipment</p> <p>2.03 Uses hoisting, lifting and staging equipment</p> <p>2.04 Uses welding and cutting equipment</p> <p>2.05 Uses electronic devices and systems for diagnostics and programming</p>			
<p>Routine Trade Activities</p> <p>3.01 Uses documentation and reference materials</p> <p>3.02 Maintains fluids, lubricants, and coolants</p> <p>3.03 Services hoses, tubing, and fittings</p> <p>3.04 Services filters</p> <p>3.05 Services bearings, bushing and seals</p> <p>3.06 Uses fasteners, sealing devices, adhesives and gaskets</p>			
<p>Communication Techniques</p> <p>4.01 Uses communication techniques</p>			<p>Mentoring Techniques</p> <p>4.02 Uses mentoring techniques</p>
	<p>Base Engine</p> <p>5.01 Services base engine</p> <p>5.02 Diagnoses base engine</p> <p>5.03 Repairs base engine</p>	<p>Base Engine</p> <p>5.01 Services base engine</p> <p>5.02 Diagnoses base engine</p> <p>5.03 Repairs base engine</p>	
	<p>Lubrication System</p> <p>6.01 Services lubrication systems</p> <p>6.02 Diagnoses lubrication systems</p> <p>6.03 Repairs lubrication systems</p>	<p>Lubrication System</p> <p>6.01 Services lubrication systems</p> <p>6.02 Diagnoses lubrication systems</p> <p>6.03 Repairs lubrication systems</p>	
	<p>Intake Systems</p> <p>7.01 Services intake-systems</p> <p>7.02 Diagnoses intake systems</p> <p>7.03 Repairs intake systems</p>	<p>Intake Systems</p> <p>7.01 Services intake systems</p> <p>7.02 Diagnoses intake systems</p> <p>7.03 Repairs intake systems</p>	
	<p>Exhaust Systems</p> <p>8.01 Services exhaust systems</p> <p>8.02 Diagnoses exhaust systems</p> <p>8.03 Repairs exhaust systems</p>	<p>Exhaust Systems</p> <p>8.01 Services exhaust systems</p> <p>8.02 Diagnoses exhaust systems</p> <p>8.03 Repairs exhaust systems</p>	
	<p>Engine Management Systems</p> <p>9.01 Services engine management systems</p> <p>9.02 Diagnoses engine management systems</p> <p>9.03 Repairs engine management systems</p>	<p>Engine Management Systems</p> <p>9.01 Services engine management systems</p> <p>9.02 Diagnoses engine management systems</p> <p>9.03 Repairs engine management systems</p>	

Level 1	Level 2	Level 3	Level 4
	<p>Fuel Delivery System</p> <p>10.01 Services fuel delivery systems 10.02 Diagnoses fuel delivery systems 10.03 Repairs fuel delivery systems</p>	<p>Fuel Delivery System</p> <p>10.01 Services fuel delivery systems 10.02 Diagnoses fuel delivery systems 10.03 Repairs fuel delivery systems</p>	
	<p>Engine Retarder Systems</p> <p>11.01 Services engine retarder systems 11.02 Diagnoses engine retarder systems 11.03 Repairs engine retarder systems</p>	<p>Engine Retarder Systems</p> <p>11.01 Services engine retarder systems 11.02 Diagnoses engine retarder systems 11.03 Repairs engine retarder systems</p>	
	<p>Cooling System</p> <p>12.01 Services cooling system 12.02 Diagnoses cooling system 12.03 Repairs cooling system</p>	<p>Cooling System</p> <p>12.01 Services cooling system 12.02 Diagnoses cooling system 12.03 Repairs cooling system</p>	
<p>Air Systems</p> <p>13.01 Services air systems 13.02 Diagnoses air systems 13.03 Repairs air systems</p>			<p>Air Systems</p> <p>13.01 Services air systems 13.02 Diagnoses air systems 13.03 Repairs air systems</p>
<p>Brake Systems</p> <p>14.01 Services brake systems 14.02 Diagnoses brake systems 14.03 Repairs brake systems</p>			<p>Brake Systems</p> <p>14.01 Services brake systems 14.02 Diagnoses brake systems 14.03 Repairs brake systems</p>
<p>Battery systems</p> <p>15.01 Services battery systems 15.02 Diagnoses battery systems 15.03 Repairs battery systems</p>			
<p>Charging Systems</p> <p>16.01 Services charging systems 16.02 Diagnoses charging systems 16.03 Repairs charging systems</p>	<p>Charging Systems</p> <p>16.01 Services charging systems 16.02 Diagnoses charging systems 16.03 Repairs charging systems</p>		
		<p>Spark Ignition Systems</p> <p>17.01 Services spark ignition systems 17.02 Diagnoses spark ignition systems 17.03 Repairs spark ignition systems</p>	
<p>Starting Systems</p> <p>18.01 Services starting systems 18.02 Diagnoses starting systems 18.03 Repairs starting systems</p>	<p>Starting Systems</p> <p>18.01 Services starting systems 18.02 Diagnoses starting systems 18.03 Repairs starting systems</p>		

Level 1	Level 2	Level 3	Level 4
<p>Electrical Components and Accessories</p> <p>19.01 Services electrical components and accessories 19.02 Diagnoses electrical components and accessories 19.03 Repairs electrical components and accessories</p>	<p>Electrical Components and Accessories</p> <p>19.01 Services electrical components and accessories 19.02 Diagnoses electrical components and accessories 19.03 Repairs electrical components and accessories</p>		
	<p>Vehicle Management Systems and Electronic Components</p> <p>20.01 Services vehicle management systems and electronic components 20.02 Diagnoses vehicle management systems and electronic components 20.03 Repairs vehicle management systems and electronic components</p>	<p>Vehicle Management Systems and Electronic Components</p> <p>20.01 Services vehicle management systems and electronic components 20.02 Diagnoses vehicle management systems and electronic components 20.03 Repairs vehicle management systems and electronic components</p>	
	<p>Clutches</p> <p>21.01 Services clutches 21.02 Diagnoses clutches 21.03 Repairs clutches</p>	<p>Clutches</p> <p>21.01 Services clutches 21.02 Diagnoses clutches 21.03 Repairs clutches</p>	
	<p>Manual Transmission and Transfer Cases</p> <p>22.01 Services manual transmission and transfer cases 22.02 Diagnoses manual transmission and transfer cases 22.03 Repairs manual transmission and transfer cases</p>	<p>Manual Transmission and Transfer Cases</p> <p>22.01 Services manual transmission and transfer cases 22.02 Diagnoses manual transmission and transfer cases 22.03 Repairs manual transmission and transfer cases</p>	
	<p>Automatic Transmissions</p> <p>23.01 Services automatic transmissions 23.02 Diagnoses automatic transmissions 23.03 Repairs automatic transmissions</p>	<p>Automatic Transmissions</p> <p>23.01 Services automatic transmissions 23.02 Diagnoses automatic transmissions 23.03 Repairs automatic transmissions</p>	
	<p>Automated Transmissions</p> <p>24.01 Services automated transmissions 24.02 Diagnoses automated transmissions 24.03 Repairs automated transmissions</p>	<p>Automated Transmissions</p> <p>24.01 Services automated transmissions 24.02 Diagnoses automated transmissions 24.03 Repairs automated transmissions</p>	
	<p>Driveline Systems</p> <p>25.01 Services driveline systems 25.02 Diagnoses driveline systems 25.03 Repairs driveline systems</p>	<p>Driveline Systems</p> <p>25.01 Services driveline systems 25.02 Diagnoses driveline systems 25.03 Repairs driveline systems</p>	
	<p>Differentials</p> <p>26.01 Services differentials 26.02 Diagnoses differentials 26.03 Repairs differentials</p>	<p>Differentials</p> <p>26.02 Diagnoses differentials 26.03 Repairs differentials</p>	

Level 1	Level 2	Level 3	Level 4
	<p style="text-align: center;">Drive Train Retarders</p> <p>27.01 Services drive train retarders 27.02 Diagnoses drive train retarders 27.03 Repairs drive train retarders</p>	<p style="text-align: center;">Drive Train Retarders</p> <p>27.01 Services drive train retarders 27.02 Diagnoses drive train retarders 27.03 Repairs drive train retarders</p>	
<p style="text-align: center;">Steering Systems</p> <p>28.01 Services steering systems 28.02 Diagnoses steering systems 28.03 Repairs steering systems</p>			<p style="text-align: center;">Steering Systems</p> <p>28.01 Services steering systems 28.02 Diagnoses steering systems 28.03 Repairs steering systems</p>
<p style="text-align: center;">Chassis/ Frames</p> <p>29.01 Services, chassis/frames 29.02 Diagnoses chassis/frames 29.03 Repairs chassis/frames</p>			<p style="text-align: center;">Chassis/ Frames</p> <p>29.01 Services, chassis/frames 29.02 Diagnoses chassis/frames 29.03 Repairs chassis/frames</p>
<p style="text-align: center;">Suspensions</p> <p>30.01 Services suspensions 30.02 Diagnoses suspensions 30.03 Repairs suspensions</p>			<p style="text-align: center;">Suspensions</p> <p>30.01 Services suspensions 30.02 Diagnoses suspensions 30.03 Repairs suspensions</p>
<p style="text-align: center;">Hitches and Couplers</p> <p>31.01 Services hitches and couplers 31.02 Diagnoses hitches and couplers 31.03 Repairs hitches and couplers</p>			<p style="text-align: center;">Hitches and Couplers</p> <p>31.01 Services hitches and couplers 31.02 Diagnoses hitches and couplers 31.03 Repairs hitches and couplers</p>
<p style="text-align: center;">Tires, Wheels and Hubs</p> <p>32.01 Services tires wheels and hubs 32.02 Diagnoses tires, wheels and hubs 32.03 Repairs tires, wheels and hubs</p>			<p style="text-align: center;">Tires, Wheels and Hubs</p> <p>32.01 Services tires wheels and hubs 32.02 Diagnoses tires, wheels and hubs 32.03 Repairs tires, wheels and hubs</p>
			<p style="text-align: center;">Interior Cab Components</p> <p>33.01 Services interior cab components 33.02 Diagnoses interior cab components 33.03 Repairs interior cab components.</p>
<p style="text-align: center;">Exterior Cab Components</p> <p>34.01 Services exterior cab components 34.02 Diagnoses exterior cab components 34.03 Repairs exterior cab components</p>			

Level 1	Level 2	Level 3	Level 4
			<p>Trailer Components and Accessories</p> <p>35.01 Services trailer components and accessories 35.02 Diagnoses trailer components and accessories 35.03 Repairs trailer components and accessories</p>
<p>Heating and Ventilation Systems</p> <p>37.01 Services heating and ventilation systems 37.02 Diagnoses heating and ventilation systems 37.03 Repairs, heating and ventilation systems</p>		<p>Heating and Ventilation Systems</p> <p>37.01 Services heating and ventilation systems 37.02 Diagnoses heating and ventilation systems 37.03 Repairs, heating and ventilation systems</p>	<p>Heating and Refrigeration Systems</p> <p>36.01 Services heating and refrigeration systems 36.02 Diagnoses heating and refrigeration systems 36.03 Repairs heating and refrigeration systems</p>
<p>Air Conditioning Systems</p> <p>38.01 Services air conditioning systems 38.02 Diagnoses air conditioning systems 38.03 Repairs air conditioning systems</p>		<p>Air Conditioning Systems</p> <p>38.01 Services air conditioning systems 38.02 Diagnoses air conditioning systems 38.03 Repairs air conditioning systems</p>	
<p>Hydraulic Systems</p> <p>39.01 Services hydraulic systems 39.02 Diagnoses hydraulic systems 39.03 Repairs hydraulic systems</p>			<p>Hydraulic Systems</p> <p>39.01 Services hydraulic systems 39.02 Diagnoses hydraulic systems 39.03 Repairs hydraulic systems</p>
<p>Hybrid Vehicles</p> <p>40.01 Services hybrid vehicles 40.02 Diagnoses hybrid vehicle 40.03 Repairs hybrid vehicles</p>			<p>Hybrid Vehicles</p> <p>40.01 Services hybrid vehicles 40.02 Diagnoses hybrid vehicle 40.03 Repairs hybrid vehicles</p>
<p>Electric Vehicles (EV)</p> <p>41.01 Services electric vehicles (EV) 41.02 Diagnoses electric vehicles (EV) 41.03 Repairs electric vehicles (EV)</p>			<p>Electric Vehicles (EV)</p> <p>41.01 Services electric vehicles (EV) 41.02 Diagnoses electric vehicles (EV) 41.03 Repairs electric vehicles (EV)</p>

Major Work Activity A

Performs common occupational skills

Task A-1 Performs safety-related functions

Task Descriptor

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

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

A-1.01 Maintains safe work environment

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

Skills

	Performance Criteria	Evidence of Attainment
A-1.01.01P	assess work area	field-level risk assessment is completed
A-1.01.02P	identify potential hazards	potential hazards in hydraulic, pneumatic, electrical, fuel and air conditioning systems are identified by performing sensory inspection of vehicles and surrounding area
A-1.01.03P	handle, store, recycle and dispose of hazardous materials	hazardous materials are handled, stored, recycled and disposed of according to company policies and procedures, and jurisdictional safety regulations
A-1.01.04P	perform housekeeping duties	housekeeping duties are performed according to company policies and procedures
A-1.01.05P	use ventilation equipment to extract and contain fumes, smoke and dust	ventilation equipment is used according to safe work procedures to extract and contain fumes, smoke and dust

A-1.01.06P	identify safe lifting locations or points	safe lifting locations or points are identified according to manufacturers' service information
A-1.01.07P	identify location of workplace safety equipment and emergency phone numbers	location of workplace safety equipment and emergency phone numbers are identified

Range of Variables

hazards include: air lines, extension cords, broken equipment, fluids and gases under high pressure, ceiling heights, overhead wires, uneven surfaces, pinch/crush points, heavy tools and parts, energized equipment

hazardous materials include: chemicals, refrigerants, high-pressure gases, fluids, fuels, lubricants

jurisdictional safety regulations include: Occupational Health and Safety (OH&S), WHMIS

housekeeping duties include: sweeping, discarding defective components, keeping area clear of obstacles

manufacturers' service information include: specifications, recommendations, procedures, standards

workplace safety equipment includes: safety stations, first aid kits, eyewash stations, fire extinguishing equipment, spill kits, PPE, automated external defibrillator (AED)

Knowledge		
	Learning Outcomes	Learning Objectives
A-1.01.01L	demonstrate knowledge of safe work practices	describe safe work practices to maintain a safe work environment
		describe procedures to handle, store, recycle and dispose of hazardous materials
		identify workplace safety equipment , and describe their characteristics and applications
A-1.01.02L	demonstrate knowledge of certification and regulatory requirements pertaining to safety	identify and describe jurisdictional safety regulations to maintain safe work environment
		identify components of Workplace Hazardous Materials Information System (WHMIS) and associated certifications
		identify and describe jurisdictional requirements for handling, recycling and disposing of hazardous materials

Range of Variables

hazardous materials include: chemicals, refrigerants, high-pressure gases, fluids, fuels, lubricants

workplace safety equipment includes: safety stations, first aid kits, eyewash stations, fire extinguishing equipment, spill kits, PPE, automated external defibrillator (AED)

jurisdictional safety regulations include: Occupational Health and Safety (OH&S), WHMIS

components of WHMIS include: safety data sheets (SDS), labels, training, muster points

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

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

Skills

	Performance Criteria	Evidence of Attainment
A-1.02.01P	select and use PPE and safety equipment	PPE and safety equipment are selected, fit and used according to work conditions and requirements , company policies and manufacturers' service information
A-1.02.02P	store and maintain PPE and safety equipment	PPE and safety equipment are stored and maintained according to company policies and manufacturers' service information
A-1.02.03P	repair or replace, and report worn damaged or defective PPE and safety equipment	worn, damaged or defective PPE and safety equipment are repaired or replaced, and reported according to company policies and jurisdictional safety regulations

Range of Variables

PPE includes: hard hats, gloves, respirators, safety glasses, hearing protection, safety boots, protective clothing, face shields, high-visibility clothing

safety equipment includes: fall arrest, fall protection, guarding, shielding, jack/support stands, wheel chocks, lock-out, tag-out

work conditions and requirements include: wearing rubber gloves when handling hazardous or carcinogenic materials, wearing eye and hearing protection when hammering and grinding metals, wearing masks and breathing protection when working around hazardous airborne and liquid substances

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

jurisdictional safety regulations include: OH&S, WHMIS

Knowledge

	Learning Outcomes	Learning Objectives
A-1.02.01L	demonstrate knowledge of PPE and safety equipment , their characteristics, applications and procedures for use	identify types of PPE and safety equipment , and describe their characteristics, applications and procedures for use
		describe handling, storage and maintenance of PPE and safety equipment

A-1.02.02L	demonstrate knowledge of training, certification and regulatory requirements for PPE and safety equipment	identify training and certification requirements pertaining to PPE and safety equipment
		identify safety manuals, standards and regulations and jurisdictional safety regulations pertaining to PPE and safety equipment

Range of Variables

PPE includes: hard hats, gloves, respirators, safety glasses, hearing protection, safety boots, protective clothing, face shields, high-visibility clothing

safety equipment includes: fall arrest, fall protection, guarding, shielding, jack/support stands, wheel chocks, lock-out, tag-out

standards and regulations include: Canadian Standards Association (CSA), OH&S, site specific (company or client)

jurisdictional safety regulations include: OH&S, WHMIS

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

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

Skills

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

Range of Variables

PPE and safety equipment specific to hybrid and EV systems include: insulated gloves, pylons, high-voltage specific tools, safety hook, lock-out, tag-out, arc flash suits, helmets

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

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

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

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

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

Range of Variables

PPE and safety equipment specific to hybrid and EV systems include: insulated gloves, pylons, high-voltage specific tools, safety hook, lock-out, tag-out, arc flash suits, helmets

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

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

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

Task A-2 Uses and maintains tools and equipment

Task Descriptor

Truck and transport mechanics use tools and equipment to perform all tasks in their trade in a safe and efficient manner. They maintain these tools and equipment to ensure longevity and safe operation of tooling.

A-2.01 Uses hand, power, measuring, testing, and diagnostic tools

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

Skills

	Performance Criteria	Evidence of Attainment
A-2.01.01P	select and use hand, power, measuring, testing and diagnostic tools	hand, power, measuring, testing and diagnostic tools are selected and used according to task, company policies and procedures, and manufacturers' service information
A-2.01.02P	inspect hand, power, measuring, testing and diagnostic tools	hand, power, measuring, testing and diagnostic tools are inspected for wear, damage and defects according to company policies and procedures, and manufacturers' service information
A-2.01.03P	clean hand, power, measuring, testing and diagnostic tools	hand, power, measuring, testing and diagnostic tools are cleaned according to company policies and procedures, and manufacturers' service information
A-2.01.04P	lubricate power tools	power tools are lubricated according to manufacturers' service information
A-2.01.05P	calibrate measuring tools	measuring tools are calibrated according to manufacturers' service information
A-2.01.06P	sharpen tools	tools are sharpened according to company policies and procedures, and type of material being used
A-2.01.07P	store hand, power, measuring, testing and diagnostic tools	hand, power, measuring, testing and diagnostic tools are stored according to company policies and procedures, and manufacturers' service information
A-2.01.08P	repair or replace worn, damaged and faulty hand, power, measuring, testing and diagnostic tools	worn, damaged and faulty hand, power, measuring, testing and diagnostic tools are repaired or replaced according to company policies and procedures

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

Knowledge		
Learning Outcomes	Learning Objectives	
A-2.01.01L	demonstrate knowledge of hand, power, measuring, testing and diagnostic tools, their characteristics, applications, maintenance and procedures for use	identify types of hand, power, measuring, testing and diagnostic tools, and describe their characteristics, applications and procedures for use
		identify hazards and describe safe work practices pertaining to hand, power, measuring, testing and diagnostic tools
		describe procedures to inspect hand, power, measuring, testing and diagnostic tools
		describe procedures to lubricate and clean tools
		describe procedures to sharpen tools
		describe procedures to take worn, damaged and faulty hand, power, measuring, testing and diagnostic tools out of service for repair or replacement
		describe procedures to destroy and dispose of damaged and defective hand, power, measuring, testing and diagnostic tools

A-2.02 Uses shop equipment

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

Skills		
Performance Criteria	Evidence of Attainment	
A-2.02.01P	select and use shop equipment	shop equipment is selected and used according to task, company policies and procedures, and manufacturers' service information
A-2.02.02P	recognize and interpret tags on shop equipment identifying load limits	tags on shop equipment identifying load limits are recognized and interpreted

A-2.02.03P	visually inspect shop equipment for inspection tags, wear, damage and defects and remove from service	shop equipment is visually inspected for inspection tags, wear, damage and defects and are removed from service and reported according to company policies and procedures
A-2.02.04P	lubricate and clean shop equipment	shop equipment is lubricated and cleaned according to company policies and procedures, and manufacturers' service information
A-2.02.05P	maintain solvent washers and biological parts washers	solvent washers and biological parts washers are maintained according to manufacturers' service information
A-2.02.06P	store shop equipment	shop equipment is stored according to company policies and procedures, and manufacturers' service information
A-2.02.07P	identify potential hazards	potential hazards are identified
A-2.02.08P	verify certification dates	certification dates are verified to ensure they are current according to jurisdictional regulations

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: ceiling heights, overhead wires, uneven surfaces, rotating equipment, exhaust fumes, pinch/crush points, fire, explosions, flying debris, tripping

Knowledge		
	Learning Outcomes	Learning Objectives
A-2.02.01L	demonstrate knowledge of shop equipment, their characteristics, applications, maintenance and procedures for use	identify types of shop equipment and describe their characteristics and applications
		identify hazards and describe safe work practices pertaining to shop equipment
		identify load limitations of shop equipment
		describe procedures to inspect shop equipment
		describe procedures to lubricate and clean shop equipment
		describe procedures to record and report damaged and defective shop equipment
		describe procedures to store shop equipment
		explain inspection certification dates on shop equipment

A-2.02.02L	demonstrate knowledge of training and certification requirements to use shop equipment	identify training and certification requirements to use shop equipment
A-2.02.03L	demonstrate knowledge of regulatory requirements to maintain shop equipment	identify and interpret standards and jurisdictional regulations to maintain shop equipment

Range of Variables

hazards include: ceiling heights, overhead wires, uneven surfaces, rotating equipment, exhaust fumes, pinch/crush points, fire, explosions, flying debris, tripping

A-2.03 Uses hoisting, lifting and staging equipment

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

Skills

	Performance Criteria	Evidence of Attainment
A-2.03.01P	select and operate hoisting, lifting and staging equipment	hoisting, lifting and staging equipment are selected and operated according to task, equipment limitations, company policies and procedures, and manufacturers' service information
A-2.03.02P	inspect hoisting, lifting and staging equipment for wear, damage, leaks and defects	hoisting, lifting and staging equipment are inspected for wear, damage, leaks and defects according to company policies and procedures, and manufacturers' service information
A-2.03.03P	repair, replace, dispose of and report worn, damaged and defective components on hoisting, lifting and staging equipment	worn, damaged and defective components on hoisting, lifting and staging equipment are repaired, replaced or disposed of, and reported according to company policies and procedures
A-2.03.04P	store hoisting, lifting and staging equipment	hoisting, lifting and staging equipment are stored according to company policies and procedures, and manufacturers' service information
A-2.03.05P	position and connect hoisting, lifting and staging equipment	hoisting, lifting and staging equipment are positioned and connected according to company policies and procedures, and manufacturers' service information

A-2.03.06P	secure hoisting, lifting and staging equipment	hoisting, lifting and staging equipment are secured to prevent movement according to company policies and procedures, and manufacturers' service information
A-2.03.07P	identify potential hazards and implement measures to minimize risk	potential hazards are identified and measures are implemented to minimize risk

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: ceiling heights, overhead wires, uneven surfaces

Knowledge		
	Learning Outcomes	Learning Objectives
A-2.03.01L	demonstrate knowledge of hoisting, lifting and staging equipment, their components, characteristics, applications and maintenance	identify types of hoisting, lifting and staging equipment and their components, and describe their characteristics and applications
		describe procedures to inspect hoisting, lifting and staging equipment
		describe procedures to repair, replace and dispose of hoisting, lifting and staging equipment components
		describe procedures to store hoisting, lifting and staging equipment
		describe procedures to position and connect hoisting, lifting and staging equipment
		describe procedures to record and report damaged and defective hoisting, lifting and staging equipment
A-2.03.02L	demonstrate knowledge of procedures to operate hoisting, lifting and staging equipment	identify factors to consider when selecting hoisting, lifting and staging equipment
		identify hazards and describe safe work practices pertaining to hoisting, lifting and staging equipment
		describe procedures to operate hoisting, lifting and staging equipment
A-2.03.03L	demonstrate knowledge of training and certification requirements to operate hoisting, lifting and staging equipment	describe training and certification requirements to operate hoisting, lifting and staging equipment
A-2.03.04L	demonstrate knowledge of regulatory requirements to operate hoisting, lifting and staging equipment	locate, identify and interpret regulations to operate hoisting, lifting and staging equipment

Range of Variables

factors include: load characteristics, environment, safety factors, anchor points, sling angles

hazards include: ceiling heights, overhead wires, uneven surfaces

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

A-2.04 Uses welding and cutting equipment

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

Skills

	Performance Criteria	Evidence of Attainment
A-2.04.01P	select and use welding and cutting equipment	welding and cutting equipment are selected and used according to task, company policies and procedures, and manufacturers' service information
A-2.04.02P	clean welding and cutting tips	welding and cutting tips are cleaned according to manufacturers' service information
A-2.04.03P	transport welding and cutting equipment	welding and cutting equipment is transported according to jurisdictional regulations and Transportation of Dangerous Goods (TDG) Act
A-2.04.04P	inspect welding and cutting equipment for wear, damage, defects and potential hazards	welding and cutting equipment is inspected for wear, damage, defects and potential hazards , and findings are reported to supervisor/manager according to company policies and procedures, and manufacturers' service information
A-2.04.05P	remove worn, damaged and defective welding and cutting equipment from service	worn, damaged and defective welding and cutting equipment is removed from service according to company policies and procedures
A-2.04.06P	determine when welding repairs should be completed by a certified welder	welding repairs to be completed by a certified welder are determined
A-2.04.07P	determine equipment and material selection	equipment and material selection are determined according to materials being worked on
A-2.04.08P	set up welding and cutting equipment	welding and cutting equipment is set up by adjusting controls for task being performed
A-2.04.09P	prepare vehicle for welding	vehicle is prepared for welding according to manufacturers' service information to prevent damage to vehicle and electronic components

A-2.04.10P	prepare work area for welding	work area is prepared for welding using methods according to task and company policies and procedures
A-2.04.11P	perform basic welding and cutting procedures	basic welding and cutting procedures are performed
A-2.04.12P	assess flow and penetration during welding	flow and penetration are assessed during welding according to sensory inspection
A-2.04.13P	shut down welding equipment	welding equipment is shut down according to company policies and procedures, and manufacturers' service information
A-2.04.14P	store and secure welding and cutting equipment	welding and cutting equipment is stored and secured according to company policies and procedures, manufacturers' service information and jurisdictional regulations

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: electrocution, fire, arc flash, metal poisoning, burns

materials include: aluminum, steel, stainless steel

methods include: removing combustibles, placing flash curtains, verifying ventilation

Knowledge		
	Learning Outcomes	Learning Objectives
A-2.04.01L	demonstrate knowledge of welding and cutting equipment, their characteristics, applications and maintenance	identify types of welding and cutting equipment, and describe their characteristics, applications and maintenance
		describe procedures to inspect welding and cutting equipment
		describe procedures to transport welding and cutting equipment
		describe procedures to store welding and cutting equipment
		identify welding materials
A-2.04.02L	demonstrate knowledge of procedures to use welding and cutting equipment	identify hazards and describe safe work practices pertaining to welding and cutting equipment
		describe procedures to use welding and cutting equipment
		identify welding and cutting principles and considerations
		identify welding and cutting basic procedures

A-2.04.03L	demonstrate knowledge of training and certification requirements to use welding and cutting equipment	identify training and certification requirements to use welding and cutting equipment
A-2.04.04L	demonstrate knowledge of regulatory requirements to transport and store welding and cutting equipment	identify and interpret standards and regulations to transport and store welding and cutting equipment

Range of Variables

welding materials include: covered and coiled wire electrodes, shielding gases

hazards include: electrocution, fire, arc flash, metal poisoning, burns

A-2.05 Uses electronic devices and systems for diagnostics and programming

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

Skills

	Performance Criteria	Evidence of Attainment
A-2.05.01P	use software applications	software applications are used according to manufacturers' service information
A-2.05.02P	verify software version, download from manufacturer and upload to controllers	software version is verified, downloaded from manufacturer and uploaded to controllers
A-2.05.03P	select and use electronic devices	electronic devices are selected and used according to task and manufacturers' service information
A-2.05.04P	download and document reports from equipment controller and forward to original equipment manufacturer (OEM) or customer	reports from equipment controller are downloaded and documented and forwarded to OEM or customer
A-2.05.05P	monitor data and parameters	data and parameters are monitored for operational status according to manufacturers' service information
A-2.05.06P	adjust parameters	parameters are adjusted according to customer request and manufacturers' service information
A-2.05.07P	interpret diagnostic results and reports	diagnostic results and reports are interpreted to determine failure and required repair

Range of Variables

software applications include: diagnostic and operating software, Internet-based technical support, remote monitoring systems

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

electronic devices include: laptops, smart phones, tablets, communication interface adapters

data includes: temperatures, speeds, pressure, switch states, state of charge

parameters include: speeds, temperatures, pressures, anti-lock braking system (ABS), roll stability, software versions, power take-off (PTO) settings

Knowledge		
	Learning Outcomes	Learning Objectives
A-2.05.01L	demonstrate knowledge of using electronic devices for diagnostics and programming	identify types of electronic devices used in diagnostics and programming, and describe their characteristics, applications and procedures for use
		describe software applications used in diagnostics and programming
		describe manufacturers' programming and monitoring procedures
		describe elements of diagnostic results and reports
A-2.05.02L	demonstrate knowledge of training and certification available to use electronic devices for diagnostics and programming	describe training and certification available to use electronic devices for diagnostics and programming

Range of Variables

electronic devices include: laptops, smart phones, tablets, communication interface adapters

software applications include: diagnostic and operating software, Internet-based technical support, remote monitoring systems

Task A-3 Performs routine work practices

Task Descriptor

Truck and transport mechanics reference different sources of documentation to diagnose, service and repair systems. Truck and transport mechanics must have knowledge of materials and hardware such as fasteners, bearings, sealing devices and their application.

A-3.01 Uses documentation and reference materials

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

Skills

	Performance Criteria	Evidence of Attainment
A-3.01.01P	locate information on vehicle	information on vehicle is located
A-3.01.02P	locate and reference most recent technical information	most recent technical information is located and referenced for diagnostic, servicing and repair procedures
A-3.01.03P	interpret and apply technical information to situation	technical information is interpreted and applied to situation
A-3.01.04P	record service history	service history is recorded according to company policies and procedures, manufacturers' requirements and jurisdictional regulations
A-3.01.05P	create list of parts needed	list of parts needed is created according to repair required, and company policies and procedures
A-3.01.06P	match replacement part to original part	replacement part is matched to original part
A-3.01.07P	record work-related information	work-related information is recorded according to company policies and procedures, and manufacturers' requirements
A-3.01.08P	complete safety-related documents	safety-related documents are completed according to jurisdictional regulations, and company policies and procedures
A-3.01.09P	report completion of documentation to management	completion of documentation is reported to management according to company policies and procedures
A-3.01.10P	follow confidentiality guidelines	confidentiality guidelines are followed according to company policies and procedures

Range of Variables

information on vehicle includes: vehicle identification numbers (VIN), component serial numbers, make and model of vehicle

technical information includes: shop service and parts manuals, troubleshooting trees, flow charts, schematics, technical drawings, specifications, test results, parameters, service bulletins

service history includes: motor vehicle inspections, warranty forms, preventive maintenance records, failure analysis using photographs

work-related information includes: technician hours worked, machine hours, VIN, parts used, task descriptions, mileage

safety-related documents include: accident reports, injury reports, safety inspection reports, workplace hazard reports

Knowledge		
Learning Outcomes	Learning Objectives	
A-3.01.01L	demonstrate knowledge of trade-related documentation, their characteristics and applications	identify types of trade-related documentation and describe their characteristics and applications
A-3.01.02L	demonstrate knowledge of procedures to use and complete trade-related documentation	describe procedures to use and complete trade-related documentation
A-3.01.03L	demonstrate knowledge of confidentiality guidelines	identify elements of confidentiality guidelines, and describe their characteristics and applications
A-3.01.04L	demonstrate knowledge of regulatory requirements pertaining to use and completion of trade-related documentation	identify and interpret regulations pertaining to use and completion of trade-related documentation

A-3.02 Maintains fluids and lubricants

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

Skills		
Performance Criteria	Evidence of Attainment	
A-3.02.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
A-3.02.02P	identify safe handling procedures for fluids and lubricants	safe handling procedures for fluids and lubricants are identified according to WHMIS
A-3.02.03P	verify fluid levels	fluid levels are verified and adjusted according to manufacturers' service information

A-3.02.04P	identify and select types and grades of fluids and lubricants	types and grades of fluids and lubricants are identified and selected according to application, environmental conditions and manufacturers' service information
A-3.02.05P	identify and select types of coolants and additives	types of coolants and additives are identified and selected according to manufacturers' service information
A-3.02.06P	verify coolant has been mixed properly	coolant is verified using tools and equipment to ensure it has been mixed properly
A-3.02.07P	store, recycle and dispose of fluids and lubricants	fluids and lubricants are stored, recycled and disposed of according to jurisdictional regulations
A-3.02.08P	take fluid samples	fluid samples are taken according to instructions and manufacturers' service information from test lab
A-3.02.09P	interpret fluid sample results	fluid sample results are interpreted to indicate issues

Range of Variables

tools and equipment include: dip sticks, sight glass, refractometers, test strips

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

fluids include: hub oil, hydraulic oil, methyl hydrate, fuel, coolants, engine oil, brake fluids, washer fluids

lubricants include: oils and greases (synthetic, semi-synthetic, non-synthetic)

fluid samples include: oils, coolants, fuels, brake fluids, diesel exhaust fluids

issues include: contamination, abnormal wear, signs of premature failure

Knowledge

	Learning Outcomes	Learning Objectives
A-3.02.01L	demonstrate knowledge of fluids and lubricants , their characteristics and applications	identify types and grades of fluids and lubricants , and describe their characteristics and applications describe consequences of mixing different types of fluids and lubricants
A-3.02.02L	demonstrate knowledge of procedures to maintain fluids and lubricants	identify tools and equipment used to maintain fluids and lubricants , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to fluids and lubricants describe procedures to maintain level of fluids and lubricants describe procedures to maintain coolants describe procedures to collect fluid samples

		describe procedures to dispose of and recycle oil, antifreeze, air conditioning refrigerant, contaminated fuels and filters
A-3.02.03L	demonstrate knowledge of regulatory requirements to recycle and dispose of oil, antifreeze, air conditioning refrigerant, contaminated fuels and filters	identify and interpret standards and regulations to recycle and dispose of oil, antifreeze, air conditioning refrigerant, contaminated fuels and filters
A-3.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to extending service intervals	identify practices that reduce material waste
		identify reusable filters

Range of Variables

fluids include: hub oil, hydraulic oil, methyl hydrate, fuel, coolants, engine oil, brake fluids, washer fluids

lubricants include: oils and greases (synthetic, semi-synthetic, non-synthetic)

tools and equipment include: dip sticks, sight glass, refractometers, test strips

hazards include: caustic, respiratory, carcinogenic, poisoning

fluid samples include: oils, coolants, fuels, brake fluids, diesel exhaust fluids

A-3.03 Services hoses, tubing and fittings

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

Skills

	Performance Criteria	Evidence of Attainment
A-3.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
A-3.03.02P	support raised components mechanically, relieve pressure and drain fluid from air and fluid systems before disconnecting hoses, tubing and fittings	raised components are supported mechanically, pressure is relieved, and fluid is drained from air and fluid systems before disconnecting hoses, tubing and fittings according to service conditions and manufacturers' service information
A-3.03.03P	identify and document faults	faults are identified and documented according to sensory inspection of hoses, tubing and fittings
A-3.03.04P	route and secure hoses, tubing and fittings	hoses, tubing and fittings are routed and secured using methods to avoid rubbing, pinch/crush points or interference with other components
A-3.03.05P	identify and replace hoses and tubing	hoses and tubing are identified and replaced according to application and manufacturers' service information

A-3.03.06P	identify and replace fittings and clamping devices	fittings and clamping devices are identified and replaced according to thread, fitting size, compatibility and manufacturers' service information
A-3.03.07P	install ferrules, nuts and inserts	ferrules, nuts and inserts are installed according to design and application
A-3.03.08P	construct hose and tube assemblies	hose and tube assemblies are constructed using tools and equipment
A-3.03.09P	create flares	flares are created using specialized flaring tools

Range of Variables

tools and equipment include: crimping tools, tube flaring tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

faults include: holes, cracks, breakage, chaffing, leaks

methods include: using clamps, springs, separators and ties

application includes: size, pressure limits, fluid type, temperature

Knowledge		
	Learning Outcomes	Learning Objectives
A-3.03.01L	demonstrate knowledge of hoses, tubing and fittings, their characteristics, applications and operation	identify types of hoses, tubing and fittings , and describe their characteristics and applications
		describe operating principles of hoses, tubing and fittings
		describe compatibility of hoses, tubing and fittings
A-3.03.02L	demonstrate knowledge of procedures to service hoses, tubing and fittings	identify tools and equipment used to service hoses, tubing and fittings, and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hoses, tubing and fittings
		describe procedures to inspect hoses, tubing and fittings
		describe procedures to remove and install hoses, tubing and fittings
A-3.03.03L	demonstrate knowledge of regulatory requirements pertaining to hoses, tubing and fittings	identify and interpret standards and regulations pertaining to hoses, tubing and fittings

Range of Variables

types of hoses, tubing and fittings include: plastic, rubber, neoprene, steel

tools and equipment include: crimping tools, tube flaring tools

A-3.04 Services filters

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

Skills

	Performance Criteria	Evidence of Attainment
A-3.04.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
A-3.04.02P	relieve system pressure before removing filters	system pressure is relieved before removing filters
A-3.04.03P	remove filters	filters are removed using tools and equipment according to manufacturers' service information
A-3.04.04P	identify performance issues and symptoms related to plugged filters	performance issues and symptoms related to plugged filters are identified to determine if replacement of filter is required
A-3.04.05P	inspect filters	filters are inspected for debris to determine condition of system
A-3.04.06P	select and install filters	filters are selected and installed according to manufacturers' service information
A-3.04.07P	dispose of filters	filters are disposed of according to jurisdictional regulations
A-3.04.08P	wash filters	filters are washed according to manufacturers' service information

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

Knowledge

	Learning Outcomes	Learning Objectives
A-3.04.01L	demonstrate knowledge of filters, their characteristics, applications and operation	identify types of filters and describe their characteristics and applications
		describe operating principles of filters

A-3.04.02L	demonstrate knowledge of procedures to service filters	identify tools and equipment used to service filters, and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to filters
		describe procedures to inspect filters
		describe procedures to remove and install filters
		describe procedures to dispose of and recycle filters
A-3.04.03L	demonstrate knowledge of regulatory requirements to recycle and dispose of filters	identify and interpret standards and regulations to recycle and dispose of filters
A-3.04.04L	demonstrate knowledge of emerging technologies and practices pertaining to reusable filters	identify practices that reduce filter waste

Range of Variables

applications include: air, fuel, oil

types of filters include: wash-out, pre-cleaners

A-3.05 Services bearings and seals

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

Skills

	Performance Criteria	Evidence of Attainment
A-3.05.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
A-3.05.02P	inspect bearings for defects	bearings are inspected for defects
A-3.05.03P	inspect seals for defects during installation	seals are inspected for defects during installation
A-3.05.04P	inspect seals and sealing surfaces for damage after installation	seals and sealing surfaces are inspected for damage after installation
A-3.05.05P	lubricate and install bearings and bushings	bearings and bushings are lubricated and installed to allowable tolerances according to application
A-3.05.06P	install seals	seals are installed according to manufacturers' service information
A-3.05.07P	adjust bearings	bearings are adjusted according to manufacturers' service information

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

bearings include: friction, non-friction

bearing defects include: pitting, scoring, discolouration, excessive wear

seals include: static, dynamic

seal defects include: distortion, warped sealing surface, installation damage, brittleness

Knowledge		
	Learning Outcomes	Learning Objectives
A-3.05.01L	demonstrate knowledge of bearings and seals , their characteristics, applications and operation	identify types of bearings and seals , and describe their characteristics and applications
		describe operating principles of bearings and seals
A-3.05.02L	demonstrate knowledge of procedures to service bearings and seals	identify tools and equipment used to service bearings and seals , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to bearings and seals
		describe procedures to inspect bearings , seals and sealing surfaces
		describe procedures to service bearings and seals
		describe procedures to remove and install bearings and seals
		identify types of shaft repairs

Range of Variables

bearings include: friction, non-friction

seals include: static, dynamic

hazards include: removal process, shards

types of shaft repairs include: installing wear sleeves, re-machining of shaft

A-3.06 Uses fasteners and sealing devices

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

Skills

	Performance Criteria	Evidence of Attainment
A-3.06.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
A-3.06.02P	select and install fasteners	fasteners are selected and installed according to factors and manufacturers' service information
A-3.06.03P	tighten fasteners	fasteners are tightened according to manufacturers' service information
A-3.06.04P	select and apply sealing devices	sealing devices are selected and applied according to application, environmental conditions and manufacturers' service information
A-3.06.05P	verify quality of fasteners and sealing devices	fasteners and sealing devices are verified according to manufacturers' service information
A-3.06.06P	remove broken fasteners while minimizing damage to threads	broken fasteners are removed while minimizing damage to threads
A-3.06.07P	repair threads	threads are repaired using tools according to manufacturers' service information
A-3.06.08P	remove sealing devices while minimizing damage to sealing surface	sealing devices are removed while minimizing damage to sealing surface
A-3.06.09P	fabricate and install sealing devices	sealing devices are fabricated and installed according to application and manufacturers' service information

Range of Variables

tools and equipment include: rivet guns, impact guns, glue guns, torque wrenches, crimpers, air hammers

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

factors include: application, type, grade, thread pitch, size

sealing devices include: weather stripping, window channel, aerobic and anaerobic sealants, O-rings, compound gaskets, paper gaskets, head gaskets

tools include: taps, dies, chasers, thread inserts

Knowledge

Learning Outcomes	Learning Objectives
A-3.06.01L	demonstrate knowledge of fasteners, their characteristics, applications and operation
	identify types, grades and torque specifications of fasteners, and describe their characteristics and applications
	describe operating principles of fasteners
A-3.06.02L	demonstrate knowledge of sealing devices , their characteristics and applications and operation
	identify types of sealing devices , and describe their characteristics and applications
	describe operating principles of sealing devices
A-3.06.03L	demonstrate knowledge of procedures to apply, remove and install fasteners and sealing devices
	identify tools and equipment used with fasteners and sealing devices , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to fasteners and sealing devices
	identify tools used to repair threads
	describe procedures used to repair threads
	describe procedures to remove and install fasteners and sealing devices
	describe procedures to apply sealing devices
	describe torque procedures for fasteners
	identify anaerobic and aerobic materials, and describe their characteristics and applications
	identify ventilation requirements when using sealants and adhesives
A-3.06.04L	demonstrate knowledge of regulatory requirements pertaining to sealants and adhesives
	identify and interpret standards and regulations pertaining to handling, storing and disposing of sealing devices

Range of Variables

sealing devices include: weather stripping, window channel, aerobic and anaerobic sealants, O-rings, compound gaskets, paper gaskets, head gaskets

tools and equipment include: rivet guns, impact guns, glue guns, torque wrenches, crimpers, air hammers

hazards include: seal failure, fastener failure, irritants

tools include: taps, dies, chasers, thread inserts

Task A-4 Uses communication and mentoring techniques

Task Descriptor

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

A-4.01 Uses communication techniques

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

Skills

	Performance Criteria	Evidence of Attainment
A-4.01.01P	demonstrate communication practices with individuals or in a group	instructions and messages are interpreted by all parties involved in communication
A-4.01.02P	listen using active listening practices	active listening practices are used
A-4.01.03P	speak clearly using correct industry terminology to ensure understanding	understanding of message is confirmed by both parties
A-4.01.04P	receive and respond to instructions	response to instructions indicates understanding
A-4.01.05P	receive and respond to feedback on work completed or performed	response to feedback indicates understanding and corrective measures are taken
A-4.01.06P	explain and provide feedback	explanation and feedback are provided, and task is carried out as directed
A-4.01.07P	use questions to improve communication	questions enhance understanding, on-the-job training and goal setting
A-4.01.08P	participate in safety and information meetings	meetings are attended, information is relayed to workforce, and is applied
A-4.01.09P	send and receive electronic messages	electronic messages are sent and received using professionalism, plain language and clear expressions according to company policy

Range of Variables

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

electronic messages include: e-mail, text messages

Knowledge

	Learning Outcomes	Learning Objectives
A-4.01.01L	demonstrate knowledge of trade terminology	define terminology used in trade
A-4.01.02L	demonstrate knowledge of effective communication practices	describe importance of using effective verbal and non-verbal communication with people in the workplace
		identify sources of information to effectively communicate
		identify communication and learning styles
		describe effective listening and speaking skills
		describe how to receive and give instructions effectively
		identify personal responsibilities and attitudes that contribute to on-the-job success
		identify value of equity, diversity and inclusion in workplace
		identify communication that constitutes bullying, harassment and discrimination
		identify communication styles appropriate to different systems and applications of electronic messages

Range of Variables

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

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

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

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

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

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

electronic messages include: e-mail, text messages

A-4.02 Uses mentoring techniques

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

Skills

	Performance Criteria	Evidence of Attainment
A-4.02.01P	identify and communicate learning objective and point of lesson	apprentice or learner can explain objective and point of lesson
A-4.02.02P	link lesson to other lessons and project	lesson order and unplanned learning opportunities are defined
A-4.02.03P	demonstrate performance of a skill to an apprentice or learner	steps required to demonstrate a skill are performed
A-4.02.04P	set up conditions required for apprentice or learner to practice a skill	practice conditions are set up so that skill can be practiced safely by apprentice or learner
A-4.02.05P	assess apprentice or learner's ability to perform tasks with increasing independence	performance of apprentice or learner improves with practice to a point where task can be done with little supervision
A-4.02.06P	give supportive and corrective feedback	apprentice or learner adopts best practice after having been given supportive or corrective feedback
A-4.02.07P	support apprentices or learners in pursuing technical training opportunities	technical training is completed within timeframe prescribed by apprenticeship authority
A-4.02.08P	support anti- harassment and anti- discrimination practices in workplace	workplace is harassment- and discrimination-free
A-4.02.09P	assess apprentice or learner suitability to trade during probationary period	apprentice or learner is given constructive feedback that helps them identify their own strengths and weaknesses and suitability for the trade

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

practice conditions mean: guided, limited independence, full independence

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

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

Knowledge

Learning Outcomes	Learning Objectives
A-4.02.01L demonstrate knowledge of strategies for learning skills in workplace	describe importance of individual experience
	describe shared responsibilities for workplace learning
	determine one's own learning preferences and explain how these relate to learning new skills
	describe importance of different types of skills in workplace
	describe importance of skills for success (essential skills) in workplace
	identify different learning styles
	identify different learning needs and strategies to meet them
	identify strategies to assist in learning a skill
	A-4.02.02L demonstrate knowledge of strategies for teaching workplace skills
describe teaching skills	
explain importance of identifying point of lesson	
identify how to choose a good time to present lesson	
explain importance of linking lessons	
identify context for learning skills	
describe considerations in setting up opportunities for skill practice	
explain importance of providing feedback	
identify techniques for giving effective feedback	
describe a skills assessment	
identify methods of assessing progress	
explain how to adjust lesson to different situations	

Range of Variables

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

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

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

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

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

Major Work Activity B

Services, diagnoses and repairs engines and supporting systems

Task B-5 Services, diagnoses and repairs base engines

Task Descriptor

The engine produces power through engine speed and torque to enable movement of the vehicle. Servicing includes the adjustment of components as well as their routine maintenance. Diagnosing is required to locate failures in order to effectively perform repairs on the engine, which may include replacement or rebuilding of components.

Truck and transport mechanics service, diagnose and repair the base engine and its components to ensure proper engine function and reduce down time.

B-5.01 Services base engines

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

Skills

	Performance Criteria	Evidence of Attainment
B-5.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-5.01.02P	collect oil sample	oil sample is collected according to sample kit instructions and manufacturers' service information
B-5.01.03P	visually inspect oil sample and send sample for analysis	oil sample is visually inspected for residual contaminants and sample is sent for analysis according to company policies and customer request
B-5.01.04P	perform sensory inspection of base engine components	sensory inspection of base engine components is performed to identify wear, damage and defects

B-5.01.05P	adjust clearance of valve train components	clearance of valve train components is adjusted according to manufacturers' service information
B-5.01.06P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: blocks, crankshafts, camshafts, cylinder heads, pistons, bushings, rocker arms, gears, bearings

Knowledge		
	Learning Outcomes	Learning Objectives
B-5.01.01L	demonstrate knowledge of base engines, their components , characteristics, applications and operation	identify types of base engines and their components , and describe their characteristics and applications
		describe operating principles of base engines and their components
		interpret information pertaining to base engines found in manufacturers' service information
B-5.01.02L	demonstrate knowledge of procedures to service base engines and their components	identify tools and equipment used to service base engines and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to base engines and their components
		describe procedures to inspect base engines and their components
		describe procedures to service base engines and their components
B-5.01.03L	demonstrate knowledge of emerging technologies and practices pertaining to base engines	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technological improvements to base engine materials and design
		identify materials that can be reconditioned, reused or recycled

Range of Variables

components include: blocks, crankshafts, camshafts, cylinder heads, pistons, bushings, rocker arms, gears, bearings

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: sharp edges, weight, size, heat, moving parts

B-5.02 Diagnoses base engines

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

Skills

	Performance Criteria	Evidence of Attainment
B-5.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
B-5.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-5.02.03P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
B-5.02.04P	perform diagnostic procedure	diagnostic procedure is performed to determine failure according to manufacturers' service information
B-5.02.05P	perform electronic and mechanical tests	electronic and mechanical tests are performed according to manufacturers' service information to assess components for wear, damage and defects
B-5.02.06P	interpret oil sample analysis results	oil sample analysis results are interpreted to determine specific component wear
B-5.02.07P	interpret test results	test results are interpreted and compared to manufacturers' service information or expected values
B-5.02.08P	perform failure analysis	failure analysis is performed to determine root cause of failure
B-5.02.09P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
B-5.02.10P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: abnormal vibration, leaks, noises, no start, hard start, low power, low oil pressure

tools and equipment include: temperature measuring devices, compression testers, wear measuring instruments, pressure measuring devices, dynamometers, fluid analysis sampling devices, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: feeling for vibrations, listening for abnormal sounds, smelling for burning oil

tests include: compression tests, cylinder leakage, oil pressure, dynamometer checks, fluid sampling for analysis, injector cut-out

components include: valves, pistons, blocks, liners, cylinder heads, cam shafts, valve trains, crank shafts, connecting rods, gears, bearings, seals, sealants, gaskets

next steps include: repairs, component replacement, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
B-5.02.01L	demonstrate knowledge of base engines, their components , characteristics, applications and operation	identify types of base engines and their components , and describe their characteristics and applications
		describe operating principles of base engines and their components
		interpret information pertaining to base engines found in manufacturers' service information
B-5.02.02L	demonstrate knowledge of procedures to diagnose base engines and their components	identify tools and equipment used to diagnose base engines and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to base engines and their components
		describe procedures to inspect base engines and their components
		describe procedures to test base engines and their components
		describe procedures to diagnose base engines and their components
		describe common causes and symptoms of problems
		identify materials that can be reconditioned, reused or recycled

B-5.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to base engines	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technological improvements to base engine materials and design

Range of Variables

components include: valves, pistons, blocks, liners, cylinder heads, cam shafts, valve trains, crank shafts, connecting rods, gears, bearings, seals, sealants, gaskets

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: temperature measuring devices, compression testers, wear measuring instruments, pressure measuring devices, dynamometers, fluid analysis sampling devices, electronic service tools

hazards include: sharp edges, weight, size, heat, moving parts

symptoms of problems include: abnormal vibration, leaks, noises, no start, hard start, low power, low oil pressure

B-5.03 Repairs base engines

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

Skills

	Performance Criteria	Evidence of Attainment
B-5.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-5.03.02P	prepare equipment for engine repair, removal and reinstallation procedures	equipment is prepared for engine repair, removal and reinstallation procedures by performing functions
B-5.03.03P	remove and replace worn, damaged or faulty components	worn, damaged or faulty components are removed and replaced
B-5.03.04P	perform updates	updates are performed according to manufacturers' service information
B-5.03.05P	rebuild cylinder head	cylinder head is rebuilt by cleaning and replacing worn cylinder head components according to manufacturers' service information
B-5.03.06P	rebuild base engine	base engine is rebuilt by cleaning and replacing worn or damaged components
B-5.03.07P	repair base engine	base engine is repaired using methods according to manufacturers' service information

B-5.03.08P	perform adjustments	adjustments are performed to ensure operation of components and equipment
B-5.03.09P	verify repairs	repairs are verified using methods
B-5.03.10P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: torque wrenches, dial indicators, measuring instruments, lifting devices, engine rotator, torque-to-yield gauge, feeler gauges, dynamometer, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

functions include: disconnecting electrical connections, draining fluids, steam cleaning engine

components include: valves, pistons, piston rings, blocks, liners, cylinder heads, cam shafts, valve trains, crank shafts, connecting rods, timing gears, bearings, seals, sealants, gaskets

cylinder head components include: valves, seals, valve guides, valve seats, springs, injector sleeves/cups

methods (to repair base engine) include: replacing parts causing failure, grinding valves, cutting block counterbores and shimming cylinder liners, using oversized bearings

adjustments include: adjusting valve train clearances, setting timing gears

methods (to verify repairs) include: road testing, dynamometer testing, electronic diagnostic testing

Knowledge		
	Learning Outcomes	Learning Objectives
B-5.03.01L	demonstrate knowledge of base engines, their components , characteristics, applications and operation	identify types of base engines and their components , and describe their characteristics and applications
		describe theory of engine operation
B-5.03.02L	demonstrate knowledge of procedures to repair base engines and their components	identify tools and equipment used to repair base engines and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to base engines and their components
		describe procedures to remove, replace, rebuild and repair base engines and their components
		identify materials that can be reconditioned, reused or recycled
B-5.03.03L	demonstrate knowledge of training and certification requirements for base engine repair	identify manufacturers' training and certification requirements for base engine repair

B-5.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to base engines	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technological improvements to base engine materials and design

Range of Variables

components include: valves, pistons, piston rings, blocks, liners, cylinder heads, cam shafts, valve trains, crank shafts, connecting rods, timing gears, bearings, seals, sealants, gaskets

tools and equipment include: torque wrenches, dial indicators, measuring instruments, lifting devices, engine rotator, torque-to-yield gauge, feeler gauges, dynamometer, electronic service tools

hazards include: sharp edges, weight, size, heat, moving parts

Task B-6 Services, diagnoses and repairs lubrication systems

Task Descriptor

The lubrication system regulates the flow of oil throughout the engine and its components to the oil cooler to transfer heat from the oil to the cooling system. It also flushes contaminants away from engine components through the oil filter. Its main purpose is to protect internal engine components by creating a thin film of oil between metal surfaces.

Servicing includes the replacement of consumables as well as the routine maintenance of the system. Diagnosing is required to determine the root cause of failures in order to effectively perform repairs on lubrication system.

Truck and transport mechanics service, diagnose and repair lubrication systems to ensure proper protection of the engine and its components.

B-6.01 Services lubrication systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-6.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-6.01.02P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
B-6.01.03P	clean lubrication system components	lubrication system components are cleaned using lint-free rags and solvents

B-6.01.04P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
B-6.01.05P	measure oil pressure, temperature and level	oil pressure, temperature and level are measured to determine if they meet manufacturers' service information and fleet/owner maintenance schedule
B-6.01.06P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information
B-6.01.07P	recycle or dispose of consumables	consumables are recycled or disposed of according to jurisdictional regulations
B-6.01.08P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: oil pump, oil cooler, pressure regulator valves, bypass valves, inlet strainers, oil filters

sensory inspections include: looking for leaks, smelling for burnt oil, checking magnetic drain plug for contamination

consumables include: oil filters, oil

Knowledge		
	Learning Outcomes	Learning Objectives
B-6.01.01L	demonstrate knowledge of lubrication systems, their components , consumables , characteristics, applications and operation	identify types of lubrication systems, their components and consumables , and describe their characteristics and applications
		describe operating principles of lubrication systems and their components
		interpret information pertaining to lubrication systems found in manufacturers' service information
		describe functions and characteristics of engine oil
		identify fluid classifications
B-6.01.02L	demonstrate knowledge of procedures to service lubrication systems and their components	identify tools and equipment used to service lubrication systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to lubrication systems and their components

		describe procedures to release or isolate stored energy
		describe procedures to inspect lubrication systems and their components
		describe procedures to service lubrication systems and their components
		describe procedures to remove and replace lubrication system components
		describe procedures to remove, replace, recycle and dispose of lubrication system consumables
		identify materials that can be recycled
		identify practices that reduce material waste
B-6.01.03L	demonstrate knowledge of regulatory requirements pertaining to lubrication systems	identify and interpret standards and regulations pertaining to lubrication systems
B-6.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to lubrication systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: oil pump, oil cooler, pressure regulator valves, bypass valves, inlet strainers, oil filters

consumables include: oil filters, oil

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

fluid classifications include: viscosity, American Petroleum Institute (API), Society of Automotive Engineers (SAE)

hazards include: high temperatures, skin irritation, splashing/dripping oil, fire

B-6.02**Diagnoses lubrication systems**

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

Skills

	Performance Criteria	Evidence of Attainment
B-6.02.01P	identify <i>symptoms of problems</i>	<i>symptoms of problems</i> are identified by consulting with customer or operator
B-6.02.02P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to task and <i>manufacturers' service information</i>
B-6.02.03P	release or isolate stored energy	stored energy is released or isolated according to <i>manufacturers' service information</i>
B-6.02.04P	perform <i>sensory inspections</i>	<i>sensory inspections</i> are performed to confirm complaint and establish preliminary diagnosis
B-6.02.05P	perform diagnostic procedures and <i>tests</i>	diagnostic procedures and <i>tests</i> are performed to determine failure by following <i>manufacturers' service information</i>
B-6.02.06P	interpret oil sample analysis results	oil sample analysis results are interpreted to determine contamination of lubricant
B-6.02.07P	compare <i>test</i> results to <i>manufacturers' service information</i> or expected values	<i>test</i> results are compared to <i>manufacturers' service information</i> or expected values to verify diagnosis
B-6.02.08P	perform failure analysis	failure analysis is performed to determine root cause of failure
B-6.02.09P	record <i>test</i> results and inspection findings	<i>test</i> results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
B-6.02.10P	interpret diagnostic results	diagnostic results are interpreted to determine <i>next steps</i>

Range of Variables

symptoms of problems include: low or high fluid level, low or high oil pressure, external oil leaks, oil dilution, cross-contaminated oil, high oil temperature

tools and equipment include: pressure gauges, infrared/direct contact thermometers, dyes, fluid analysis sampling devices

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: listening for engine knock, smelling oil, looking for leaks, visual inspection of levels

tests include: oil pressure and temperature, contamination

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
B-6.02.01L	demonstrate knowledge of lubrication systems, their components , characteristics, applications and operation	identify types of lubrication systems and their components , and describe their characteristics, applications and operation
		describe operating principles of lubrication systems and their components
		interpret information pertaining to lubrication systems found in manufacturers' service information
B-6.02.02L	demonstrate knowledge of procedures to diagnose lubrication systems and their components	identify tools and equipment used to diagnose lubrication systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to lubrication systems and their components
		describe procedures to release or isolate stored energy
		describe procedures to inspect lubrication systems and their components
		describe procedures to test and diagnose lubrication systems and their components
		describe common causes and symptoms of problems
		identify materials that can be recycled
B-6.02.03L	demonstrate knowledge of regulatory requirements pertaining to lubrication system waste disposal	identify practices that reduce material waste
		identify and interpret standards and regulations pertaining to lubrication system waste disposal

B-6.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to lubrication systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: oil pump, oil cooler, pressure regulator valves, bypass valves, inlet strainers, oil filters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: pressure gauges, infrared/direct contact thermometers, dyes, fluid analysis sampling devices

hazards include: high temperatures, skin irritation, splashing/dripping oil, fire

symptoms of problems include: low or high fluid level, low or high oil pressure, external oil leaks, oil dilution, cross-contaminated oil, high oil temperature

B-6.03 Repairs lubrication systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-6.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-6.03.02P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
B-6.03.03P	remove and replace components	components are removed and replaced according to manufacturers' service information
B-6.03.04P	verify repairs	repairs are verified using methods while running engine at operating condition
B-6.03.05P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: pumps, oil thermostats, piston cooling nozzles, bearings

methods include: checking oil pressure, temperature and levels

Knowledge		
	Learning Outcomes	Learning Objectives
B-6.03.01L	demonstrate knowledge of lubrication systems, their components , characteristics, applications and operation	identify types of lubrication systems, their components , and describe their characteristics, applications and operation describe operating principles of lubrication systems and their components interpret information pertaining to lubrication systems found in manufacturers' service information
B-6.03.02L	demonstrate knowledge of procedures to repair lubrication systems and their components	identify tools and equipment used to repair lubrication systems and their components , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to lubrication systems and their components describe procedures to release or isolate stored energy describe procedures to remove, replace and repair lubrication systems and their components
B-6.03.03L	demonstrate knowledge of regulatory requirements pertaining to lubrication system waste disposal	identify and interpret standards and regulations pertaining to lubrication system waste disposal
B-6.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to lubrication systems	identify technologies and practices that contribute to net zero and carbon neutral commitments identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: pumps, oil thermostats, piston cooling nozzles, bearings

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: high temperatures, skin irritation, splashing/dripping oil, fire

Task B-7 Services, diagnoses and repairs intake systems

Task Descriptor

The engine intake systems supply cool filtered air to the engine. Emissions control systems are often an integral part of intake systems.

Servicing includes the replacement of consumables and components as well as their routine maintenance. Diagnosing is required to determine root cause of failures in order to effectively perform repairs on intake systems.

Truck and transport mechanics must service, diagnose and repair intake systems to ensure proper operation and performance of the engine.

B-7.01 Services intake systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-7.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-7.01.02P	clean intake components	intake components are cleaned according to manufacturers' service information
B-7.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
B-7.01.04P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule
B-7.01.05P	recycle and dispose of consumables	consumables are recycled and disposed of
B-7.01.06P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: looking for soot deposits indicating leaks, listening for air escaping, looking for incorrect fit or installation of piping, checking gauges

components include: charge air coolers (CAC), turbochargers (variable geometry turbochargers [VGT] and compound), piping, manifolds, gaskets, filter housing, clamps, pressure and temperature sensors, intake throttle valves

consumables include: gaskets, filters

Knowledge		
	Learning Outcomes	Learning Objectives
B-7.01.01L	demonstrate knowledge of intake systems, their components , consumables , characteristics, applications and operation	identify types of intake systems, their components and consumables , and describe their characteristics and applications
		describe operating principles of intake systems and their components
		interpret information pertaining to intake systems found in manufacturers' service information
		identify types of starting aids and describe their characteristics, applications and safe use
B-7.01.02L	demonstrate knowledge of procedures to service intake systems, their components and consumables	identify tools and equipment used to service intake systems, their components and consumables , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to intake systems and their components
		describe procedures to inspect intake systems and their components and consumables
		describe procedures to service intake systems and their components and consumables
B-7.01.03L	demonstrate knowledge of emerging technologies and practices pertaining to intake systems	describe procedures to remove, replace, recycle and dispose of intake system consumables
		identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: charge air coolers (CAC), turbochargers (variable geometry turbochargers [VGT] and compound), piping, manifolds, gaskets, filter housing, clamps, pressure and temperature sensors, intake throttle valves

consumables include: gaskets, filters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

starting aids include: pre-heaters, ether injection

hazards include: running engine in confined spaces, dangers surrounding air inlets

B-7.02 Diagnoses intake systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-7.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
B-7.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-7.02.03P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
B-7.02.04P	perform diagnostic procedure and tests	diagnostic procedure and tests are performed to determine failure according to manufacturers' service information
B-7.02.05P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
B-7.02.06P	perform failure analysis	failure analysis is performed to determine root cause of failure
B-7.02.07P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
B-7.02.08P	interpret diagnostic results	diagnostic results are interpreted to determine next steps
B-7.02.09P	inspect and test starting aids	starting aids are inspected and tested according to manufacturers' service information

Range of Variables

symptoms of problems include: visible exhaust smoke, low power, no start, low boost, noises

tools and equipment include: electronic service tools, intake CAC pressure test kits, manometers

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: looking for soot deposits indicating leaks, listening for air escaping, looking for incorrect fit or installation of piping, checking gauges

tests include: boost test, intake and CAC pressure test, exhaust gas recirculation (EGR) operation test

next steps include: repairs, component replacement or adjustment, further diagnosis

starting aids include: pre-heaters, ether injection

Knowledge		
	Learning Outcomes	Learning Objectives
B-7.02.01L	demonstrate knowledge of intake systems, their components , consumables , characteristics, applications and operation	identify types of intake systems, their components and consumables , and describe their characteristics and applications
		describe operating principles of intake systems and their components
		interpret information pertaining to intake systems found in manufacturers' service information
		identify types of starting aids and describe their characteristics, applications and safe use
		identify intake system contamination
B-7.02.02L	demonstrate knowledge of procedures to diagnose intake systems and their components	identify emergency shutdown devices
		identify tools and equipment used to diagnose intake systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to intake systems and their components
		describe procedures to inspect intake systems and their components
		describe procedures to test intake systems and their components
		describe procedures to diagnose intake systems and their components
		describe common causes and symptoms of problems

B-7.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to intake systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: CAC, turbochargers (VGT and compound), piping, manifolds, gaskets, filter housing, clamps, pressure and temperature sensors, intake throttle valve

consumables include: gaskets, filters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

starting aids include: pre-heaters, ether injection

intake system contamination includes: dust, oil, antifreeze

emergency shutdown devices include: air dams (cable and switch operated)

tools and equipment include: electronic service tools, intake CAC pressure test kits, manometers

hazards include: running engine in confined spaces, dangers surrounding air inlets

symptoms of problems include: visible exhaust smoke, low power, no start, low boost, noises

B-7.03 Repairs intake systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-7.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-7.03.02P	remove and replace worn, damaged or faulty components	worn, damaged or faulty components are removed and replaced according to manufacturers' service information
B-7.03.03P	remove and replace worn, damaged or faulty starting aid components	worn, damaged or faulty starting aid components are removed and replaced according to manufacturers' service information
B-7.03.04P	calibrate intake electronic components	intake electronic components are calibrated according to manufacturers' service information

B-7.03.05P	verify repairs	repairs are verified using methods according to manufacturers' service information
B-7.03.06P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: CAC, turbochargers (VGT and compound), piping, manifolds, gaskets, filter housing, clamps, pressure and temperature sensors, intake throttle valves

electronic components include: intake throttle valves, VGT, EGR

methods include: pressure testing intake system, performing sensory observations of intake system

Knowledge		
	Learning Outcomes	Learning Objectives
B-7.03.01L	demonstrate knowledge of intake systems, their components , consumables , characteristics, applications and operation	identify types of intake systems, their components and consumables , and describe their characteristics and applications
		describe operating principles of intake systems and their components
		interpret information pertaining to intake systems found in manufacturers' service information
B-7.03.02L	demonstrate knowledge of procedures to repair intake systems and their components	identify tools and equipment used to repair intake systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to intake systems and their components
		describe procedures to remove, replace and repair intake systems and their components
B-7.03.03L	demonstrate knowledge of training and certification requirements pertaining to intake systems	identify training and certification pertaining to intake systems
B-7.03.04L	demonstrate knowledge of regulations pertaining to intake systems	identify and interpret regulations pertaining to intake systems
B-7.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to intake systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: CAC, turbochargers (VGT and compound), piping, manifolds, gaskets, filter housing, clamps, pressure and temperature sensors, intake throttle valves

consumables include: gaskets, filters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: running engine in confined spaces, dangers surrounding air inlets

Task B-8 Services, diagnoses and repairs exhaust systems

Task Descriptor

Exhaust systems work in conjunction with other engine systems to reduce noise pollution, nitric oxide and nitrogen dioxide (NO_x gases), carbon emissions and other harmful by-products of combustion to meet jurisdictional environmental requirements.

Servicing includes the replacement of consumables and components as well as their routine maintenance. Diagnosing is required to determine root cause of failures in order to effectively perform repairs on exhaust systems.

Truck and transport mechanics service, diagnose and repair exhaust systems to ensure proper operation and performance of the engine, and to ensure emissions levels meet requirements.

B-8.01 Services exhaust systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-8.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-8.01.02P	clean components	components are cleaned according to manufacturers' service information
B-8.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged or defective components
B-8.01.04P	perform software updates and reset electronic service reminders	software updates are performed and electronic service reminders are reset according to manufacturers' service information
B-8.01.05P	remove and replace components and consumables	components and consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule

B-8.01.06P	recycle and dispose of components and consumables	components and consumables are recycled and disposed of according to jurisdictional regulations
B-8.01.07P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: electronic service tools, temperature and pressure measuring devices, diesel exhaust fluid (DEF) refractometer, diesel particulate filter (DPF) cleaning machines

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: DPFs, fluid dosing pump, pressure differential and temperature sensors, DEF injectors, catalysts, EGR valves and coolers, turbochargers (VGT and compound), exhaust manifolds

sensory inspections include: looking for leaks, observing DEF levels, looking for accumulation of urea crystals, looking for visible exhaust smoke

consumables include: DEF, filters

Knowledge		
	Learning Outcomes	Learning Objectives
B-8.01.01L	demonstrate knowledge of exhaust systems, their components , consumables , characteristics, applications and operation	identify types of exhaust systems, their components and consumables , and describe their characteristics and applications
		identify types of emission systems
		describe operating principles of exhaust systems and their components
		interpret information pertaining to exhaust systems found in manufacturers' service information
		identify types of controls and describe their characteristics and applications
B-8.01.02L	demonstrate knowledge of procedures to service exhaust systems, their components and consumables	identify tools and equipment used to service exhaust systems, their components and consumables , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to exhaust systems and their components
		describe procedures to inspect exhaust systems and their components
		describe procedures to clean exhaust system components
		describe procedures to remove, replace, recycle and dispose of exhaust system consumables

		describe procedures to perform software updates
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
B-8.01.03L	demonstrate knowledge of regulatory requirements pertaining to exhaust systems	identify and interpret standards and regulations pertaining to exhaust systems
B-8.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to exhaust systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: DPFs, fluid dosing pump, pressure differential and temperature sensors, DEF injectors, catalysts, EGR valves and coolers, turbochargers (VGT and compound), exhaust manifolds

consumables include: DEF, filters

types of emission systems include: DPF, EGR, selective catalytic reduction (SCR), crankcase ventilation systems

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

types of controls include: electronic control management systems, electronic and manual switches

tools and equipment include: electronic service tools, temperature and pressure measuring devices, DEF refractometer, DPF cleaning machines

hazards include: skin and eye irritation, high temperature, hazardous fumes, operating engine in confined spaces

B-8.02 Diagnoses exhaust systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-8.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
B-8.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-8.02.03P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis

B-8.02.04P	perform diagnostic procedure and tests	diagnostic procedure and tests are performed by following manufacturers' service information
B-8.02.05P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
B-8.02.06P	perform failure analysis	failure analysis is performed to determine root cause of failure
B-8.02.07P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
B-8.02.08P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: leaks, low power, visible exhaust smoke, frequent regeneration, warning lights, fault codes

tools and equipment include: electronic service tools, temperature and pressure measuring devices

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: looking for leaks, observing DEF levels, looking for accumulation of urea crystals, looking for visible exhaust smoke

tests include: computer-based tests, DEF concentration tests, manual temperature and pressure gauge tests

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
B-8.02.01L	demonstrate knowledge of exhaust systems, their components , consumables , characteristics, applications and operation	identify types of exhaust systems, their components and consumables , and describe their characteristics and applications
		describe operating principles of exhaust systems and their components
		interpret information pertaining to exhaust systems found in manufacturers' service information
		identify types of emission systems
		identify types of controls and describe their characteristics and applications
B-8.02.02L	demonstrate knowledge of procedures to diagnose exhaust systems and their components	identify tools and equipment used to diagnose exhaust systems and their components , and describe their applications and procedures for use

		identify hazards and describe safe work practices pertaining to exhaust systems and their components
		describe procedures to diagnose exhaust systems and their components
		describe common causes and symptoms of problems
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
B-8.02.03L	demonstrate knowledge of regulatory requirements pertaining to exhaust systems	identify and interpret standards and regulations pertaining to exhaust systems
B-8.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to exhaust systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: DPFs, fluid dosing pump, pressure differential and temperature sensors, DEF injectors, catalysts, EGR valves and coolers, turbochargers (VGT and compound), exhaust manifolds

consumables include: DEF, filters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

types of emission systems include: DPF, EGR, SCR, crankcase ventilation systems

types of controls include: electronic control management systems, electronic and manual switches

tools and equipment include: electronic service tools, temperature and pressure measuring devices

hazards include: skin and eye irritation, high temperature, hazardous fumes, operating engine in confined spaces, noises

symptoms of problems include: leaks, low power, visible exhaust smoke, frequent regeneration, warning lights, fault codes

B-8.03 Repairs exhaust systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-8.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-8.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
B-8.03.03P	perform updates	updates are performed according to manufacturers' service information
B-8.03.04P	reprogram parameters after repair	parameters are reprogrammed after repair according to manufacturers' service information
B-8.03.05P	verify repairs	repairs are verified using methods
B-8.03.06P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: DPF cleaning units, manufacturer-specific tools, welding equipment, electronic service tools, temperature and pressure measuring devices

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: DPFs, fluid dosing pump, pressure differential and temperature sensors, DEF injectors, catalysis, EGR valves and coolers, turbochargers (VGT and compound), exhaust manifolds

methods include: operating vehicle, parked regeneration, monitoring operation

Knowledge

	Learning Outcomes	Learning Objectives
B-8.03.01L	demonstrate knowledge of exhaust systems, their components , consumables , characteristics, applications and operation	identify types of exhaust systems, their components and consumables , and describe their characteristics and applications
		describe operating principles of exhaust systems and their components
		interpret information pertaining to exhaust systems found in manufacturers' service information
		identify types of emissions systems

		identify types of controls and describe their characteristics and applications
B-8.03.02L	demonstrate knowledge of procedures to repair exhaust systems and their components	identify tools and equipment used to repair exhaust systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to exhaust systems and their components
		describe procedures to remove, replace and repair exhaust system components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
B-8.03.03L	demonstrate knowledge of regulatory requirements pertaining to exhaust systems	identify and interpret standards and regulations pertaining to exhaust systems
B-8.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to exhaust systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: DPFs, fluid dosing pump, pressure differential and temperature sensors, DEF injectors, catalysts, EGR valves and coolers, turbochargers (VGT and compound), exhaust manifolds

consumables include: DEF, filters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

types of emission systems include: DPF, EGR, SCR, crankcase ventilation systems

types of controls include: electronic control management systems, electronic and manual switches

tools and equipment include: DPF cleaning units, manufacturer-specific tools, welding equipment, electronic service tools, temperature and pressure measuring devices

hazards include: skin and eye irritation, high temperature, hazardous fumes, operating engine in confined spaces

Task B-9 Services, diagnoses and repairs engine management systems

Task Descriptor

Engine management systems receive analog/digital inputs and distribute analog/digital outputs to many components throughout the vehicle to optimize vehicle performance.

Servicing is primarily a matter of updating software to meet both manufacturer programming and fleet/owner requirements. Diagnosing is required to determine root cause of failures in order to effectively perform repairs on engine management systems.

Truck and transport mechanics service, diagnose and repair engine management systems to ensure proper operation of multiple components of the vehicle.

B-9.01 Services engine management systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-9.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-9.01.02P	adjust values of electronic control module (ECM) parameters	values of ECM parameters are adjusted according to manufacturers' service information and fleet/owner requirements
B-9.01.03P	perform software updates	engine management system software updates are performed according to manufacturers' service information

Range of Variables

tools and equipment include: electronic service tools, multimeters, breakout harnesses

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

ECM parameters include: shutdowns, cruise controls, speed controls, fan controls, application specific (e.g., enabling PTO, geo-fencing, retarder, shift points)

Knowledge

Learning Outcomes	Learning Objectives
B-9.01.01L demonstrate knowledge of engine management systems, their components , characteristics, applications and operation	identify engine management systems and their components , and describe their characteristics and applications
	describe operating principles of engine management systems and their components
	describe effect of static electricity and external voltage induction on delicate electronic components
B-9.01.02L demonstrate knowledge of procedures to service engine management systems and their components	identify tools and equipment used to service engine management systems and their components , and describe their applications and procedures for use
	describe procedures to service engine management systems and their components
	describe procedures to perform software updates
B-9.01.03L demonstrate knowledge of training and certification requirements pertaining to engine management systems	identify training and certification requirements pertaining to engine management systems
B-9.01.04L demonstrate knowledge of regulatory requirements pertaining to engine management systems	identify codes, standards and regulations pertaining to engine management systems
B-9.01.05L demonstrate knowledge of emerging technologies and practices pertaining to engine management systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
	identify technologies that address emissions and pollution, and describe their characteristics and applications
	identify emerging technologies pertaining to engine management systems and safe vehicle operation

Range of Variables

components include: harnesses, ECMs, switches, sensors, actuators

tools and equipment include: electronic service tools, multimeters, breakout harnesses

B-9.02 Diagnoses engine management systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-9.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
B-9.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-9.02.03P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
B-9.02.04P	perform diagnostic procedure	diagnostic procedure is performed to determine failures by following manufacturers' service information
B-9.02.05P	perform tests	tests are performed according to manufacturers' service information
B-9.02.06P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
B-9.02.07P	perform failure analysis	failure analysis is performed to determine root cause of failure
B-9.02.08P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
B-9.02.09P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: misfires, gauges with readings outside expected range, engine shutdowns, no start, de-rated power, fault codes, warning lights

tools and equipment include: electronic service tools, multimeters, pin-out equipment, break-out harnesses

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

failures include: poor connections, chafed or corroded harnesses, faulty components

tests include: resistance, voltage drop, commanded actuator

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

Learning Outcomes	Learning Objectives
B-9.02.01L demonstrate knowledge of engine management systems, their components , characteristics, applications and operation	identify engine management systems and their components , and describe their characteristics and applications
	describe operating principles of engine management systems and their components
	interpret information pertaining to engine management systems found in manufacturers' service information
	describe effect of static electricity and external voltage induction on delicate electronic components
	identify types of specialized connectors and harnesses
	identify spark ignition system components, and describe their characteristics and applications
B-9.02.02L demonstrate knowledge of procedures to diagnose engine management systems and their components	describe elements of manufacturers' engine ratings
	identify tools and equipment used to diagnose engine management systems and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to engine management systems and their components
	describe procedures to inspect engine management systems and their components
	describe procedures to test engine management systems and their components
	describe procedures to diagnose engine management systems and their components
B-9.02.03L demonstrate knowledge of training and certification requirements pertaining to engine management systems	describe common causes and symptoms of problems and failures
B-9.02.04L demonstrate knowledge of regulatory requirements pertaining to engine management systems	identify training and certification requirements pertaining to engine management systems
B-9.02.04L demonstrate knowledge of regulatory requirements pertaining to engine management systems	identify codes, standards and regulations pertaining to engine management systems

B-9.02.05L	demonstrate knowledge of emerging technologies and practices pertaining to engine management systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to engine management systems and safe vehicle operation

Range of Variables

components include: harnesses, ECMs, switches, sensors, actuators

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

types of specialized connectors and harnesses include: sensor connections, injector harnesses, ECM connectors

tools and equipment include: electronic service tools, multimeters, pin-out equipment, break-out harnesses

hazards include: high-voltage outputs, hot surfaces, sharp edges, pinch/crush points, moving parts

symptoms of problems include: misfires, gauges with readings outside expected range, engine shutdowns, no start, de-rated power, fault codes, warning lights

failures include: poor connections, chafed or corroded harnesses, faulty components

B-9.03 Repairs engine management systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-9.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-9.03.02P	remove and replace damaged and faulty components	damaged and faulty components are removed and replaced according to manufacturers' service information
B-9.03.03P	perform updates and recalls	updates and recalls are performed according to manufacturers' service information
B-9.03.04P	repair components	components are repaired by soldering, splicing and crimping according to manufacturers' service information
B-9.03.05P	calibrate components	components are calibrated according to manufacturers' service information

B-9.03.06P	verify repairs	repairs are verified using methods
B-9.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: ECMs, harnesses, sensors, actuators, resistors, switches

components (to be repaired) include: harnesses, connectors, terminals

components (to be calibrated) include: injectors, turbochargers, speed control sensors, EGR valves, intake throttle valves, exhaust sensors

methods include: clearing codes, resetting virtual breaker, verifying that fault codes remain inactive, performing operational tests

Knowledge		
	Learning Outcomes	Learning Objectives
B-9.03.01L	demonstrate knowledge of engine management systems, their components , characteristics, applications and operation	identify engine management systems and their components , and describe their characteristics and applications
		describe operating principles of engine management systems and their components
B-9.03.02L	demonstrate knowledge of procedures to repair engine management systems and their components	identify tools and equipment used to repair engine management systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to engine management systems and their components
		describe procedures to remove, replace, calibrate and repair engine management system components
B-9.03.03L	demonstrate knowledge of training and certification requirements pertaining to engine management systems	identify training and certification requirements pertaining to engine management systems
B-9.03.04L	demonstrate knowledge of regulatory requirements pertaining to engine management systems	identify codes, standards and regulations pertaining to engine management systems

B-9.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to engine management systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to engine management systems and safe vehicle operation

Range of Variables

components include: ECMs, harnesses, sensors, actuators, resistors, switches
intake throttle valves, exhaust sensors

hazards include: high-voltage outputs, hot surfaces, sharp edges, pinch/crush points, moving parts

Task B-10 Services, diagnoses and repairs fuel delivery systems

Task Descriptor

The fuel delivery system supplies clean fuel to the engine at regulated pressure and volume. Fuels include diesel, propane, bio-diesel and natural gas.

Truck and transport mechanics service, diagnose and repair fuel delivery systems to ensure proper engine operation and minimize downtime.

B-10.01 Services fuel delivery systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-10.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-10.01.02P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
B-10.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged or defective components

B-10.01.04P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule
B-10.01.05P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
B-10.01.06P	prime fuel system for operation	fuel system is primed for operation according to manufacturers' service information
B-10.01.07P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: smelling or looking for fuel leaks, looking for excessive exhaust smoke, listening for engine miss

components include: pumps, injectors, tanks, check valves, fuel regulating valves, lines

consumables include: fuels, filters, fuel-water separators, fuel additives

Knowledge

	Learning Outcomes	Learning Objectives
B-10.01.01L	demonstrate knowledge of fuel delivery systems, their components , consumables , characteristics, applications and operation	<p>identify types of fuel delivery systems, their components and consumables, and describe their characteristics and applications</p> <p>describe operating principles of fuel delivery systems and their components</p> <p>identify types of fuels and describe their characteristics and applications</p> <p>identify types of fuel additives and describe their characteristics, applications and effects</p> <p>interpret information pertaining to fuel additives found in manufacturers' service information</p>
B-10.01.02L	demonstrate knowledge of procedures to service fuel delivery systems, their components and consumables	<p>identify tools and equipment used to service fuel delivery systems, their components and consumables, and describe their applications and procedures for use</p> <p>identify hazards and describe safe work practices pertaining to fuel delivery systems and their components</p> <p>describe procedures to release or isolate stored energy</p>

		describe procedures to inspect fuel delivery systems and their components
		describe procedures to remove, replace, recycle and dispose of fuel delivery system consumables
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
B-10.01.03L	demonstrate knowledge of training and certification requirements pertaining to fuel delivery systems	identify training and certification requirements pertaining to fuel delivery systems
B-10.01.04L	demonstrate knowledge of regulatory requirements pertaining to fuel delivery systems	identify and interpret regulations pertaining to fuel delivery systems
B-10.01.05L	demonstrate knowledge of emerging technologies and practices pertaining to fuel delivery systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: pumps, injectors, tanks, check valves, fuel regulating valves, lines

consumables include: fuels, filters, fuel-water separators, fuel additives

types of fuel delivery systems include: mechanical, electronic

types of fuels include: winter and summer fuels, natural gas, propane, diesel, biodiesel, gasoline

types of fuel additives include: cetane boost, antigel/antiwax, fuel conditioner

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: extreme high pressure, flammable and explosive materials, environmental irritant, noxious fumes

B-10.02 Diagnoses fuel delivery systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-10.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
B-10.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information

B-10.02.03P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
B-10.02.04P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
B-10.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
B-10.02.06P	interpret fuel system flow schematics and perform tests	fuel system flow schematics are interpreted and tests are performed according to manufacturers' service information
B-10.02.07P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
B-10.02.08P	perform failure analysis	failure analysis is performed to determine root cause of failure
B-10.02.09P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
B-10.02.10P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: exhaust smoke, rough running engine, poor engine performance, no start, fuel leaks

tools and equipment include: pressure gauges, vacuum gauges, flow meters, dynamometers, electronic service tools, injector testers

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: smelling and looking for leaks, listening for engine misfires and vibrations, looking for excessive exhaust smoke

tests include: injector cut-out, injector performance, transfer pump pressure, return volume, filter restriction, injector leakage

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
B-10.02.01L	demonstrate knowledge of fuel delivery systems, their components , consumables , characteristics, applications and operation	identify types of fuel delivery systems , their components and consumables , and describe their characteristics and applications
		describe operating principles of fuel delivery systems and their components

		interpret information pertaining to fuel delivery systems found in manufacturers' service information
		identify types of fuels and describe their characteristics and applications
		identify types of fuel additives and describe their characteristics and applications
		interpret information pertaining to fuel additives found in manufacturers' service information
B-10.02.02L	demonstrate knowledge of procedures to diagnose fuel delivery systems and their components	identify tools and equipment used to diagnose fuel delivery systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to fuel delivery systems and their components
		describe procedures to release or isolate stored energy
		describe procedures to inspect fuel delivery systems and their components
		describe procedures to test fuel delivery systems and their components
		describe procedures to test fuels
		describe procedures to diagnose fuel delivery systems and their components
		describe common causes and symptoms of problems
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
B-10.02.03L	demonstrate knowledge of training and certification requirements pertaining to fuel delivery systems	identify training and certification requirements pertaining to fuel delivery systems
B-10.02.04L	demonstrate knowledge of regulatory requirements pertaining to fuel delivery systems	identify and interpret regulations pertaining to fuel delivery systems
B-10.02.05L	demonstrate knowledge of emerging technologies and practices pertaining to fuel delivery systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: pumps, injectors, tanks, check valves, fuel regulating valves, lines

consumables include: fuels, filters, fuel-water separators

types of fuel delivery systems include: mechanical, electronic

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

types of fuels include: winter and summer fuels, natural gas, propane, diesel, biodiesel, gasoline

types of fuel additives include: cetane boost, antigel/antiwax, fuel conditioners

tools and equipment include: pressure gauges, vacuum gauges, flow meters, dynamometers, electronic service tools, injector testers

hazards include: extreme high pressure, flammable and explosive materials, environmental irritant, noxious fumes

symptoms of problems include: exhaust smoke, rough running engine, poor engine performance, no start, fuel leaks

B-10.03 Repairs fuel delivery systems

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

Skills

Performance Criteria		Evidence of Attainment
B-10.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-10.03.02P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
B-10.03.03P	remove and replace worn, damaged or faulty components	worn, damaged or faulty components are removed and replaced according to manufacturers' service information
B-10.03.04P	perform updates, recalls and recalibration	updates, recalls and recalibration are performed according to manufacturers' service information
B-10.03.05P	perform measurements	measurements are performed to determine if they meet manufacturers' service information
B-10.03.06P	perform adjustments to components	adjustments are performed on components according to manufacturers' service information
B-10.03.07P	prime fuel system for operation	fuel system is primed for operation according to manufacturers' service information

B-10.03.08P	verify repairs	repairs are verified using methods
B-10.03.09P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: torque wrenches, manufacturer-specific tools, pullers, dial indicators, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: low- and high-pressure pumps, injectors, tanks, check valves, fuel regulating valves, lines

measurements include: injector height, fuel pressure, pump inlet restriction

adjustments include: entering calibration values for electronic injectors, setting injector pre-load, confirming high and low throttle (mechanical injection systems), adjusting throttle linkages, setting injector height, setting pump timing

methods include: running equipment at operating condition, performing manufacturers' test procedures

Knowledge		
	Learning Outcomes	Learning Objectives
B-10.03.01L	demonstrate knowledge of fuel delivery systems, their components , consumables , characteristics, applications and operation	identify types of fuel delivery systems , their components and consumables , and describe their characteristics and applications
		describe operating principles of fuel delivery systems and their components
		identify types of fuels and describe their characteristics and applications
B-10.03.02L	demonstrate knowledge of procedures to repair fuel delivery systems and their components	identify tools and equipment used to repair fuel delivery systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to fuel delivery systems and their components
		describe procedures to release or isolate stored energy
		describe procedures to remove, replace, calibrate, adjust and repair fuel delivery system components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
B-10.03.03L	demonstrate knowledge of training and certification requirements pertaining to fuel delivery systems	identify training and certification requirements pertaining to fuel delivery systems

B-10.03.04L	demonstrate knowledge of regulatory requirements pertaining to fuel delivery systems	identify and interpret regulations pertaining to fuel delivery systems
B-10.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to fuel delivery systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: low- and high-pressure pumps, injectors, tanks, check valves, fuel regulating valves, lines

consumables include: fuels, filters, fuel-water separators

types of fuel delivery systems include: mechanical, electronic

types of fuels include: winter and summer fuels, natural gas, propane, diesel, biodiesel, gasoline

tools and equipment include: torque wrenches, manufacturer-specific tools, pullers, dial indicators, electronic service tools

hazards include: extreme high pressure, flammable and explosive materials, environmental irritant, noxious fumes

Task B-11 Services, diagnoses and repairs engine retarder systems

Task Descriptor

Engine retarder systems are an optional component used to assist the primary braking system to slow the vehicle and to prolong primary brake life. These systems receive inputs from the vehicle and operator to determine appropriate timing to manage compression within the engine by controlling exhaust flow or valve position.

Truck and transport mechanics service, diagnose and repair engine retarder systems to ensure proper function and reduce down time.

B-11.01 Services engine retarder systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-11.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-11.01.02P	perform adjustments to components	adjustments are performed on components according to manufacturers' service information and operator preferences
B-11.01.03P	perform ECM programming	ECM programming is performed according to fleet/owner requirements
B-11.01.04P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: manufacturer-specific gauges, feeler gauge

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

adjustments include: valve clearances, parameters, compression brake clearances

Knowledge

	Learning Outcomes	Learning Objectives
B-11.01.01L	demonstrate knowledge of engine retarder systems, their components , characteristics, applications and operation	identify types of engine retarder systems and their components , and describe their characteristics and applications
		describe operating principles of engine retarder systems and their components
		describe function of electronic controls used with engine retarder systems
B-11.01.02L	demonstrate knowledge of procedures to service engine retarder systems and their components	identify tools and equipment used to service engine retarder systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to engine retarder systems and their components
		describe procedures to service engine retarder system components
		describe procedures to perform ECM programming
		describe procedures to test engine retarder systems and their components

Range of Variables

types of engine retarder systems include: compression, exhaust

components include: harnesses, exhaust valves, secondary pistons, ECMs, solenoids, switches, O-rings

tools and equipment include: manufacturer-specific gauges, feeler gauge

hazards include: high temperatures, skin irritation, moving parts, sharp edges

B-11.02 Diagnoses engine retarder systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-11.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
B-11.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information

B-11.02.03P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
B-11.02.04P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
B-11.02.05P	perform tests	tests are performed to assess components for wear, damage and defects
B-11.02.06P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
B-11.02.07P	perform failure analysis	failure analysis is performed to determine root cause of failure
B-11.02.08P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
B-11.02.09P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: poor engine retarder performance, unusual engine noises, loss of oil pressure

tools and equipment include: electronic service tools, pressure testing equipment, multimeters, feeler gauges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tests include: oil pressure, solenoid operation, electrical circuitry, functionality

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
B-11.02.01L	demonstrate knowledge of engine retarder systems, their components , characteristics, applications and operation	identify types of engine retarder systems and their components , and describe their characteristics and applications
		describe operating principles of engine retarder systems and their components
		interpret information pertaining to engine retarder systems found in manufacturers' service information
		describe function of electronic controls used with engine retarder systems

B-11.02.02L	demonstrate knowledge of procedures to diagnose engine retarder systems and their components	identify tools and equipment used to diagnose engine retarder systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to engine retarder systems and their components
		describe procedures to inspect engine retarder systems and their components
		describe procedures to test engine retarder systems and their components
		describe procedures to diagnose engine retarder systems and their components
		describe common causes and symptoms of problems

Range of Variables

components include: harnesses, exhaust valves, secondary pistons, ECMs, solenoids, switches

types of engine retarder systems include: compression, exhaust

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: electronic service tools, pressure testing equipment, multimeters, feeler gauges

hazards include: high temperatures, skin irritation, moving parts, sharp edges

symptoms of problems include: poor engine retarder performance, unusual engine noises, loss of oil pressure

B-11.03 Repairs engine retarder systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-11.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-11.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
B-11.03.03P	perform ECM software updates	ECM software updates are performed according to manufacturers' service information
B-11.03.04P	repair harnesses	harnesses are repaired according to manufacturers' service information

B-11.03.05P	perform adjustments to components	adjustments are performed on components according to manufacturers' service information
B-11.03.06P	verify repairs	repairs are verified using methods
B-11.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: electronic service tools, pressure testing equipment, multimeter, feeler gauges, manufacturer-specific tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: harnesses, exhaust valves, secondary pistons, ECMs, solenoids, switches

adjustments include: valve clearances, parameters, exhaust brake, compression brake clearances

methods include: road testing, function testing

Knowledge		
	Learning Outcomes	Learning Objectives
B-11.03.01L	demonstrate knowledge of engine retarder systems, their components , characteristics, applications and operation	identify types of engine retarder systems and their components , and describe their characteristics and applications describe operating principles of engine retarder systems and their components describe function of electronic controls used with engine retarder systems
B-11.03.02L	demonstrate knowledge of procedures to repair engine retarder systems and their components	identify tools and equipment used to repair engine retarder systems and their components , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to engine retarder systems and their components describe procedures to remove, replace, adjust and repair engine retarder system components describe procedures to perform software updates

Range of Variables

components include: harnesses, exhaust valves, secondary pistons, ECMs, solenoids, switches

types of engine retarder systems include: compression, exhaust

tools and equipment include: electronic service tools, pressure testing equipment, multimeter, feeler gauges, manufacturer-specific tools

hazards include: high temperatures, skin irritation, moving parts, sharp edges

Task B-12 Services, diagnoses and repairs cooling systems

Task Descriptor

The cooling system regulates the circulation of coolant throughout the engine and other components to the radiator to transfer heat from the engine to the atmosphere and the heating, ventilation and air conditioning (HVAC) system.

Servicing includes the replacement of consumables and components as well as their routine maintenance. Diagnosing is required to determine root cause of failures in order to effectively perform repairs on cooling systems.

Truck and transport mechanics service, diagnose and repair cooling systems to ensure proper operating temperature of the engine and function of the HVAC system.

B-12.01 Services cooling systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-12.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-12.01.02P	flush cooling system	cooling system is flushed according to manufacturers' service information and fleet/owner maintenance schedule
B-12.01.03P	perform sensory inspections	sensory inspections of cooling system are performed to identify problems
B-12.01.04P	adjust belt tension	belt tension is adjusted according to manufacturers' service information
B-12.01.05P	measure coolant pH, sulphate and chloride levels	coolant pH, sulphate and chloride levels are measured to determine if they meet manufacturers' service information based on type of coolant
B-12.01.06P	test freezing point of coolant	freezing point of coolant is tested using tools and equipment
B-12.01.07P	release stored energy	stored energy is released by allowing system to cool and vent
B-12.01.08P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule

B-12.01.09P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
B-12.01.10P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: refractometers, test strips, hydrometers, vacuum fill kits, flushing equipment

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: smelling leaking coolant, looking for leaks

problems include: coolant leaks, low levels, condition of coolant, deterioration and contamination, cracked or missing fan blades, damaged hoses and belts, white exhaust

stored energy includes: heat, pressure

consumables include: coolant filters, coolant

Knowledge		
	Learning Outcomes	Learning Objectives
B-12.01.01L	demonstrate knowledge of cooling systems, their components , consumables , characteristics, applications and operation	identify types of cooling systems, their consumables and components , and describe their characteristics and applications
		describe operating principles of cooling systems and their components
		identify types of coolants and coolant additives, and describe their characteristics and applications
		describe coolant properties
B-12.01.02L	demonstrate knowledge of procedures to service cooling systems, their components and consumables	identify tools and equipment used to service cooling systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to cooling systems and their components
		describe procedures to release stored energy
		describe procedures to inspect cooling systems and their components
		describe procedures to test coolants

describe procedures to adjust and measure cooling system **components**

describe procedures to remove, replace, recycle and dispose of cooling system **consumables**

Range of Variables

components include: oil cooler, thermostats, cooling fan, radiator, hoses, clamps, seals, sealants, gaskets, fans, fan drives, radiator shrouds, belts, radiator caps, recovery tanks, coolant heaters, sensors, mechanical and electric water pumps, controllers

consumables include: coolant filters, coolant

types of coolants include: conventional, extended life, diesel specific, waterless

coolant properties include: pH, freezing point, additive concentrations, conductivity

tools and equipment include: refractometers, test strips, hydrometers, vacuum fill kits, flushing equipment

hazards include: pressure, steam, extreme heat, moving parts, skin irritation, toxicity

stored energy includes: heat, pressure

B-12.02 Diagnoses cooling systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-12.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
B-12.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-12.02.03P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
B-12.02.04P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
B-12.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
B-12.02.06P	perform tests to assess system function	tests are performed to assess system function using manufacturer's recommended tools and equipment, and following jurisdictional safety guidelines

B-12.02.07P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
B-12.02.08P	perform failure analysis	failure analysis is performed to determine root cause of failure
B-12.02.09P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
B-12.02.10P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: coolant loss, low or high operating temperatures, excessive system pressure, warning lights, coolant leaks, no cab heat

tools and equipment include: leak testing equipment, pressure measuring devices, refractometers, temperature measuring devices, test strips, fluid analysis sampling kit, hydrometers, belt tension gauges, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: looking for leaks and cracked hoses, smelling for coolant, feeling hoses for damage, checking for contact wear (improper length, routing and securing of hose)

tests include: dye, pressure, temperature, fan speed, radiator cap

system functions include: correct operation of thermostat, water pump, fan hub and radiator cap

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
B-12.02.01L	demonstrate knowledge of cooling systems, their components , characteristics, applications and operation	identify types of cooling systems and their components , and describe their characteristics and applications
		describe operating principles of cooling systems and their components
		interpret information pertaining to cooling systems found in manufacturers' service information
		identify types of coolants and coolant additives, and describe their characteristics and applications
		describe coolant properties
B-12.02.02L	demonstrate knowledge of procedures to diagnose cooling systems and their components	identify tools and equipment used to diagnose cooling systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to cooling systems and their components

		describe procedures to release or isolate stored energy
		describe procedures to inspect cooling systems and their components
		describe procedures to test cooling systems and their components
		describe procedures to diagnose cooling systems and their components
		describe common causes and symptoms of problems
B-12.02.03L	demonstrate knowledge of regulatory requirements pertaining to cooling systems and their components	identify and interpret standards and regulations pertaining to cooling systems and their components

Range of Variables

components include: oil cooler, thermostats, cooling fan, radiator, hoses, clamps, seals, sealants, gaskets, fans, fan drives, radiator shrouds, belts, radiator caps, recovery tanks, coolant heaters, sensors, mechanical and electric water pumps, controllers

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

types of coolants include: conventional, extended life, diesel specific, waterless

coolant properties include: pH, freezing point, additive concentrations, conductivity

tools and equipment include: leak testing equipment, pressure measuring devices, refractometers, temperature measuring devices, test strips, fluid analysis sampling kit, hydrometers, belt tension gauges, electronic service tools

hazards include: pressure, steam, extreme heat, moving parts, skin irritation, toxicity

symptoms of problems include: coolant loss, low or high operating temperatures, excessive system pressure, warning lights, coolant leaks, no cab heat

B-12.03 Repairs cooling systems

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

Skills

	Performance Criteria	Evidence of Attainment
B-12.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
B-12.03.02P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
B-12.03.03P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information

B-12.03.04P	rebuild components	components are rebuilt by replacing parts according to manufacturers' service information
B-12.03.05P	adjust belt tension	belt tension is adjusted according to manufacturers' service information to ensure proper operation of fan and water pump
B-12.03.06P	verify repairs	repairs are verified using methods
B-12.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: torque wrenches, manufacturer-specific tools, lifting devices, flushing equipment, coolant handling equipment, temperature measuring devices, thermostat testing equipment

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: oil cooler, thermostats, cooling fan, radiator, hoses, clamps, seals, sealants, gaskets, fans, fan drives, radiator shrouds, belts, radiator caps, recovery tanks, coolant heaters, sensors, mechanical and electric water pumps, controllers

methods include: road testing, pressure testing

Knowledge

	Learning Outcomes	Learning Objectives
B-12.03.01L	demonstrate knowledge of cooling systems, their components , characteristics, applications and operation	identify types of cooling systems and their components , and describe their characteristics and applications
		describe operating principles of cooling systems and their components
		identify types of coolants and coolant additives, and describe their characteristics and applications
		describe coolant properties
B-12.03.02L	demonstrate knowledge of procedures to repair cooling systems and their components	identify tools and equipment used to repair cooling systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to cooling systems and their components
		describe procedures to release or isolate stored energy

		describe procedures to remove, replace, adjust, rebuild and repair cooling system components
B-12.03.03L	demonstrate knowledge of regulatory requirements pertaining to cooling systems	identify and interpret standards and regulations to cooling systems

Range of Variables

components include: oil cooler, thermostats, cooling fan, radiator, hoses, clamps, seals, sealants, gaskets, fans, fan drives, radiator shrouds, belts, radiator caps, recovery tanks, coolant heaters, sensors, mechanical and electric water pumps, controllers

types of coolants include: conventional, extended life, diesel specific, waterless

coolant properties include: pH, freezing point, additive concentrations, conductivity

tools and equipment include: torque wrenches, manufacturer-specific tools, lifting devices, flushing equipment, coolant handling equipment, temperature measuring devices, thermostat testing equipment

hazards include: pressure, steam, extreme heat, moving parts, skin irritation, toxicity

Major Work Activity C

Services, diagnoses and repairs air systems and brake systems

Task C-13 Services, diagnoses and repairs air systems

Task Descriptor

Air systems provide compressed air to control and operate vehicle systems and components such as braking, fan hubs and ride height, and accessories such as seats, wipers and 5th wheel slide cylinders. Truck and transport mechanics service, diagnose and repair air systems to ensure proper function and reduce down time.

C-13.01 Services air systems

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

Skills

	Performance Criteria	Evidence of Attainment
C-13.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
C-13.01.02P	perform sensory inspections	sensory inspections are performed to identify worn, damaged, defective and incorrect components
C-13.01.03P	measure air pressures	air pressures are measured to determine if they meet manufacturers' service information and jurisdictional regulations
C-13.01.04P	release stored energy	stored energy is released by opening air tank drain valves, caging spring brake and fanning down brakes
C-13.01.05P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule
C-13.01.06P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations

C-13.01.07P	adjust governing air pressures	governing air pressures are adjusted according to jurisdictional regulations and manufacturers' service information
C-13.01.08P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: air pressure gauges, soap and water, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: air lines, air dryers, governors, compressors, brake chambers (pots), air tanks, valves, low air warning systems

stored energy includes: air pressure, spring pressure

consumables include: air filters, desiccant

Knowledge		
	Learning Outcomes	Learning Objectives
C-13.01.01L	demonstrate knowledge of air systems, their components and consumables , characteristics, applications and operation	identify types of air systems and their components and consumables , and describe their characteristics and applications
		describe operating principles and design of air systems
C-13.01.02L	demonstrate knowledge of procedures to service air systems and their components	identify tools and equipment used to service air systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to air systems and their components
		describe procedures to release stored energy
		describe procedures to inspect air systems and their components
		describe procedures to service air systems and their components
		describe procedures to remove, replace, recycle and dispose of air system consumables
		identify materials that can be reconditioned, reused or recycled
C-13.01.03L	demonstrate knowledge of regulatory requirements pertaining to air systems	identify and interpret standards and regulations pertaining to air systems

C-13.01.04L	demonstrate knowledge of regulatory requirements pertaining to recycling and disposal of air system consumables	identify and interpret standards and regulations pertaining to recycling and disposal of air system consumables
C-13.01.05L	demonstrate knowledge of emerging technologies and practices pertaining to air system	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: air lines, air dryers, governors, compressors, brake chambers (pots), air tanks, valves, low air warning systems

consumables include: air filters, desiccant

tools and equipment include: air pressure gauges, soap and water, electronic service tools

hazards include: spring brake, pressurized air

stored energy includes: air pressure, spring pressure

C-13.02 Diagnoses air systems

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

Skills

	Performance Criteria	Evidence of Attainment
C-13.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
C-13.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
C-13.02.03P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
C-13.02.04P	perform sensory inspections	sensory inspections of components are performed to confirm complaint and establish preliminary diagnosis
C-13.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
C-13.02.06P	perform tests	tests are performed to assess components for wear, damage and defects by using tools and equipment
C-13.02.07P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis

C-13.02.08P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
C-13.02.09P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: air leaks, slow air pressure build up, system not building pressure

tools and equipment include: soap and water, gauges, hand tools, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards, logic diagrams

components include: brake chambers (pots), air lines, tanks, valves, air gauges, air dryers

tests include: pressure tests, timed tests, leak down

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
C-13.02.01L	demonstrate knowledge of air systems, their components , characteristics, applications and operation	identify types of air systems and their components , and describe their characteristics and applications
		describe operating principles, design and function of air systems
		interpret information pertaining to air systems found in manufacturers' service information
C-13.02.02L	demonstrate knowledge of procedures to diagnose air systems and their components	identify tools and equipment used to diagnose air systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to air systems and their components
		describe procedures to release or isolate stored energy
		describe procedures to inspect air systems and their components
		describe procedures to test air systems and their components
		describe procedures to diagnose air systems and their components
		describe common causes and symptoms of problems

		identify materials that can be reconditioned, reused or recycled
C-13.02.03L	demonstrate knowledge of regulatory requirements pertaining to air systems	identify and interpret standards and regulations pertaining to air systems

Range of Variables

components include: brake chambers (pots), air lines, tanks, valves, air gauges, air dryers

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards, logic diagrams

tools and equipment include: soap and water, gauges, hand tools, electronic service tools

hazards include: pressurized air, airborne contaminants, pinch/crush points

symptoms of problems include: air leaks, slow air pressure build up, system not building pressure

C-13.03 Repairs air systems

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

Skills

	Performance Criteria	Evidence of Attainment
C-13.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
C-13.03.02P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
C-13.03.03P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
C-13.03.04P	rebuild components	components are rebuilt by replacing worn parts according to manufacturers' service information
C-13.03.05P	repair components	components are repaired by replacing parts causing failure, according to manufacturers' service information
C-13.03.06P	adjust components	components are adjusted according to manufacturers' service information
C-13.03.07P	disarm and dispose of spring brake chambers	spring brake chambers are disarmed and disposed of according to manufacturers' service information and jurisdictional regulations

C-13.03.08P	verify repairs	repairs are verified using methods
C-13.03.09P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be removed and replaced) include: air lines, relay valves, brake chambers, modulating valves, governors, compressors, air dryer filters

components (to be rebuilt) include: air compressors, air dryers, purge valves

components (to be repaired) include: air starters, compressors, air dryers, driver warning system, brake chambers

components (to be adjusted) include: air governors, ride height valves (levelling valves)

methods include: road testing, load testing, sensory observations

Knowledge		
	Learning Outcomes	Learning Objectives
C-13.03.01L	demonstrate knowledge of air systems, their components , characteristics, applications and operation	identify types of air systems and their components , and describe their characteristics and applications
		describe operating principles, design and function of air systems
C-13.03.02L	demonstrate knowledge of procedures to repair air systems and their components	identify tools and equipment used to repair air systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to air systems and their components
		describe procedures to release or isolate stored energy
		describe procedures to remove, replace, rebuild, repair and adjust air system components
		identify materials that can be reconditioned, reused or recycled
C-13.03.03L	demonstrate knowledge of regulatory requirements pertaining to air systems	identify and interpret standards and regulations pertaining to air systems

Range of Variables

components include: air lines, relay valves, air compressors, brake chambers, modulating valves, air dryers, filters (air dryer, desiccant), purge valves, air starters, driver warning system, air governors, ride height valves (levelling valves)

hazards include: pressurized air, airborne contaminants, pinch/crush points

Task C-14 Services, diagnoses and repairs brake systems

Task Descriptor

Brake systems slow, stop or park the vehicle in a safe and controlled manner by using air, hydraulics or cable in conjunction with electronic controls.

Truck and transport mechanics service, diagnose and repair brake systems to ensure proper function and reduce down time.

C-14.01 Services brake systems

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

Skills

	Performance Criteria	Evidence of Attainment
C-14.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
C-14.01.02P	release stored energy in components	stored energy is released in components according to manufacturers' service information
C-14.01.03P	clean components	components are cleaned
C-14.01.04P	perform sensory inspections	sensory inspections are performed to identify leaks and worn, damaged and defective components
C-14.01.05P	measure components	components are measured for brake stroke, out of round, drum or rotor wear and thicknesses to determine if they meet manufacturers' service information and jurisdictional regulations
C-14.01.06P	check fluid levels in brake reservoir	fluid levels in brake reservoir are checked to determine if they meet manufacturers' service information
C-14.01.07P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information
C-14.01.08P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
C-14.01.09P	adjust brakes and lubricate components	brakes are adjusted and components are lubricated according to manufacturers' service information
C-14.01.10P	recalibrate ABS components	ABS components are recalibrated according to manufacturers' service information

C-14.01.11P	bleed hydraulic brakes	hydraulic brakes are bled according to manufacturers' service information
C-14.01.12P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: ABS components, drums, shoes, pads, rotors, cams, slack adjusters, calipers

components (to be measured) include: slack adjusters, brake lining, rotors, drums

consumables include: brake linings, fluids

Knowledge		
	Learning Outcomes	Learning Objectives
C-14.01.01L	demonstrate knowledge of brake systems, their components, consumables, characteristics, applications and operation	identify types of brake systems and their components and consumables , and describe their characteristics and applications
		describe operating principles of brake systems and their components
		describe operating principles of ABS and their components , roll stability protection and traction control
		identify air brake components and describe their characteristics and applications
		identify hydraulic brake components and describe their characteristics and applications
		identify emergency (parking) brake components , and describe their characteristics and applications
		identify ABS components and describe their characteristics and applications
		identify types of brake shoes, pads and linings, and describe their characteristics and applications
		identify traction control and braking systems, and describe their characteristics and applications
		identify warning systems and describe their characteristics and applications
		identify types of power-assisted hydraulic brakes and describe their characteristics and applications

C-14.01.02L	demonstrate knowledge of procedures to service brake systems and their components	identify tools and equipment used to service brake systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to brake systems and their components
		describe procedures to release stored energy
		describe procedures to inspect brake systems and their components
		describe procedures to clean, measure, lubricate, adjust and recalibrate brake system components
		describe procedures to remove, replace, recycle and dispose of brake system consumables
		identify materials that can be reconditioned, reused or recycled
C-14.01.03L	demonstrate knowledge of regulatory requirements pertaining to brake systems	identify and interpret standards and regulations pertaining to brake systems
C-14.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to brake systems	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: ABS components, drums, shoes, pads, rotors, cams, slack adjusters, calipers

consumables include: brake linings, fluids

types of brake systems include: air, hydraulic, emergency (parking) brake, air over hydraulic

air brake components include: brake chambers, slack adjusters (automatic and manual), rotors, S-cams, pins, bushings

hydraulic brake components include: reservoirs, cylinders, wheel cylinders, brake proportioning valves, brake lines

emergency (parking) brake components include: drums, shoes

ABS components include: wiring, ECMs, modulating valves and sensors

hazards include: pressurized air, oil injection, airborne contaminants, pinch/crush points

C-14.02 Diagnoses brake systems

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

Skills

	Performance Criteria	Evidence of Attainment
C-14.02.01P	identify <i>symptoms of problems</i>	<i>symptoms of problems</i> are identified by consulting with customer or operator
C-14.02.02P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to task and <i>manufacturers' service information</i>
C-14.02.03P	perform <i>sensory inspections</i>	<i>sensory inspections</i> are performed to confirm complaint and establish preliminary diagnosis
C-14.02.04P	measure <i>components</i>	<i>components</i> are measured for brake stroke, out of round, drum or rotor wear, and thicknesses
C-14.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following <i>manufacturers' service information</i> to determine failure
C-14.02.06P	perform <i>tests</i> to assess components for wear, damage or defects	<i>tests</i> are performed to assess components for wear, damage or defects using ABS and hydraulic diagnostic equipment
C-14.02.07P	interpret schematics and compare <i>test</i> results to <i>manufacturers' service information</i> or expected values	schematics are interpreted and <i>test</i> results are compared to <i>manufacturers' service information</i> or expected values to verify diagnosis
C-14.02.08P	perform failure analysis	failure analysis is performed to determine root cause of failure
C-14.02.09P	record <i>test</i> results and inspection findings	<i>test</i> results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
C-14.02.10P	interpret diagnostic results	diagnostic results are interpreted to determine <i>next steps</i>

Range of Variables

symptoms of problems include: faulty brake operation, air leaks, noises, stopping distance too long, ABS lights on, extended air pressure build time

tools and equipment include: digital voltmeter, ABS scan tool, hydraulic diagnostic equipment, electronic service tool, air pressure gauges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: braking performance, ABS lights, oil and air leaks

components (to be measured) include: slack adjusters, brake lining and rotors

tests include: leak down, performance, road, electronically initiated operational and performance

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
Learning Outcomes	Learning Objectives	
C-14.02.01L	demonstrate knowledge of brake systems, their components , characteristics, applications and operation	identify types of brake systems and their components , and describe their characteristics and applications
		describe operating principles of brake systems and their components
		interpret information pertaining to brake systems found in manufacturers' service information
C-14.02.02L	demonstrate knowledge of procedures to diagnose brake systems and their components	identify tools and equipment used to diagnose brake systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to brake systems and their components
		describe procedures to inspect brake systems and their components
		describe procedures to test brake systems and their components
		describe procedures to diagnose brake systems and their components
		describe common causes and symptoms of problems
		identify steps for failure analysis
C-14.02.03L	demonstrate knowledge of regulatory requirements pertaining to brake systems	identify materials that can be reconditioned, reused or recycled
		identify and interpret standards and regulations pertaining to brake systems

Range of Variables

components include: ABS components, drums, shoes, pads, rotors, cams, slack adjusters, calipers

types of brake systems include: air, hydraulic, emergency (parking) brake, air over hydraulic, electric

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: digital volt meter, ABS scan tool, hydraulic diagnostic equipment, electronic service tool, air pressure gauges

hazards include: pressurized air, oil injection, airborne contaminants, pinch/crush points

symptoms of problems include: faulty brake operation, air leaks, noises, stopping distance too long, ABS lights on, extended air pressure build time

C-14.03 Repairs brake systems

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

Skills

	Performance Criteria	Evidence of Attainment
C-14.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
C-14.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
C-14.03.03P	rebuild and repair components	components are rebuilt and repaired according to manufacturers' service information
C-14.03.04P	adjust components	components are adjusted according to manufacturers' service information
C-14.03.05P	verify repairs	repairs are verified using methods
C-14.03.06P	document repairs and verifications	repairs and verifications are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be removed and replaced) include: slack adjusters, brake chambers, cables, wheel cylinders, cylinders

components (to be rebuilt and repaired) include: cylinders, calipers, air lines, hydraulic lines, ABS components

components (to be adjusted) include: brakes, ABS sensors, parking brakes

methods include: road testing, load testing, sensory observations

Knowledge

Learning Outcomes	Learning Objectives
C-14.03.01L demonstrate knowledge of brake systems, their components , characteristics, applications and operation	identify types of brake systems and their components , and describe their characteristics and applications
	describe operating principles of brake systems and their components
C-14.03.02L demonstrate knowledge of procedures to repair brake systems and their components	identify tools and equipment used to repair brake systems and their components , and describe their applications and procedures for use
	describe procedures to remove, replace, rebuild, adjust and repair brake system components
	identify hazards and describe safe work practices pertaining to brake systems and their components
	describe methods used to verify repairs
C-14.03.03L demonstrate knowledge of regulatory requirements pertaining to brake systems	identify materials that can be reconditioned, reused or recycled
	identify and interpret standards and regulations pertaining to brake systems
C-14.03.04L demonstrate knowledge of emerging technologies and practices pertaining to brake systems	identify jurisdictional requirements for road testing and road worthiness
	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: ABS components, drums, shoes, pads, rotors, cams, slack adjusters, calipers

types of brake systems include: air, hydraulic, emergency (parking) brake, air over hydraulic

hazards include: pressurized air, spring pressure, oil injection, airborne contaminants, pinch/crush points

methods include: road testing, load testing, sensory observations

Major Work Activity D

Services, diagnoses and repairs electrical and electronic systems

Task D-15 Services, diagnoses and repairs battery systems

Task Descriptor

Truck and transport mechanics need to understand low-voltage battery systems, their applications and limitations in order to service, diagnose and repair them safely. Safety is an important consideration when working with battery systems.

D-15.01 Services battery systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-15.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-15.01.02P	clean battery components	battery components are cleaned
D-15.01.03P	perform sensory inspection	sensory inspection of battery system is performed to identify defects
D-15.01.04P	test batteries	batteries are tested to confirm they maintain charge
D-15.01.05P	measure specific gravity of each cell	specific gravity of each cell is measured
D-15.01.06P	compare test results to manufacturers' specifications and standards or expected values	test results are compared to manufacturers' service information or expected values
D-15.01.07P	replace faulty and damaged batteries	faulty and damaged batteries are replaced
D-15.01.08P	adjust electrolyte levels	electrolyte levels are adjusted
D-15.01.09P	recharge batteries	batteries are recharged according to manufacturers' service information
D-15.01.10P	disconnect and connect batteries in sequence	batteries are disconnected and connected in sequence according to manufacturers' service information

D-15.01.11P	apply anti-corrosion compounds to terminals and connections	anti-corrosion compounds are applied to terminals and connections according to manufacturers' service information
D-15.01.12P	recycle and dispose of batteries	batteries are recycled and disposed of according to jurisdictional regulations
D-15.01.13P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: hand tools, specialized testing equipment, multimeters, carbon pile, inductance testers, hydrometers, refractometers, electronic service tools

manufacturers' service information include: specifications, standards, procedures

components include: terminals, connections, casing, compartment

defects include: corroded and loose terminals, missing caps, damaged casing, loose and missing battery securement (hold-downs), low electrolyte

Knowledge		
	Learning Outcomes	Learning Objectives
D-15.01.01L	demonstrate knowledge of battery systems, their components , characteristics, applications and operation	identify types of battery systems and their components , and describe their characteristics and applications
		describe operating principles of battery systems and their components
		identify types of batteries and their components , and describe their characteristics and applications
		identify battery ratings
D-15.01.02L	demonstrate knowledge of procedures to service battery systems and their components	describe battery maintenance schedules
		identify tools and equipment used to service battery systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to battery systems and their components
		describe procedures to inspect battery systems and their components
		describe procedures to test battery systems and their components
		describe procedures to service battery systems and their components
		describe procedures to remove, replace, recharge, recycle and dispose of batteries
identify materials that can be reconditioned, reused or recycled		

		identify practices that reduce material waste
D-15.01.03L	demonstrate knowledge of regulatory requirements pertaining to recycling and disposal of batteries	identify and interpret standards and regulations pertaining to recycling and disposal of batteries
D-15.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to battery systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: terminals, connections, casing, compartment

types of battery systems include: parallel, series, series/parallel

types of batteries include: sealed, vented, absorbed glass mat (AGM), gel cell, lithium, capacitor

battery ratings include: cranking amps (CA), cold cranking amps (CCA), reserve capacity (RC), amp hour, voltages

tools and equipment include: hand tools, specialized testing equipment, multimeters, carbon pile, inductance testers, hydrometers, refractometers, electronic service tools

hazards include: shocks, sparks, explosive gases, acid spillage, acid burns, electrical burns, heavy weight, lead exposure

D-15.02 Diagnoses battery systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-15.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
D-15.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-15.02.03P	perform sensory inspection	sensory inspection of battery system is performed to identify defects
D-15.02.04P	test batteries	batteries are tested to assess condition and capacity
D-15.02.05P	measure specific gravity	specific gravity is measured to assess condition of each cell for lack of clarity due to sulfating and for correct electrolyte value according to manufacturers' service information

D-15.02.06P	perform voltage drop on cable systems	voltage drop on cable systems is performed according to manufacturers' service information
D-15.02.07P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
D-15.02.08P	perform failure analysis	failure analysis is performed to determine root cause of failure
D-15.02.09P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: no start, hard start, battery smells, battery compartment smoking, noises, charging issues

tools and equipment include: hand tools, specialized testing equipment, multimeters, carbon pile, inductance testers, hydrometers, refractometers, electronic service tools

manufacturers' service information include: specifications, recommendations, procedures, standards

defects include: corroded and loose terminals, missing caps, casing damage, loose and missing battery securement (hold-downs), low electrolyte

failures include: parasitic amperage draw, overcharging, undercharging, loose connections, corroded connections, frozen battery, low open circuit voltage

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
D-15.02.01L	demonstrate knowledge of battery systems, their components , characteristics, applications and operation	identify types of battery systems and their components , and describe their characteristics and applications describe operating principles of battery systems and their components identify types of batteries and their components , and describe their characteristics and applications identify battery ratings describe battery maintenance schedules
D-15.02.02L	demonstrate knowledge of procedures to diagnose battery systems and their components	identify tools and equipment used to diagnose battery systems and their components , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to battery systems and their components describe procedures to inspect battery systems and their components describe procedures to test battery systems and their components

		describe procedures to diagnose battery systems and their components
		describe common causes and symptoms of problems
		identify defects and failures found in battery systems
		identify procedures and safe work practices to boost vehicles
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-15.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to battery systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: terminals, connections, casing, compartment

types of battery systems include: parallel, series, series/parallel,

types of batteries include: sealed, vented, AGM, gel cell, lithium, capacitor

battery ratings include: CA, CCA, RC, amp-hour

tools and equipment include: hand tools, specialized testing equipment, multimeters, carbon pile, inductance testers, hydrometers, refractometers, electronic service tools

hazards include: shocks, sparks, explosive gases, acid spillage, acid burns, electrical burns, heavy weight, lead exposure

symptoms of problems include: no start, hard start, battery smells, battery compartment smoking, noises, charging issues

defects include: corroded and loose terminals, missing caps, casing damage, loose and missing battery securement (hold-downs), low electrolyte

failures include: parasitic amperage draw, overcharging, undercharging, loose connections, corroded connections, frozen battery, low open circuit voltage

D-15.03 Repairs battery systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-15.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-15.03.02P	clean battery components	battery components are cleaned
D-15.03.03P	disconnect and connect batteries in sequence	batteries are disconnected and connected in sequence according to manufacturers' service information
D-15.03.04P	replace faulty and damaged batteries	faulty and damaged batteries are replaced
D-15.03.05P	apply anti-corrosion compounds to terminals and connections	anti-corrosion compounds are applied to terminals and connections according to manufacturers' service information
D-15.03.06P	replace and repair connecting cables	connecting cables are replaced and repaired according to manufacturers' service information
D-15.03.07P	check battery hold-downs and compartment	battery hold-downs and compartment are checked to ensure they are secure and in good condition
D-15.03.08P	recharge batteries	batteries are recharged according to manufacturers' service information
D-15.03.09P	recycle or dispose of batteries	batteries are recycled or disposed of according to jurisdictional regulations
D-15.03.10P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: hand tools, lifting equipment, electronic service tools

manufacturers' service information include: specifications, recommendations, procedures, standards

components include: terminals, connections, compartment

Knowledge

	Learning Outcomes	Learning Objectives
D-15.03.01L	demonstrate knowledge of battery systems, their components , characteristics, applications and operation	identify types of battery systems and their components , and describe their characteristics and applications
		describe operating principles of battery systems and their components

		identify types of batteries and their components , and describe their characteristics and applications
		identify battery ratings
D-15.03.02L	demonstrate knowledge of procedures to repair battery systems and their components	identify tools and equipment used to repair battery systems and their components , and describe their applications and procedures for use
		describe procedures to repair battery systems and their components
		describe procedures to remove, replace, recharge, recycle and dispose of batteries
		identify hazards and describe safe work practices pertaining to battery systems and their components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-15.03.03L	demonstrate knowledge of regulatory requirements pertaining to recycling and disposal of batteries	identify and interpret standards and regulations pertaining to recycling and disposal of batteries
D-15.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to battery systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: terminals, connections, compartment

types of battery systems include: parallel, series, series/parallel

types of batteries include: sealed, vented, AGM, gel cell, lithium, capacitor

battery ratings include: CA, CCA, RC, amp-hour

tools and equipment include: hand tools, lifting equipment, electronic service tools

hazards include: shocks, sparks, explosive gases, acid spillage, acid burns, electrical burns, heavy weight, lead exposure

Task D-16 Services, diagnoses and repairs charging systems

Task Descriptor

Truck and transport mechanics must have a good understanding of the different vehicle charging systems, their operation and components.

D-16.01 Services charging systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-16.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-16.01.02P	clean terminals and connections of components	terminals and connections of components are cleaned according to manufacturers' service information
D-16.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
D-16.01.04P	adjust voltage regulator and belt tension	voltage regulator and belt tension are adjusted according to manufacturers' service information
D-16.01.05P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: hand tools, belt tension gauges, torque wrenches, carbon pile testers, multimeters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: alternators, internal and external regulators, diodes, wiring, relays, belts, cooling fins, ECMs, mounting hardware

Knowledge

	Learning Outcomes	Learning Objectives
D-16.01.01L	demonstrate knowledge of charging systems, their components , characteristics, applications and operation	identify types of charging systems and their components , and describe their characteristics and applications
		describe operating principles of charging systems and their components
		describe basic principles of electricity and circuit components
		identify types of alternators and their components, and describe their ratings, characteristics, applications and operation
D-16.01.02L	demonstrate knowledge of procedures to service charging systems and their components	identify tools and equipment used to service charging systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to charging systems and their components
		describe procedures to inspect charging systems and their components
		describe procedures to clean and adjust charging system components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-16.01.03L	demonstrate knowledge of emerging technologies and practices pertaining to charging systems	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: alternators, internal and external regulators, diodes, wiring, relays, belts, cooling fins, ECMs, mounting hardware

types of charging systems include: A or B regulator, 12-volt and 24-volt batteries, externally or internally regulated, solid-state chargers

types of alternators include: air/oil cooled, belt-driven, gear-driven

tools and equipment include: hand tools, belt tension gauges, torque wrenches, carbon pile testers, multimeters

hazards include: sparks, moving components, burns, shocks, battery explosions, noises

D-16.02 Diagnoses charging systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-16.02.01P	identify <i>symptoms of problems</i>	<i>symptoms of problems</i> are identified by consulting with customer or operator
D-16.02.02P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to task and <i>manufacturers' service information</i>
D-16.02.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective <i>components</i> to confirm complaint and establish preliminary diagnosis
D-16.02.04P	perform <i>tests</i>	<i>tests</i> are performed according to <i>manufacturers' service information</i>
D-16.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following <i>manufacturers' service information</i> to determine failure
D-16.02.06P	compare <i>test</i> results to <i>manufacturers' service information</i> or expected values	<i>test</i> results are compared to <i>manufacturers' service information</i> or expected values to verify diagnosis
D-16.02.07P	perform failure analysis	failure analysis is performed to determine root cause of failure
D-16.02.08P	interpret diagnostic results	diagnostic results are interpreted to determine <i>next steps</i>

Range of Variables

symptoms of problems include: overcharging, undercharging, warning lights, smells, failed lights, components not working, dead battery, noises

tools and equipment include: hand tools, belt tension gauges, torque wrenches, carbon pile testers, multimeters, inductance testers, electronic service tools

manufacturers' service information include: specifications, recommendations, procedures, standards

components include: alternators, internal and external regulators, diodes, wiring, relays, belts, cooling fins, ECMs, mounting hardware

tests include: full fielding alternator, voltage drop of cables, alternator output, checking fault codes

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

Learning Outcomes	Learning Objectives
D-16.02.01L demonstrate knowledge of charging systems, their components , characteristics, applications and operation	identify types of charging systems and their components , and describe their characteristics and applications
	describe operating principles of charging systems and their components
	describe basic principles of electricity and circuit components
	identify types of alternators and their components, and describe their ratings, characteristics, applications and operation
D-16.02.02L demonstrate knowledge of procedures to diagnose charging systems and their components	identify tools and equipment used to diagnose charging systems and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to charging systems and their components
	describe procedures to inspect charging systems and their components
	describe procedures to test charging systems and their components
	describe procedures to diagnose charging systems and their components
	describe common causes and symptoms of problems
	identify common faults found when diagnosing charging systems
	identify materials that can be reconditioned, reused or recycled
	identify practices that reduce material waste
D-16.02.03L demonstrate knowledge of emerging technologies and practices pertaining to charging systems	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: alternators, internal and external regulators, diodes, wiring, relays, belts, cooling fins, ECMs, mounting hardware

types of charging systems include: A or B regulator, 12-volt and 24-volt batteries, externally or internally regulated, solid-state chargers

types of alternators include: air/oil cooled, belt-driven, gear-driven

tools and equipment include: hand tools, belt tension gauges, torque wrenches, carbon pile testers, multimeters, inductance testers, electronic service tools

hazards include: sparks, moving components, burns, shocks, battery explosions, noises

symptoms of problems include: overcharging, undercharging, warning lights, smells, failed lights, components not working, dead battery, noises

D-16.03 Repairs charging systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-16.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-16.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
D-16.03.03P	adjust belt tension	belt tension is adjusted according to manufacturers' service information
D-16.03.04P	construct and repair cables	cables are constructed and repaired by crimping and soldering connectors and terminals
D-16.03.05P	rebuild, repair or replace alternator	alternator is rebuilt or repaired by testing and replacing failed components, or replaced according to manufacturers' service information
D-16.03.06P	verify repairs	repairs are verified using methods
D-16.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: hand tools, belt tension gauges, torque wrenches, carbon pile testers, multimeters, inductance testers, cable crimpers, soldering tools, electronic service tools

manufacturers' service information include: specifications, recommendations, procedures, standards

components include: alternators, internal and external regulators, diodes, wiring, relays, belts, cooling fins, ECMs, mounting hardware

methods include: full fielding, bench testing, on-vehicle testing, checking fault codes

Knowledge		
	Learning Outcomes	Learning Objectives
D-16.03.01L	demonstrate knowledge of charging systems, their components , characteristics, applications and operation	identify types of charging systems and their components , and describe their characteristics and applications
		describe operating principles of charging systems and their components
		describe basic principles of electricity and circuit components
		identify types of alternators and their components, and describe their ratings, characteristics, applications and operation
D-16.03.02L	demonstrate knowledge of procedures to repair charging systems and their components	identify tools and equipment used to repair charging systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to charging systems and their components
		describe procedures to remove, replace, adjust, rebuild and repair charging systems and their components
		describe procedures to excite alternators
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-16.03.03L	demonstrate knowledge of emerging technologies and practices pertaining to charging systems	identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to testing charging systems

Range of Variables

components include: alternators, internal and external regulators, diodes, wiring, relays, belts, cooling fins, ECMs, mounting hardware

types of charging systems include: A or B regulator, 12-volt and 24-volt batteries, externally or internally regulated, solid-state chargers

types of alternators include: air/oil cooled, belt-driven, gear-driven

tools and equipment include: hand tools, belt tension gauges, torque wrenches, carbon pile testers, multimeters, inductance testers, cable crimpers, soldering tools, electronic service tools

hazards include: sparks, moving components, burns, shocks, battery explosions, noises

Task D-17 Services, diagnoses and repairs spark ignition systems

Task Descriptor

Spark ignition systems are being reintroduced into the truck and transport industry through alternate fuel sources that reduce greenhouse gas emissions and costs. Although there have been some changes due to technological advances, the basic principles are still applicable today.

Truck and transport mechanics service, diagnose and repair spark ignition systems to ensure proper function and reduce down time.

D-17.01 Services spark ignition systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-17.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-17.01.02P	perform sensory inspections	sensory inspections are performed to identify defects
D-17.01.03P	replace components	components are replaced according to manufacturers' service information
D-17.01.04P	adjust spark plug gap	spark plug gap is adjusted according to manufacturers' service information
D-17.01.05P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: scan tools, electronic service tools, oscilloscopes, spark testers, spark plug gapping tools, feeler gauges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

defects include: damaged wires, coil terminals and spark plugs

components include: spark plugs, coils, high-tension wires, ECMs

Knowledge		
	Learning Outcomes	Learning Objectives
D-17.01.01L	demonstrate knowledge of spark ignition systems, their components , characteristics, applications and operation	identify types of spark ignition systems and their components , and describe their characteristics and applications
		describe operating principles of spark ignition systems and their components
		describe electrical fundamentals
		describe engine operating principles
D-17.01.02L	demonstrate knowledge of procedures to service spark ignition systems and their components	identify tools and equipment used to service spark ignition systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to spark ignition systems and their components
		describe procedures to inspect spark ignition systems and their components
		describe procedures to measure, adjust and replace spark ignition system components
		identify materials that can be reconditioned, reused or recycled
D-17.01.03L	demonstrate knowledge of emerging technologies and practices pertaining to spark ignition systems	identify practices that reduce material waste
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: spark plugs, coils, high-tension wires, ECMs

engine operating principles include: firing order, ignition timing, combustion cycle

tools and equipment include: scan tools, electronic service tools, oscilloscopes, spark testers, spark plug gapping tools, feeler gauges

hazards include: shocks, sparks, moving components, burns, noises

D-17.02 Diagnoses spark ignition systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-17.02.01P	identify <i>symptoms of problems</i>	<i>symptoms of problems</i> are identified by consulting with customer or operator
D-17.02.02P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to task and <i>manufacturers' service information</i>
D-17.02.03P	perform sensory inspections	sensory inspections are performed to identify <i>defects</i>
D-17.02.04P	perform <i>tests</i>	<i>tests</i> are performed according to <i>manufacturers' service information</i>
D-17.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following <i>manufacturers' service information</i> to determine failure
D-17.02.06P	compare <i>test</i> results to <i>manufacturers' service information</i> or expected values	<i>test</i> results are compared to <i>manufacturers' service information</i> or expected values to verify diagnosis
D-17.02.07P	interpret diagnostic results	diagnostic results are interpreted to determine <i>next steps</i>

Range of Variables

symptoms of problems include: intermittent problems, no start, hard starting, misfiring, fuel economy issues

tools and equipment include: scan tools, electronic service tools, oscilloscopes, spark testers, spark plug gapping tools, feeler gauges, multimeters

manufacturers' service information include: specifications, recommendations, procedures, standards

defects include: damaged wires, coil terminals, spark plugs, distributor caps and rotors

tests include: measure coil resistance in primary and secondary circuits, spark testing, high tension leads

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
D-17.02.01L	demonstrate knowledge of spark ignition systems, their <i>components</i> , characteristics, applications and operation	identify types of spark ignition systems and their <i>components</i> , and describe their characteristics and applications
		describe operating principles of spark ignition systems and their <i>components</i>
		describe electrical fundamentals
		describe <i>engine operating principles</i>

D-17.02.02L	demonstrate knowledge of procedures to diagnose spark ignition systems and their components	identify tools and equipment used to diagnose spark ignition systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to spark ignition systems and their components
		describe procedures to inspect spark ignition systems and their components
		describe procedures to test spark ignition systems and their components
		describe procedures to diagnose spark ignition systems and their components
		describe common causes and symptoms of problems
		identify common faults found in spark ignition systems
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-17.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to spark ignition systems	identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: spark plugs, coils, high-tension wires, modules, distributor caps and rotors

engine operating principles include: firing order, ignition timing, combustion cycle

tools and equipment include: scan tools, electronic service tools, oscilloscopes, spark testers, spark plug gapping tools, feeler gauges, multimeters

hazards include: shocks, sparks, moving components, burns, noises

symptoms of problems include: intermittent problems, no start, hard starting, misfiring, fuel economy issues

common faults include: faulty wiring, low voltage, faulty ECMs, poor grounds, faulty spark plugs, faulty coils, faulty high-tension wires, faulty distributor caps and rotors

D-17.03 Repairs spark ignition systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-17.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-17.03.02P	perform sensory inspections	sensory inspections are performed to identify defects
D-17.03.03P	replace and repair components	components are replaced and repaired according to manufacturers' service information
D-17.03.04P	adjust spark plug gap	spark plug gap is adjusted according to manufacturers' service information
D-17.03.05P	verify repairs	repairs are verified using methods while running engine at operating condition
D-17.03.06P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: scan tools, electronic service tools, oscilloscopes, spark testers, spark plug gapping tools, feeler gauges, multimeters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

defects include: damaged wires, coil terminals, spark plugs, distributor caps and rotors

components include: plugs, coils, high-tension wires, wiring, modules, distributor caps and rotors

methods include: road testing, checking fault codes, re-testing oscilloscope readings

Knowledge

	Learning Outcomes	Learning Objectives
D-17.03.01L	demonstrate knowledge of spark ignition systems, their components , characteristics, applications and operation	identify types of spark ignition systems and their components , and describe their characteristics and applications
		describe operating principles of spark ignition systems and their components
		describe electrical fundamentals
		describe engine operating principles
D-17.03.02L	demonstrate knowledge of procedures to repair spark ignition systems and their components	identify tools and equipment used to repair spark ignition systems and their components , and describe their applications and procedures for use

		identify hazards and describe safe work practices pertaining to spark ignition systems and their components
		describe procedures to inspect spark ignition systems and their components
		describe procedures to measure, adjust, replace and repair spark ignition system components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-17.03.03L	demonstrate knowledge of emerging technologies and practices pertaining to spark ignition systems	identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: plugs, coils, high-tension wires, wiring, modules, distributor caps and rotors

engine operating principles include: firing order, ignition timing, combustion cycle

tools and equipment include: scan tools, electronic service tools, oscilloscopes, spark testers, spark plug gapping tools, feeler gauges, multimeters

hazards include: shocks, sparks, moving components, burns, noises

Task D-18 Services, diagnoses and repairs starting systems

Task Descriptor

Truck and transport mechanics must have a good understanding of starting systems, their operation and components in order to safely service, diagnose and repair them.

D-18.01 Services starting systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-18.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-18.01.02P	perform sensory inspections	sensory inspections are performed to identify defects
D-18.01.03P	clean components	components are cleaned according to manufacturers' service information
D-18.01.04P	perform tests	tests are performed according to manufacturers' service information

Range of Variables

tools and equipment include: hand tools, carbon pile testers, multimeters, electronic service tools, test lights

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

defects include: loose, worn and corroded cables; loose starter mountings; loose and corroded magnetic switch connections; arcing connections

components (to be cleaned) include: connections, terminals

tests include: starter amp draw, voltage drop cables, neutral safety system

Knowledge

	Learning Outcomes	Learning Objectives
D-18.01.01L	demonstrate knowledge of starting systems, their components , characteristics, applications and operation	identify types of starting systems and their components , and describe their characteristics and applications
		describe operating principles of starting systems and their components
		interpret information pertaining to starting systems found in manufacturers' service information

		describe safety interlock devices designed to prevent starting of vehicle in an unsafe condition
		describe basic principles of electricity and circuit components
D-18.01.02L	demonstrate knowledge of procedures to service starting systems and their components	identify tools and equipment used to service starting systems and their components , and describe their applications and procedures for use
		describe procedures to service starting systems and their components
		describe procedures to inspect starting systems and their components
		identify hazards and describe safe work practices pertaining to starting systems and their components
		identify defects found in starting systems
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-18.01.03L	demonstrate knowledge of emerging technologies and practices pertaining to starting systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: starters, ECMs, solenoids, relays, cables, connections, terminals, ignition switches, wiring

types of starting systems include: 12-volt, 24-volt

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: hand tools, carbon pile testers, multimeters, electronic service tools, test lights

hazards include: shocks, sparks, moving components, burns, noises, lead and toxic metal exposure

defects include: loose, worn and corroded cables; loose starter mountings; loose and corroded magnetic switch connections; arcing connections

D-18.02 Diagnoses starting systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-18.02.01P	identify <i>symptoms of problems</i>	<i>symptoms of problems</i> are identified by consulting with customer or operator
D-18.02.02P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to task and <i>manufacturers' service information</i>
D-18.02.03P	perform sensory inspections	sensory inspections are performed to identify <i>defects</i>
D-18.02.04P	perform <i>tests</i>	<i>tests</i> are performed according to <i>manufacturers' service information</i>
D-18.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following <i>manufacturers' service information</i> to determine failure
D-18.02.06P	compare <i>test</i> results to <i>manufacturers' service information</i> or expected values	<i>test</i> results are compared to <i>manufacturers' service information</i> or expected values to verify diagnosis
D-18.02.07P	perform failure analysis	failure analysis is performed to determine root cause of failure
D-18.02.08P	interpret diagnostic results	diagnostic results are interpreted to determine <i>next steps</i>

Range of Variables

symptoms of problems include: no, slow or constant cranking; intermittent operation; noisy starter operation

tools and equipment include: hand tools, carbon pile testers, multimeters, electronic service tools, test lights

manufacturers' service information include: specifications, recommendations, procedures, standards, logic diagrams

defects include: loose, worn and corroded cables; loose starter mountings; loose and corroded magnetic switch connections; arcing connections

tests include: starter draw, voltage drop, fault codes

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

Learning Outcomes	Learning Objectives	
D-18.02.01L	demonstrate knowledge of starting systems, their components , characteristics, applications and operation	identify types of starting systems and their components , and describe their characteristics and applications
		describe operating principles of starting systems and their components
		describe basic principles of electricity and circuit components
		interpret information pertaining to starting systems found in manufacturers' service information
		describe safety interlock devices designed to prevent starting of vehicle in an unsafe condition
D-18.02.02L	demonstrate knowledge of procedures to diagnose starting systems and their components	identify tools and equipment used to diagnose starting systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to starting systems and their components
		describe procedures to inspect starting systems and their components
		describe procedures to test starting systems and their components
		describe procedures to diagnose starting systems and their components
		describe common causes and symptoms of problems
		describe common faults found while inspecting starting systems and their components
		identify materials that can be reconditioned, reused or recycled
	identify practices that reduce material waste	
D-18.02.03L	demonstrate knowledge of regulatory requirements pertaining to neutral safety systems	identify and interpret standards and jurisdictional regulations pertaining to neutral safety systems

D-18.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to starting systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: starters, modules, solenoids, relays, cables, connections, terminals, ignition switches, wiring

types of starting systems include: 12-volt, 24-volt

manufacturers' service information include: specifications, recommendations, procedures, standards, logic diagrams

tools and equipment include: hand tools, carbon pile testers, multimeters, electronic service tools, test lights

hazards include: shocks, sparks, moving components, burns, noises, lead and toxic metal exposure

symptoms of problems include: no, slow or constant cranking; intermittent operation; noisy starter operation

common faults include: dead battery, frayed cables, high resistance in cables and connections, excess starter draw, burnt and corroded solenoid contacts

D-18.03 Repairs starting systems

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

Skills

	Performance Criteria	Evidence of Attainment
D-18.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-18.03.02P	clean components	components are cleaned according to manufacturers' service information
D-18.03.03P	remove and replace starter	starter is removed and replaced according to manufacturers' service information
D-18.03.04P	replace components	components are replaced according to manufacturers' service information
D-18.03.05P	rebuild starter	starter is rebuilt using methods according to manufacturers' service information

D-18.03.06P	verify repairs	repairs are verified using methods
D-18.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: carbon pile testers, multimeters, electronic service tools, test lights, armature growlers

manufacturers' service information include: specifications, recommendations, procedures, standards
components (to be cleaned) include: connections, terminals

components (to be replaced) include: solenoids, relays, cables, connections, ignition switches, modules, interlock switches

methods (to rebuild starter) include: replacing solenoid, brushes, bushings and starter drives; testing armatures and field windings; setting starter drive air gap

methods (to verify repairs) include: testing bench and starter draw, verifying fault codes

Knowledge		
	Learning Outcomes	Learning Objectives
D-18.03.01L	demonstrate knowledge of starting systems, their components , characteristics, applications and operation	identify types of starting systems and their components , and describe their characteristics and applications
		describe operating principles of starting systems and their components
		interpret information pertaining to starting systems found in manufacturers' service information
		describe basic principles of electricity and circuit components
D-18.03.02L	demonstrate knowledge of procedures to repair starting systems and their components	describe safety interlock devices designed to prevent starting of vehicle in an unsafe condition
		identify tools and equipment used to repair starting systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to starting systems and their components
		describe procedures to replace, clean and repair starting system components
		describe procedures to rebuild starters
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste

D-18.03.03L	demonstrate knowledge of regulatory requirements pertaining to neutral safety systems	identify and interpret standards and jurisdictional regulations pertaining to neutral safety systems
D-18.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to starting systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: connections, terminals, solenoids, relays, cables, ignition switches, modules, interlock switches

types of starting systems include: 12-volt, 24-volt

manufacturers' service information include: specifications, recommendations, procedures, standards

tools and equipment include: carbon pile testers, multimeters, electronic service tools, test lights, armature growlers

hazards include: shocks, sparks, moving components, burns, noises, lead and toxic metal exposure, heavy components

Task D-19 Services, diagnoses and repairs electrical components and accessories

Task Descriptor

Truck and transport mechanics must be able to service, diagnose and repair electrical system faults using multimeters and specialized tools in order to return the vehicle to service. They must have a good understanding of the basic principles of electricity and circuitry.

D-19.01 Services electrical components and accessories

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

Skills

	Performance Criteria	Evidence of Attainment
D-19.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-19.01.02P	clean components	components are cleaned according to manufacturers' service information
D-19.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components and connections
D-19.01.04P	identify high-voltage electrical systems requiring specialized training and safety precautions	high-voltage electrical systems requiring specialized training and safety precautions are identified
D-19.01.05P	identify and tighten loose connections	loose connections are identified and tightened according to manufacturers' service information
D-19.01.06P	apply anti-corrosion compound	anti-corrosion compound is applied according to manufacturers' service information
D-19.01.07P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: hand tools, multimeters, test lights, terminal cleaning tools

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

components (to be cleaned) include: corroded terminals, sockets, junction boxes

components include: terminals, sockets, junction boxes, light bulbs, fuses, harnesses, plug-in connectors, wiring, resistors, relays, switches, diodes, breakers

high-voltage electrical systems include: hybrid, EV, lighting (fluorescents, dash lights)

Knowledge		
	Learning Outcomes	Learning Objectives
D-19.01.01L	demonstrate knowledge of electrical components and accessories , their characteristics, applications and operation	identify types of electrical components and accessories , and describe their characteristics and applications
		describe operating principles of electricity and electrical components and accessories
		interpret wiring schematics and logic diagrams
		identify systems with stored energy sources
D-19.01.02L	demonstrate knowledge of high-voltage electrical systems , their characteristics, applications and operation	identify hazards and describe safe work practices pertaining to high-voltage electrical systems and their components and accessories
D-19.01.03L	demonstrate knowledge of procedures to service electrical components and accessories	identify tools and equipment used to service electrical components and accessories , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to electrical components and accessories
		describe procedures to inspect electrical components and accessories
		describe procedures to clean electrical components and accessories
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste

D-19.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to electrical components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: terminals, sockets, junction boxes, light bulbs, fuses, harnesses, plug-in connectors, wiring, resistors, relays, switches, diodes, breakers

accessories include: driving lights, rotary beacons, block heaters, auxiliary power units, seat heaters

high-voltage electrical systems include: hybrid, EV, lighting (fluorescents, dash lights)

hazards include: electrocution, shocks, sparks, moving parts

tools and equipment include: hand tools, multimeters, test lights, terminal cleaning tools

D-19.02 Diagnoses electrical components and accessories

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

Skills

Performance Criteria		Evidence of Attainment
D-19.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
D-19.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-19.02.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components and connections
D-19.02.04P	identify high-voltage electrical systems requiring specialized training and safety precautions	high-voltage electrical systems requiring specialized training and safety precautions are identified
D-19.02.05P	perform tests	tests are performed according to manufacturers' service information
D-19.02.06P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
D-19.02.07P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis

D-19.02.08P	perform failure analysis	failure analysis is performed on components and accessories to determine root cause of failure
D-19.02.09P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' service information
D-19.02.10P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: blown fuses, dim or bright lighting, components not operating, noises, smells, smoke, hot components

tools and equipment include: multimeters, test lights, hand tools

manufacturers' service information include: specifications, recommendations, procedures, standards, service bulletins, logic diagrams

components include: terminals, sockets, junction boxes, light bulbs, fuses, harnesses, plug-in connectors, wiring, resistors, relays, switches, diodes, breakers

high-voltage electrical systems include: hybrid, EV, lighting (fluorescents, dash lights)

tests include: measuring voltage, amperage and resistance values in electrical circuits

accessories include: driving lights, rotary beacons, block heaters, auxiliary power units, seat heaters

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
D-19.02.01L	demonstrate knowledge of electrical components and accessories , their characteristics, applications and operation	identify types of electrical components and accessories , and describe their characteristics and applications
		describe operating principles of electricity and electrical components and accessories
		interpret wiring schematics and logic diagrams
		identify systems with stored energy sources
D-19.02.02L	demonstrate knowledge of high-voltage electrical systems , their characteristics, applications and operation	identify hazards and describe safe work practices pertaining to high-voltage electrical systems
D-19.02.03L	demonstrate knowledge of procedures to diagnose electrical components and accessories	identify tools and equipment used to diagnose electrical components and accessories , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to electrical components and accessories
		describe procedures to inspect electrical components and accessories

		describe procedures to test electrical components and accessories
		describe procedures to diagnose electrical components and accessories
		describe common causes and symptoms of problems
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-19.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to electrical components and accessories	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: terminals, sockets, junction boxes, light bulbs, fuses, harnesses, plug-in connectors, wiring, resistors, relays, switches, diodes, breakers

accessories include: driving lights, rotary beacons, block heaters, auxiliary power units, seat heaters

high-voltage electrical systems include: hybrid, EV, lighting (fluorescents, dash lights)

tools and equipment include: multimeters, test lights, hand tools

hazards include: electrocution, shocks, sparks, moving parts

symptoms of problems include: blown fuses, dim or bright lighting, components not operating, noises, smells, smoke, hot components

D-19.03 Repairs electrical components and accessories

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

Skills

	Performance Criteria	Evidence of Attainment
D-19.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-19.03.02P	clean components	components are cleaned according to manufacturers' service information
D-19.03.03P	identify high-voltage electrical systems requiring specialized training and safety precautions	high-voltage electrical systems requiring specialized training and safety precautions are identified

D-19.03.04P	replace components and accessories	components and accessories are replaced according to manufacturers' service information
D-19.03.05P	repair components	components are repaired according to manufacturers' service information
D-19.03.06P	identify and tighten loose connections	loose connections are identified and tightened according to manufacturers' service information
D-19.03.07P	apply anti-corrosion compound	anti-corrosion compound is applied according to manufacturers' service information
D-19.03.08P	select and match components to electrical load	components are selected and matched to electrical load according to manufacturers' service information
D-19.03.09P	install optional accessories	optional accessories are installed according to manufacturers' service information
D-19.03.10P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
D-19.03.11P	verify repairs	repairs are verified under normal operating conditions to ensure it is within manufacturers' service information
D-19.03.12P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: multimeters, test lights, hand tools, terminal and connector repair tools

manufacturers' service information include: specifications, recommendations, procedures, standards, service bulletins

components (to be cleaned) include: corroded terminals, sockets, junction boxes

high-voltage electrical systems include: hybrid, EV, lighting (fluorescents, dash lights)

components (to be replaced) include: light bulbs, fuses, harnesses, plug-in connectors, switches, relays, breakers

accessories include: driving lights, rotary beacons, block heaters, auxiliary power units, seat heaters

components (to be repaired) include: faulty wiring, corroded terminals, sockets and connectors

components (to be matched to electrical load) include: wiring, resistors, fuses, relays, switches, diodes

consumables include: light ballast, fluorescent lighting

Knowledge

	Learning Outcomes	Learning Objectives
D-19.03.01L	demonstrate knowledge of electrical components and accessories , their characteristics, applications and operation	identify types of electrical components and accessories , and describe their characteristics and applications
		describe operating principles of electricity and electrical components

		interpret wiring schematics and logic diagrams
		identify systems with stored energy sources
D-19.03.02L	demonstrate knowledge of high-voltage electrical systems , their characteristics, applications and operation	identify hazards and describe safe work practices pertaining to high-voltage electrical systems
D-19.03.03L	demonstrate knowledge of procedures to repair electrical components and accessories	identify tools and equipment used to repair electrical components and accessories , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to electrical components and accessories
		describe procedures to clean, replace and repair electrical components and accessories
		describe procedures to recycle and dispose of electrical components , accessories and consumables
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-19.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to electrical components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: terminals, sockets, junction boxes, light bulbs, fuses, harnesses, plug-in connectors, wiring, resistors, relays, switches, diodes, breakers

accessories include: driving lights, rotary beacons, block heaters, auxiliary power units, seat heaters

high-voltage electrical systems include: hybrid, EV, lighting (fluorescents, dash lights)

tools and equipment include: multimeters, test lights, hand tools, terminal and connector repair tools

hazards include: electrocution, shocks, sparks, moving parts

consumables include: light ballast, fluorescent lighting

Task D-20 Services, diagnoses and repairs vehicle management systems and electronic components

Task Descriptor

Technological advancement throughout the industry has resulted in more complex vehicle management and electronic systems. Truck and transport mechanics must have a good understanding of the integration between vehicle management systems and other electronic components in a multiplex wiring system.

D-20.01 Services vehicle management systems and electronic components

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

Skills

	Performance Criteria	Evidence of Attainment
D-20.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-20.01.02P	perform sensory inspections	sensory inspections are performed to identify component securement, loose and faulty wiring, and damages according to manufacturers' service information
D-20.01.03P	check and manage fault codes	fault codes are checked and managed according to manufacturers' service information
D-20.01.04P	perform software updates	software updates are performed according to manufacturers' service information
D-20.01.05P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: electronic service tools, scan tools, multimeters, oscilloscope

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

components include: actuators, sensors, ECMs, multi-function controls, wiring, connectors, data links, communication plugs, terminating resistors

damages include: overheating and exposure to moisture and contaminants, gauges not sweeping, communication problems, low voltage, failed modules, poor grounds, failed or out of adjustment sensors

Knowledge

Learning Outcomes	Learning Objectives
D-20.01.01L demonstrate knowledge of vehicle management systems, their components , characteristics, applications and operation	identify types of vehicle management systems and their components , and describe their characteristics and applications
	describe operating principles of vehicle management systems and their components
	identify and interpret manufacturers' service information
	describe communication protocols , their characteristics and applications
	describe network structure and components, their characteristics and applications
D-20.01.02L demonstrate knowledge of procedures to service vehicle management systems and their components	identify data links and describe network communication between modules
	identify tools and equipment used to service vehicle management systems and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to vehicle management systems and their components
	describe procedures to inspect vehicle management systems and their components
	describe procedures to service vehicle management systems and their components
	describe handling procedures for electronic components
	identify materials that can be reconditioned, reused or recycled
D-20.01.03L demonstrate knowledge of emerging technologies and practices pertaining to vehicle management systems and electronic components	identify practices that reduce material waste
	identify technologies and practices that contribute to net zero and carbon neutral commitments
	identify technologies that address emissions and pollution, and describe their characteristics and applications
	identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: actuators, sensors, ECMs, multi-function controls, wiring, connectors, data links, communication plugs, terminating resistors

types of vehicle management systems include: daytime running lights (DRL), ABS/traction control, vehicle stability control, driver communication, adaptive cruise control, supplemental restraint system (SRS), remote monitoring systems, lane departure systems, multiplex electrical systems

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

communication protocols include: J1939, Bluetooth, Wi-Fi

tools and equipment include: electronic service tools, scan tools, multimeters, oscilloscope

hazards include: shocks, sparks

handling procedures for electronic components include: avoiding static electricity, moisture and other contaminants

D-20.02 Diagnoses vehicle management systems and electronic components

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

Skills

Performance Criteria		Evidence of Attainment
D-20.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
D-20.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-20.02.03P	perform sensory inspections	sensory inspections are performed to identify loose and faulty wiring, and damages
D-20.02.04P	check and interpret fault codes	fault codes are checked and interpreted according to manufacturers' service information
D-20.02.05P	perform diagnostic procedures	diagnostic procedures are performed by following manufacturers' service information to determine failure
D-20.02.06P	perform tests	tests are performed according to manufacturers' service information
D-20.02.07P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
D-20.02.08P	perform failure analysis	failure analysis is performed to determine root cause of failure

D-20.02.09P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty purposes
D-20.02.10P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: intermittent or no operation, component not operating as expected, gauges not sweeping or all the time, indicator lights, dash messages

tools and equipment include: scan tools, multimeters, oscilloscopes, electronic service tools, OEM specialty diagnostic tools, hand tools, wiring repair tools

manufacturers' service information include: specifications, recommendations, procedures, standards, service bulletins, logic diagrams

damages include: overheating, exposure to moisture or other contaminants, chafed wiring, improper connections

next steps include: repairs, component replacement or adjustment, software updates, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
D-20.02.01L	demonstrate knowledge of vehicle management systems, their components , characteristics, applications and operation	identify types of vehicle management systems and their components , and describe their characteristics and applications
		describe operating principles of vehicle management systems and their components
		identify and interpret manufacturers' service information
		describe communication protocols , their characteristics and applications
		describe network structure and components, their characteristics and applications
		identify data links and describe network communication between modules
D-20.02.02L	demonstrate knowledge of procedures to diagnose vehicle management systems and their components	identify tools and equipment used to diagnose vehicle management systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to vehicle management systems and their components
		describe procedures to inspect vehicle management systems and their components

		describe procedures to test vehicle management systems and their components
		describe procedures to diagnose vehicle management systems and their components
		describe common causes and symptoms of problems
		describe procedures to release stored energy
		identify types of wiring and standards
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
D-20.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to vehicle management systems and their components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: actuators, sensors, ECMs, multi-function controls, wiring, connectors, data links, communication plugs, terminating resistors

types of vehicle management systems include: DRL, ABS/traction control, vehicle stability control, driver communication, adaptive cruise control, SRS, remote monitoring systems, lane departure systems, multiplex electrical systems

manufacturers' service information include: specifications, recommendations, procedures, standards, service bulletins, logic diagrams

communication protocols include: J1939, Bluetooth, Wi-Fi

tools and equipment include: scan tools, multimeters, oscilloscopes, electronic service tools, OEM specialty diagnostic tools, hand tools, wiring repair tools

hazards include: shocks, sparks

symptoms of problems include: intermittent or no operation, component not operating as expected, gauges not sweeping or all the time, indicator lights, dash messages

types of wiring include: shielded, multi-strand, twisted pairs, coaxial, fibre optic, insulation

D-20.03 Repairs vehicle management systems and electronic components

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

Skills

	Performance Criteria	Evidence of Attainment
D-20.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
D-20.03.02P	check and perform software updates	software updates are checked and performed according to manufacturers' service information
D-20.03.03P	remove power supply and release stored energy	power supply is removed and stored energy is released by disconnecting power sources and allowing capacitors to discharge in SRS modules
D-20.03.04P	replace components	components are replaced according to manufacturers' service information
D-20.03.05P	repair components	components are repaired according to manufacturers' service information
D-20.03.06P	adjust components	components are adjusted according to manufacturers' service information
D-20.03.07P	reprogram ECM to accommodate accessories and modifications	ECM is reprogrammed according to manufacturers' service information to accommodate accessories and modifications
D-20.03.08P	verify repairs	repair is verified under normal operating conditions to ensure it is within manufacturers' service information
D-20.03.09P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: scan tools, multimeters, oscilloscopes, electronic service tools, OEM specialty diagnostic tools, hand tools, wiring and terminal repair tools

manufacturers' service information include: specifications, recommendations, procedures, standards, service bulletins, logic diagrams

components (to be replaced) include: ECMs, connectors, switches, solenoids, sensors, terminating resistors, wiring, harnesses, actuators

components (to be repaired) include: wiring, connectors, terminals

components (to be adjusted) include: actuators, switches, sensors

accessories and modifications include: addition of auxiliary lighting systems, addition of auxiliary components, change in operating characteristics

Knowledge

Learning Outcomes	Learning Objectives
D-20.03.01L demonstrate knowledge of vehicle management systems, their components , characteristics, applications and operation	identify types of vehicle management systems and their components , and describe their characteristics and applications
	describe operating principles of vehicle management systems and their components
	interpret information pertaining to vehicle management systems found in manufacturers' service information
	describe communication protocols , their characteristics and applications
	describe network structure and components, their characteristics and applications
D-20.03.02L demonstrate knowledge of procedures to repair vehicle management systems and their components	identify tools and equipment used to repair vehicle management systems and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to vehicle management systems and their components
	describe procedures to release stored energy
	describe procedures to repair vehicle management systems and their components
	describe procedures to repair wiring
	identify types of wiring and standards
	describe procedures to reprogram ECMs
	describe procedures to perform software updates
	identify materials that can be reconditioned, reused or recycled
	identify practices that reduce material waste

D-20.03.03L	demonstrate knowledge of emerging technologies and practices pertaining to vehicle management systems and their components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: actuators, sensors, ECMs, multi-function controls, wiring, connectors, data links, communication plugs, terminating resistors

types of vehicle management systems include: DRL, ABS/traction control, vehicle stability control, driver communication, adaptive cruise control, SRS, remote monitoring systems, lane departure systems, multiplex electrical systems

manufacturers' service information include: specifications, recommendations, procedures, standards, service bulletins, logic diagrams

communication protocols include: J1939, Bluetooth, Wi-Fi

tools and equipment include: scan tools, multimeters, oscilloscopes, electronic service tools, OEM specialty diagnostic tools, hand tools, wiring and terminal repair tools

hazards include: shocks, sparks

procedures to repair wiring include: soldering, heat shrinking, terminal installation, insulation protection

types of wiring include: shielded, multi-strand, twisted pairs, coaxial, fibre optic, insulation

Major Work Activity E

Services, diagnoses and repairs drive trains

Task E-21 Services, diagnoses and repairs clutches

Task Descriptor

The clutch transfers energy and provides a means of disconnect from the engine to the transmission. Truck and transport mechanics must diagnose, service and repair the clutch to increase longevity and optimal performance of the vehicle. Servicing includes lubrication and adjustment of components as well as routine maintenance.

E-21.01 Services clutches

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

Skills

	Performance Criteria	Evidence of Attainment
E-21.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-21.01.02P	lubricate cross shafts, linkages and release bearings	cross shafts, linkages and release bearings are lubricated according to manufacturers' service information
E-21.01.03P	adjust clutch and linkages	clutch and linkages are adjusted to obtain manufacturer's tolerance between release bearing and clutch brake
E-21.01.04P	inspect primary and secondary cylinders	primary and secondary cylinders are inspected to identify leaks and damage
E-21.01.05P	inspect and adjust cables, linkages and clutch brakes	cables, linkages and clutch brakes are inspected and adjusted according to manufacturers' service information

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

Knowledge

	Learning Outcomes	Learning Objectives
E-21.01.01L	demonstrate knowledge of clutches, their components , characteristics, applications and operation	identify types of clutches and their components , and describe their characteristics and applications
		describe operating principles of clutches and their components
		identify types of clutch controls , and describe their characteristics and applications
E-21.01.02L	demonstrate knowledge of procedures to service clutches and their components	identify tools and equipment used to service clutches and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to clutches and their components
		describe procedures to inspect clutches and their components
		describe procedures to lubricate and adjust clutches and their components
		identify materials that can be reconditioned, reused or recycled

Range of Variables

components include: discs, centre plate, release springs, release bearings

types of clutches include: pull, push, self-adjusting, manual adjusting

clutch controls include: cable, linkage, hydraulic-assisted, air-assisted, electronically controlled

hazards include: pinch/crush points, airborne contaminants, fluid leaks, air leaks

E-21.02 Diagnoses clutches

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

Skills

	Performance Criteria	Evidence of Attainment
E-21.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
E-21.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information

E-21.02.03P	perform sensory inspections and road test	sensory inspections and road test are performed to confirm complaint and establish preliminary diagnosis
E-21.02.04P	inspect primary and secondary cylinders, and related hoses and lines	primary and secondary cylinders, and related hoses and lines are inspected for leaks and damage
E-21.02.05P	compare results to manufacturers' service information or expected values to verify diagnosis	results are compared to manufacturers' service information or expected values to verify diagnosis
E-21.02.06P	perform failure analysis	failure analysis is performed to determine root cause of failure
E-21.02.07P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: hard shifting, loss of pedal free play, excessive pedal free play, slipping clutch, high engine RPMs, difficult initial gear engagement

tools and equipment include: feeler gauges, spring gauges, measuring devices

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: pedal feel, observing clutch material, worn or broken components

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
E-21.02.01L	demonstrate knowledge of clutches, their components , characteristics, applications and operation	identify types of clutches and their components , and describe their characteristics and applications
		describe operating principles of clutches and their components
		identify types of clutch controls and describe their characteristics and applications
		identify and describe clutch faults
E-21.02.02L	demonstrate knowledge of procedures to diagnose clutches and their components	identify tools and equipment used to diagnose clutches and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to clutches and their components
		describe procedures to inspect clutches and their components
		describe procedures to test clutches and their components
		describe procedures to diagnose clutches and their components

	identify steps for failure analysis
	describe common causes and symptoms of problems
	identify materials that can be reconditioned, reused or recycled

Range of Variables

components include: discs, centre plate, release springs, release bearings, clutch break

types of clutches include: pull, push, self-adjusting, manual adjusting

clutch controls include: cable, linkage, hydraulic-assisted, air-assisted, electronically controlled

clutch faults include: shock loads, worn parts, seized release bearings, broken clutch springs

tools and equipment include: feeler gauges, spring gauges, measuring devices

hazards include: pinch/crush points, airborne contaminants, fluid leaks, air leaks

symptoms of problems include: hard shifting, loss of pedal free play, excessive pedal free play, slipping clutch, high engine RPMs, difficult initial gear engagement

E-21.03 Repairs clutches

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

Skills

	Performance Criteria	Evidence of Attainment
E-21.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-21.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
E-21.03.03P	recondition or replace flywheels	flywheels are reconditioned or replaced according to manufacturers' service information
E-21.03.04P	verify alignment of discs and pressure plates	alignment of discs and pressure plates is verified according to manufacturers' service information
E-21.03.05P	adjust clutch and linkages	clutch and linkages are adjusted to manufacturers' service information
E-21.03.06P	bleed air from primary and secondary cylinders	air from primary and secondary cylinders are bled
E-21.03.07P	verify repairs	repairs are verified using methods
E-21.03.08P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: linkages, cross shafts, bushings, clutch, pressure plate, fly wheels

methods include: road testing, sensory observations

Knowledge		
	Learning Outcomes	Learning Objectives
E-21.03.01L	demonstrate knowledge of clutches, their components , characteristics, applications and operation	identify types of clutches and their components , and describe their characteristics and applications
		describe operating principles of clutches and their components
		identify types of clutch controls , and describe their characteristics and applications
E-21.03.02L	demonstrate knowledge of procedures to repair clutches and their components	identify tools and equipment used to repair clutches and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to clutches and their components
		describe procedures to remove, replace, adjust and repair clutches and their components
		identify materials that can be reconditioned, reused or recycled

Range of Variables

components include: linkages, cross shafts, bushings, clutch, pressure plate, fly wheels

types of clutches include: pull, push, self-adjusting, manual adjusting

clutch controls include: cable, linkage, hydraulic-assisted, air-assisted, electronically controlled

hazards include: pinch/crush points, airborne contaminants, fluid leaks, air leaks, heavy components, clutch break

Task E-22 Services, diagnoses and repairs manual transmissions and transfer cases

Task Descriptor

The transmission of a vehicle transfers power from the engine through the drive shaft to the wheels to enable movement of the vehicle. The transmission allows for selection of gear ratios needed for various loads and speed conditions. The transfer case allows transmission power to be directed to components such as additional axles and accessories.

Truck and transport mechanics diagnose, service and repair transmission and transfer cases minimizing down time of the vehicle, and ensuring the safety of the vehicle, driver and public. Servicing includes routine maintenance.

E-22.01 Services manual transmissions and transfer cases

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

Skills

	Performance Criteria	Evidence of Attainment
E-22.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-22.01.02P	clean components for inspection	components are cleaned for inspection
E-22.01.03P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule
E-22.01.04P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
E-22.01.05P	inspect manual transmission and transfer case components	manual transmission and transfer case components are inspected for leakage and damage
E-22.01.06P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be cleaned) include: breathers, transmission cases

consumables include: oil, filter

manual transmission and transfer case components include: seals, gaskets, gears, bearings, splines, air cylinders, range valves, air lines, filters, synchronizers, main shafts, counter shafts, detent, shift rails

Knowledge		
	Learning Outcomes	Learning Objectives
E-22.01.01L	demonstrate knowledge of manual transmissions, their components , consumables , characteristics, applications and operation	identify types of manual transmissions and their components and consumables , and describe their characteristics and applications
		describe operating principles of manual transmissions and their components
E-22.01.02L	demonstrate knowledge of transfer cases, their components , characteristics, applications and operation	identify types of transfer cases and their components , and describe their characteristics and applications
		describe operating principles of transfer cases and their components , and transfer case shift controls
		identify auxiliary shift components , and describe their characteristics and applications
E-22.01.03L	demonstrate knowledge of procedures to service manual transmissions and transfer cases, and their components	identify tools and equipment used to service manual transmissions and transfer cases, and their components , and describe their applications and procedures for use
		identify hazards safe work practices pertaining to manual transmissions and transfer cases, and their components
		describe procedures to inspect manual transmission and transfer case components
		describe procedures to clean components
E-22.01.04L	demonstrate knowledge of regulatory requirements pertaining to recycling and disposal of oils	describe procedures to remove, replace, recycle and dispose of consumables
		identify standards and regulations pertaining to recycling and disposal of oils

Range of Variables

components include: breathers, transmission cases

consumables include: oil, filter

types of manual transmissions include: single countershaft, multiple countershaft, synchronized, non-synchronized

transfer case shift controls include: air, electrical, mechanical

auxiliary shift components include: air cylinders, air lines, regulators, shift knobs

hazards include: spills, pinch/crush points, sharp edges

manual transmission and transfer case components include: seals, gaskets, gears, bearings, splines, air cylinders, range valves, air lines, filters, synchronizers, main shafts, counter shafts, detent, shift rails

E-22.02 Diagnoses manual transmissions and transfer cases

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

Skills

Performance Criteria		Evidence of Attainment
E-22.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
E-22.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-22.02.03P	perform diagnostic procedures	diagnostic procedures are performed by following manufacturers' service information to confirm complaint
E-22.02.04P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values
E-22.02.05P	perform failure analysis	failure analysis is performed to determine root cause of failure
E-22.02.06P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
E-22.02.07P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: hard shifting, jumping out of gear, noises

manufacturers' service information include: specifications, recommendations, procedures, standards

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
E-22.02.01L	demonstrate knowledge of manual transmissions, their components , characteristics, applications and operation	identify types of manual transmissions and their components , and describe their characteristics and applications describe operating principles of manual transmissions and their components interpret information pertaining to manual transmissions found in manufacturers' service information
E-22.02.02L	demonstrate knowledge of transfer cases, their components , characteristics, applications and operation	identify types of transfer cases and their components , and describe their characteristics and applications describe operating principles of transfer cases and their components , and transfer case shift controls identify auxiliary shift components , and describe their characteristics and applications
E-22.02.03L	demonstrate knowledge of procedures to diagnose manual transmissions and transfer cases, and their components	identify tools and equipment used to diagnose manual transmissions and transfer cases, and their components , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to manual transmissions and transfer cases, and their components describe procedures to inspect manual transmissions and transfer cases, and their components describe procedures to test manual transmissions and transfer cases, and their components describe procedures to diagnose manual transmissions and transfer cases, and their components identify steps for failure analysis identify common faults found in manual transmissions and transfer cases, and their components describe common causes and symptoms of problems identify materials that can be reconditioned, reused or recycled

Range of Variables

manual transmission and transfer case components include: seals, gaskets, gears, bearings, splines, air cylinders, range valves, air lines, filters, synchronizers, main shafts, counter shafts, detent, shift rails

types of manual transmissions include: single countershaft, multiple countershaft, synchronized, non-synchronized

manufacturers' service information include: specifications, recommendations, procedures, standards

transfer case shift controls include: air, electrical, mechanical

auxiliary shift components include: air cylinders, air lines, regulators, shift knobs

hazards include: spills, pinch/crush points, sharp edges

faults include: missing teeth in gears, lack of lubrication, worn synchronizers

symptoms of problems include: hard shifting, jumping out of gear, noises

E-22.03 Repairs manual transmissions and transfer cases

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

Skills

	Performance Criteria	Evidence of Attainment
E-22.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-22.03.02P	repair manual transmission and transfer case components	manual transmission and transfer case components are repaired according to manufacturers' service information
E-22.03.03P	rebuild manual transmissions and transfer cases	manual transmissions and transfer cases are rebuilt by replacing worn or broken parts according to manufacturers' service information
E-22.03.04P	remove and replace worn, damaged and faulty manual transmission and transfer case components	worn, damaged and faulty manual transmission and transfer case components are removed and replaced according to manufacturers' service information
E-22.03.05P	time gears and adjust bearing pre-loads	gears are timed and bearing pre-loads are adjusted according to manufacturers' service information
E-22.03.06P	install PTOs and adjust gear backlash	PTOs are installed and gear backlash is adjusted according to manufacturers' service information
E-22.03.07P	verify repairs	repairs are verified using methods
E-22.03.08P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

manual transmission and transfer case components include: seals, gaskets, gears, bearings, splines, air cylinders, range valves, air lines, filters, synchronizers, main shafts, counter shafts, detent, shift rails

methods include: road testing, sensory observations

Knowledge		
	Learning Outcomes	Learning Objectives
E-22.03.01L	demonstrate knowledge of manual transmissions, their components , characteristics, applications and operation	identify types of manual transmissions and their components , and describe their characteristics and applications
		describe operating principles of manual transmissions and their components
E-22.03.02L	demonstrate knowledge of transfer cases, their components , characteristics, applications and operation	identify types of transfer cases and their components , and describe their characteristics and applications
		describe operating principles of transfer cases and their components , and transfer case shift controls
		identify auxiliary shift components and describe their characteristics and applications
E-22.03.03L	demonstrate knowledge of procedures to repair manual transmissions and transfer cases, and their components	identify tools and equipment used to repair manual transmissions and transfer cases, and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to manual transmissions and transfer cases, and their components
		describe procedures to remove, replace, rebuild and repair manual transmissions and transfer cases, and their components
		identify materials that can be reconditioned, reused or recycled

Range of Variables

manual transmission and transfer case components include: seals, gaskets, gears, bearings, splines, air cylinders, range valves, air lines, filters, synchronizers, main shafts, counter shafts, detent, shift rails

types of manual transmissions include: single countershaft, multiple countershaft, synchronized, non-synchronized

transfer case shift controls include: air, electrical, mechanical

auxiliary shift components include: air cylinder, air lines, regulators, shift knobs

hazards include: spills, pinch/crush points, sharp edges, heavy components

Task E-23 Services, diagnoses and repairs automatic transmissions

Task Descriptor

Truck and transport mechanics must have a good understanding of automatic transmission operation and components in order to service, diagnose and repair, ensure proper function and reduce downtime.

E-23.01 Services automatic transmissions

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

Skills

	Performance Criteria	Evidence of Attainment
E-23.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-23.01.02P	perform sensory inspections	sensory inspections of components are performed to identify leaks, breaks and excessive wear
E-23.01.03P	check and perform software updates	software is checked and updates are performed according to manufacturers' service information
E-23.01.04P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule
E-23.01.05P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
E-23.01.06P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: torque converters, valve bodies, pumps, solenoids, clutches, clutch packs, bearings, seals, bands, servos, planetaries

consumables include: oil, filters

Knowledge

Learning Outcomes	Learning Objectives
E-23.01.01L demonstrate knowledge of automatic transmissions, their components , consumables , characteristics, applications and operation	identify automatic transmissions and their components and consumables , and describe their characteristics and applications
	describe operating principles of automatic transmissions and their components
	identify automatic hybrid transmissions, and describe their characteristics and applications
	identify types of coolers, and describe their locations, characteristics and applications
E-23.01.02L demonstrate knowledge of procedures to service automatic transmissions and their components	identify tools and equipment used to service automatic transmissions and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to automatic transmissions and their components
	describe procedures to inspect automatic transmission components
	describe procedures to service automatic transmission components
	describe procedures to remove, replace, recycle and dispose of automatic transmission consumables
	describe procedures to perform software updates and calibrations
	describe procedures to disconnect and reconnect high-voltage systems in hybrid vehicles
	describe effects of component failures
E-23.01.03L demonstrate knowledge of regulatory requirements pertaining to recycling and disposal of automatic transmission consumables	identify and interpret standards and regulations pertaining to recycling and disposal of automatic transmission consumables
E-23.01.04L demonstrate knowledge of emerging technologies and practices pertaining to automatic transmissions and their components	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: torque converters, valve bodies, pumps, solenoids, clutches, clutch packs, bearings, seals, bands, servos, planetaries

consumables include: oil, filters

hazards include: fluid spills, sharp edges, hot fluids

E-23.02 Diagnoses automatic transmissions

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

Skills

	Performance Criteria	Evidence of Attainment
E-23.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
E-23.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-23.02.03P	check for external leaks and oil condition	external leaks and oil condition are checked
E-23.02.04P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
E-23.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
E-23.02.06P	assess components for wear, damage and defects	components are assessed for wear, damage and defects by performing road test and using tools and equipment
E-23.02.07P	interpret fault codes and test results	fault codes and test results are interpreted to ensure operation is according to manufacturers' service information
E-23.02.08P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
E-23.02.09P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
E-23.02.10P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: harsh shifting, noises, delayed shift, no gear selection

tools and equipment include: pressure gauges, electronic service tools, manufacturer-specific equipment

manufacturers' service information include: specifications, recommendations, procedures, standards

sensory inspections include: road testing, checking for leaks, smells, noises, wiggling components

components include: torque converters, valve bodies, pumps, solenoids, clutches, clutch packs, bearings, seals, bands, servos, planetaries

tests include: stall testing, pressure readings, temperature

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
Learning Outcomes	Learning Objectives	
E-23.02.01L	demonstrate knowledge of automatic transmissions, their components , characteristics, applications and operation	identify automatic transmissions and their components , and describe their characteristics and applications
		describe operating principles of automatic transmissions and their components
		interpret information pertaining to automatic transmissions found in manufacturers' service information and fault codes
		identify hybrid transmissions, and describe their characteristics and applications
		identify types of coolers, and describe their locations, characteristics and applications
E-23.02.02L	demonstrate knowledge of procedures to diagnose automatic transmissions and their components	identify tools and equipment used to diagnose automatic transmissions and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to automatic transmissions and their components
		describe procedures to inspect automatic transmissions and their components
		describe procedures to test automatic transmissions and their components
		describe procedures to diagnose automatic transmissions and their components
		describe procedures to perform software updates and calibrations
		describe common causes and symptoms of problems
describe effects of component failures		

		identify materials that can be reconditioned, reused or recycled
E-23.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to automatic transmissions	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: torque converters, valve bodies, pumps, solenoids, clutches, clutch packs, bearings, seals, bands, servos, planetaries

manufacturers' service information include: specifications, recommendations, procedures, standards

tools and equipment include: pressure gauges, electronic service tools, manufacturer-specific equipment

hazards include: fluid spills, sharp edges, hot fluids

symptoms of problems include: harsh shifting, noises, delayed shift, no gear selection

E-23.03 Repairs automatic transmissions

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

Skills

	Performance Criteria	Evidence of Attainment
E-23.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-23.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
E-23.03.03P	verify most current version of software is installed in ECM	software installed in ECM is verified to ensure it is most up-to-date version
E-23.03.04P	disconnect and reconnect high-voltage systems in hybrid vehicles	high-voltage systems in hybrid vehicles are disconnected and reconnected according to manufacturers' service information
E-23.03.05P	rebuild transmission	transmission is rebuilt according to manufacturers' service information
E-23.03.06P	repair transmission	transmission is repaired by replacing internal components and external components according to manufacturers' service information

E-23.03.07P	verify repairs	repairs are verified using methods to ensure operation according to manufacturers' service information
E-23.03.08P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: pressure gauges, electronic service tools, manufacturer-specific equipment

manufacturers' service information include: specifications, recommendations, procedures, standards

components include: torque converters, valve bodies, pumps, solenoids, clutches, clutch packs, bearings, seals, bands, servos, planetaries

internal components include: torque converters, pumps, valve bodies

external components include: oil coolers, hydraulic retarder

methods include: road testing, function testing, stall testing

Knowledge		
	Learning Outcomes	Learning Objectives
E-23.03.01L	demonstrate knowledge of automatic transmissions, their components , characteristics, applications and operation	identify automatic transmissions and their components , and describe their characteristics and applications
		describe operating principles of automatic transmissions and their components
		interpret information pertaining to automatic transmissions found in manufacturers' service information and fault codes
		identify automatic hybrid transmissions, and describe their characteristics and applications
		identify types of coolers, and describe their locations, characteristics and applications
E-23.03.02L	demonstrate knowledge of procedures to repair automatic transmissions and their components	identify tools and equipment used to repair automatic transmissions and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to automatic transmissions and their components
		describe procedures to remove, replace, adjust and repair automatic transmissions and their components
		describe procedures to perform software updates and calibrations

		describe procedures to disconnect and reconnect high-voltage systems in hybrid vehicles
		describe effects of component failures
		identify materials that can be reconditioned, reused or recycled
E-23.03.03L	demonstrate knowledge of emerging technologies and practices pertaining to automatic transmissions and their components	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: torque converters, valve bodies, pumps, solenoids, clutches, clutch packs, bearings, seals, bands, servos, planetaries

manufacturers' service information include: specifications, recommendations, procedures, standards

tools and equipment include: pressure gauges, electronic service tools, manufacturer-specific equipment

hazards include: fluid spills, sharp edges, hot fluids, pinch/crush points

Task E-24 Services, diagnoses and repairs automated transmissions

Task Descriptor

The automated transmission is a standard transmission shifted automatically using computer controlled actuators and may have a clutch pedal and electronic gear selector.

Truck and transport mechanics service, diagnose and repair automated transmissions to ensure proper function and reduce down time.

E-24.01 Services automated transmissions

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

Skills

	Performance Criteria	Evidence of Attainment
E-24.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-24.01.02P	perform sensory inspections	sensory inspections of components are performed to identify leaks, breaks and excessive wear

E-24.01.03P	check and perform software updates	software is checked and updates are performed according to manufacturers' service information
E-24.01.04P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule
E-24.01.05P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
E-24.01.06P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: wiring, solenoids, sensors, actuators, force motors, ECMs

consumables include: oil, filters

Knowledge		
	Learning Outcomes	Learning Objectives
E-24.01.01L	demonstrate knowledge of automated transmissions, their components , characteristics, applications and operation	identify automated transmissions and their components , and describe their characteristics and applications
		describe operating principles of automated transmissions and their components
		identify electrical components and circuits, and describe their characteristics and applications
		identify automated hybrid transmissions, and describe their characteristics and applications
E-24.01.02L	demonstrate knowledge of procedures to service automated transmissions and their components	describe effects of component failures
		identify tools and equipment used to service automated transmissions and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to automated transmissions and their components
		describe procedures to inspect automated transmission components
		describe procedures to service automated transmission components

		describe procedures to perform software updates and calibrations
		describe procedures to remove, replace, recycle and dispose of automated transmission consumables
		describe procedures to disconnect and reconnect high-voltage systems in hybrid vehicles
		identify materials that can be reconditioned, reused or recycled
E-24.01.03L	demonstrate knowledge of regulatory requirements pertaining to recycling and disposal of automatic transmission consumables	identify codes, standards and regulations to pertaining to recycling and disposal of automatic transmission consumables
E-24.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to automated transmissions	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: wiring, solenoids, sensors, actuators, force motors, ECMs

hazards include: fluid spills, sharp edges, hot fluids

consumables include: oil, filters

E-24.02 Diagnoses automated transmissions

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

Skills

	Performance Criteria	Evidence of Attainment
E-24.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
E-24.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-24.02.03P	check for external leaks and oil condition	external leaks and oil condition are checked
E-24.02.04P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
E-24.02.05P	perform diagnostic procedures	diagnostic procedures are performed by following manufacturers' service information to determine failure
E-24.02.06P	perform tests	tests are performed using tools and equipment

E-24.02.07P	assess components for wear, damage and defects	components are assessed for wear, damage and defects by performing road test and using tools and equipment
E-24.02.08P	interpret fault codes and test results	fault codes and test results are interpreted to ensure operation is according to manufacturers' service information
E-24.02.09P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
E-24.02.10P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
E-24.02.11P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: noises, hard shifting, poor changing or stuck gears

tools and equipment include: electronic service tools, manufacturer-specific equipment

manufacturers' service information include: specifications, recommendations, procedures, standards

sensory inspections include: road testing; checking for leaks, smells, noises and wiggling components

components include: wiring, solenoids, sensors, actuators, motors, ECMs, oils

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
E-24.02.01L	demonstrate knowledge of automated transmissions, their components , characteristics, applications and operation	identify automated transmissions and their components , and describe their characteristics and applications
		describe operating principles of automated transmissions and their components
		interpret information pertaining to automated transmissions found in manufacturers' service information
		identify electrical components and circuits, and describe their characteristics and applications
		identify automated hybrid transmissions, and describe their characteristics and applications
E-24.02.02L	demonstrate knowledge of procedures to diagnose automated transmissions and their components	identify tools and equipment used to diagnose automated transmissions and their components , and describe their applications and procedures for use

		identify hazards and describe safe work practices pertaining to automated transmissions and their components
		describe procedures to inspect automated transmissions and their components
		describe procedures to test automated transmissions and their components
		describe procedures to diagnose automated transmissions and their components
		describe common causes and symptoms of problems
		describe procedures to perform software updates and calibrations
		identify common faults in automated transmissions and their components
		describe effects of component failures
		identify materials that can be reconditioned, reused or recycled
E-24.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to automated transmissions	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: wiring, solenoids, sensors, actuators, motors, ECMs, oils

manufacturers' service information include: specifications, recommendations, procedures, standards

tools and equipment include: electronic service tools, manufacturer-specific equipment

hazards include: fluid spills, sharp edges, hot fluids

symptoms of problems include: noises, hard shifting, poor changing or stuck gears

faults include: missing teeth in gears, lack of lubrication, worn synchronizers, hard shifting, jumping out of gear, noises, defective automated controls

E-24.03 Repairs automated transmissions

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

Skills

	Performance Criteria	Evidence of Attainment
E-24.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-24.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
E-24.03.03P	verify most current version of software is installed in ECM	software installed in ECM is verified to ensure it is most up-to-date version
E-24.03.04P	disconnect and reconnect high-voltage systems in hybrid vehicles	high-voltage systems in hybrid vehicles are disconnected and reconnected according to manufacturers' service information
E-24.03.05P	rebuild transmission	transmission is rebuilt according to manufacturers' service information
E-24.03.06P	repair transmission	transmission is repaired by replacing internal components and external components according to manufacturers' service information
E-24.03.07P	verify repairs	repairs are verified using methods to ensure operation according to manufacturers' service information
E-24.03.08P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: specifications, recommendations, procedures, standards

components include: wiring, solenoids, sensors, actuators, motors, ECMs, oils, valves, hoses, lines, gaskets, wiring harnesses, gears, bearings

internal components include: gears, bearings, detents, shift rails, synchronizers

external components include: solenoids, wiring harnesses, speed sensors

methods include: road testing, function testing, electrical testing

Knowledge

	Learning Outcomes	Learning Objectives
E-24.03.01L	demonstrate knowledge of automated transmissions, their components , characteristics, applications and operation	identify automated transmissions and their components , and describe their characteristics and applications
		describe operating principles of automated transmissions and their components
		interpret information pertaining to automated transmissions and their components found in manufacturers' service information
		identify electrical components and circuits, and describe their characteristics and applications
E-24.03.02L	demonstrate knowledge of procedures to repair automated transmissions and their components	identify automated hybrid transmissions, and describe their characteristics and applications
		identify tools and equipment used to repair automated transmissions and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to automated transmissions and their components
		describe procedures to remove, replace, adjust and repair automated transmissions and their components
		describe procedures to perform software updates and calibrations
		describe procedures to disconnect and reconnect high-voltage systems in hybrid vehicles
		describe effects of component failures
E-24.03.03L	demonstrate knowledge of emerging technologies and practices pertaining to automated transmissions	identify materials that can be reconditioned, reused or recycled
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: wiring, solenoids, sensors, actuators, motors, ECMs, oils, valves, hoses, lines, gaskets, wiring harnesses, gears, bearings

manufacturers' service information include: specifications, recommendations, procedures, standards

hazards include: fluid spills, sharp edges, hot fluids, pinch/crush points

Task E-25 Services, diagnoses and repairs driveline systems

Task Descriptor

The driveline provides a mechanical linkage between the transmission and the drive axle. A truck and transport mechanic must understand the influence of driveline length, angles and correct phasing on the driveline system.

E-25.01 Services driveline systems

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

Skills

	Performance Criteria	Evidence of Attainment
E-25.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-25.01.02P	perform sensory inspections	sensory inspections are performed to identify worn, damaged, loose or defective components
E-25.01.03P	lubricate serviceable u-joints and slip joints	serviceable u-joints and slip joints are lubricated according to manufacturers' service information
E-25.01.04P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: u-joint tool, hand tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: yokes, u-joints, mounting hardware, steady bearings

Knowledge

	Learning Outcomes	Learning Objectives
E-25.01.01L	demonstrate knowledge of driveline systems, their components , characteristics, applications and operation	identify driveline systems and their components , and describe their characteristics and applications
		describe operating principles of driveline systems and their components

		identify and distinguish between serviceable and non-serviceable driveline systems
E-25.01.02L	demonstrate knowledge of procedures to service driveline systems and their components	identify tools and equipment used to service driveline systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to driveline systems and their components
		describe procedures to inspect driveline system and their components
		describe procedures to service driveline system and their components
		describe procedures to lubricate serviceable u-joints and slip joints

Range of Variables

components include: yokes, u-joints, mounting hardware, steady bearings

tools and equipment include: u-joint tool, hand tools

hazards include: tangling in PTOs, grease injection, sharp edges, airborne contaminants, crushing from heavy components

E-25.02 Diagnoses driveline systems

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

Skills

	Performance Criteria	Evidence of Attainment
E-25.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
E-25.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-25.02.03P	perform sensory inspections	sensory inspections of components are performed to confirm complaint and establish preliminary diagnosis
E-25.02.04P	describe correct orientation and phasing of drive shaft	drive shaft is checked for correct phasing and orientation
E-25.02.05P	perform tests	tests are performed to determine cause of problem or failure
E-25.02.06P	check ride height and driveline angles	ride height and driveline angles are checked to confirm driveline alignment

E-25.02.07P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
E-25.02.08P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: vibration, noises

tools and equipment include: vibration analyzer, angle gauges, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: u-joints, slip joints, steady bearings, motor mounts, suspension

tests include: road testing, angle gauge

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
E-25.02.01L	demonstrate knowledge of driveline systems, their components , characteristics, applications and operation	identify driveline systems and their components , and describe their characteristics and applications
		describe operating principles of driveline systems and their components
		identify and distinguish between serviceable and non-serviceable driveline systems
		describe function of driveline savers
		identify driveline angles and support bearings, and describe their characteristics, applications and wear limits
		describe correct orientation and phasing of drive shaft
E-25.02.02L	demonstrate knowledge of procedures to diagnose driveline systems and their components	identify tools and equipment used to diagnose driveline systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to driveline systems and their components
		describe procedures to inspect driveline systems and their components
		describe procedures to test driveline systems and their components

describe procedures to diagnose driveline systems and their **components**

describe common causes and **symptoms of problems**

Range of Variables

components include: u-joints, slip joints, steady bearings, motor mounts, suspension

tools and equipment include: vibration analyzer, angle gauges, electronic service tools

hazards include: tangling in PTOs, grease injection, sharp edges, airborne contaminants, crushing from heavy components

symptoms of problems include: vibration, noises

E-25.03 Repairs driveline systems

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

Skills

	Performance Criteria	Evidence of Attainment
E-25.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-25.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
E-25.03.03P	perform adjustment procedures	adjustment procedures are performed according to manufacturers' service information to ensure operation of components and equipment
E-25.03.04P	lubricate u-joints and slip joints	u-joints and slip joints are lubricated according to manufacturers' service information
E-25.03.05P	verify repairs	repairs are verified using methods
E-25.03.06P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: u-joint tool, hand tools

manufacturers' service information include: specifications, recommendations, procedures, standards

components include: u-joints, steady bearings, slip joints, motor mounts, suspension

adjustment procedures include: phasing, balancing, adjusting driveline angle

methods include: road testing, angle gauge

Knowledge

	Learning Outcomes	Learning Objectives
E-25.03.01L	demonstrate knowledge of driveline systems, their components , characteristics, applications and operation	identify driveline systems and their components , and describe their characteristics and applications describe operating principles of driveline systems and their components identify and distinguish between serviceable and non-serviceable driveline systems describe function of driveline savers describe correct orientation and phasing of drive shaft
E-25.03.02L	demonstrate knowledge of procedures to repair driveline systems and their components	identify tools and equipment used to repair driveline systems and their components , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to driveline systems and their components describe procedures to remove, replace, adjust and repair driveline systems and their components describe procedures to lubricate serviceable u-joints and slip joints describe procedures to install and phase driveline systems

Range of Variables

components include: u-joints, steady bearings, slip joints, motor mounts, suspension

tools and equipment include: u-joint tool, hand tools

hazards include: tangling in PTOs, grease injection, sharp edges, airborne contaminants, crushing from heavy components

Task E-26 Services, diagnoses and repairs drive axle assemblies

Task Descriptor

The drive axle assembly transfers power from the engine and transmission to the wheels. Truck and transport mechanics must be able to service, diagnose and repair drive axle assemblies.

E-26.01 Services drive axle assemblies

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

Skills

	Performance Criteria	Evidence of Attainment
E-26.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-26.01.02P	clean components	components are cleaned according to manufacturers' service information
E-26.01.03P	check oil level and visually inspect oil and plug condition	oil level is checked, and oil and plug condition is visually inspected during scheduled maintenance for irregularities according to manufacturers' service information
E-26.01.04P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information
E-26.01.05P	perform sensory inspections	sensory inspections of seals and gaskets are performed to identify leaks and need for repair
E-26.01.06P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
E-26.01.07P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be cleaned) include: breathers, vents

irregularities include: material, metal attached to drain plug, water in oil

consumables include: oil, filters

Knowledge

Learning Outcomes	Learning Objectives
E-26.01.01L demonstrate knowledge of drive axle assemblies, their components , consumables , characteristics, applications and operation	identify types of drive axle assemblies , their components and consumables , and describe their characteristics and applications
	describe operating principles of drive axle assemblies and their components
	identify electrical components and circuits, and describe their characteristics and applications
	identify different weight ratings and gear ratios, and describe their characteristics and applications
E-26.01.02L demonstrate knowledge of procedures to service drive axle assemblies and their components and consumables	identify tools and equipment used to service drive axle assemblies and their components and consumables , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to drive axle assemblies and their components and consumables
	describe procedures to disconnect and reconnect high-voltage systems in EV
	describe procedures to inspect drive axle assemblies and their components and consumables
	describe procedures to clean drive axle assemblies and their components
	describe procedures to remove, replace and service drive axle assemblies and their components
	describe procedures to perform software updates for electronic lock-ups and new technology
	describe procedures to remove, replace, recycle and dispose of drive axle assembly consumables
	identify materials that can be reconditioned, reused or recycled

E-26.01.03L	demonstrate knowledge of regulatory requirements pertaining to recycling and disposal of drive axle assembly consumables	identify and interpret standards and regulations pertaining to recycling and disposal of drive axle assembly consumables
E-26.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to drive axle assemblies	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: seals, axle shaft, gaskets, hubs, gears, bearings, differentials

consumables include: oil, filters

types of drive axle assemblies include: locking, two-speed, limited slip, planetary drive, electric drive motors

hazards include: sharp edges, fluid spills

E-26.02 Diagnoses drive axle assemblies

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

Skills

	Performance Criteria	Evidence of Attainment
E-26.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
E-26.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-26.02.03P	confirm complaint	complaint is confirmed by performing road test
E-26.02.04P	check oil level and visually inspect oil, plug, filter and vent condition	oil level is checked, and oil, plug, filter and vent condition are visually inspected for irregularities according to manufacturers' service information
E-26.02.05P	inspect components	components are inspected for incorrect backlash, wear or incorrect preload according to manufacturers' service information
E-26.02.06P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
E-26.02.07P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: noises, inter-axle differential lock not working, no drive

manufacturers' service information include: specifications, recommendations, procedures, standards

irregularities include: material, metal attached to drain plug, water in oil

components include: fork, bearings, crown and pinion gears, spider gears, differentials

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
E-26.02.01L	demonstrate knowledge of drive axle assemblies, their components , characteristics, applications and operation	identify types of drive axle assemblies , their components , and describe their characteristics and applications
		describe operating principles of drive axle assemblies and their components
		interpret information pertaining to drive axle assemblies found in manufacturers' service information
		identify different weight ratings and gear ratios, and describe their characteristics and applications
E-26.02.02L	demonstrate knowledge of procedures to diagnose drive axle assemblies and their components	identify tools and equipment used to diagnose drive axle assemblies and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to drive axle assemblies and their components
		describe procedures to inspect drive axle assemblies and their components
		describe procedures to test drive axle assemblies and their components
		describe procedures to diagnose drive axle assemblies and their components
		describe common causes and symptoms of problems
		identify materials that can be reconditioned, reused or recycled

Range of Variables

components include: fork, bearings, crown and pinion gears, spider gears, differentials

types of drive axle assemblies include: locking, two-speed, limited slip, planetary drive, electric drive motors

manufacturers' service information include: specifications, recommendations, procedures, standards

hazards include: sharp edges, fluid spills, pinch/crush points

symptoms of problems include: noises, inter-axle differential lock not working, no drive

E-26.03 Repairs drive axle assemblies

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

Skills

	Performance Criteria	Evidence of Attainment
E-26.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-26.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
E-26.03.03P	clean components	components are cleaned to remove debris and contaminants
E-26.03.04P	perform failure analysis	failure analysis is performed to determine root cause of failure
E-26.03.05P	repair components	components are repaired according to manufacturers' service information
E-26.03.06P	perform overhaul procedures	overhaul procedures are performed according to manufacturers' service information
E-26.03.07P	verify repairs	repairs are verified using methods
E-26.03.08P	refill housing	housing is refilled using lubricant according to manufacturers' service information
E-26.03.09P	confirm repairs	repairs are confirmed by performing road test
E-26.03.10P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: manufacturer-specific tools, measuring tools, hand tools

manufacturers' service information include: specifications, recommendations, procedures, standards

components (to be removed and replaced) include: seals, gaskets, bearings, planetary gear sets, crown and pinion, differentials

components (to be cleaned) include: vents, housings, gasket surfaces, gears, hubs

components (to be repaired) include: housings, spindle threads

overhaul procedures include: setting and adjusting preload and backlash, checking and adjusting crown and pinion gear tooth pattern

methods include: marking paste, dial indicators, weight scales

Knowledge

	Learning Outcomes	Learning Objectives
E-26.03.01L	demonstrate knowledge of drive axle assemblies, their components , characteristics, applications and operation	identify types of drive axle assemblies , their components , and describe their characteristics and applications describe operating principles of drive axle assemblies and their components interpret information pertaining to drive axle assemblies found in manufacturers' service information identify different weight ratings and gear ratios, and describe their characteristics and applications identify types of lubricants and additives, and describe their characteristics and applications identify differential or inter-axle differential lock activating methods , and describe their characteristics and applications
E-26.03.02L	demonstrate knowledge of procedures to repair drive axle assemblies and their components	identify tools and equipment used to repair drive axle assemblies and their components , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to drive axle assemblies and their components describe procedures to disconnect and reconnect high-voltage systems in EV describe procedures to remove, replace, clean, adjust and repair drive axle assemblies and their components describe procedures to secure hubs to spindles using pre-set and conventional bearing types identify steps for failure analysis identify and describe common faults in drive axle assemblies identify materials that can be reconditioned, reused or recycled
E-26.03.03L	demonstrate knowledge of emerging technologies and practices pertaining to drive axle assemblies	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: seals, gaskets, bearings, planetary gear sets, crown and pinion

types of drive axle assemblies include: locking, two-speed, limited slip, planetary drive, electric drive motors

manufacturers' service information include: specifications, recommendations, procedures, standards

types of lubricants include: conventional, semi-synthetic, synthetic

activating methods include: air, electric

tools and equipment include: manufacturer-specific tools, measuring tools, hand tools

hazards include: sharp edges, fluid spills, pinch/crush points, heavy components

common faults include: missing teeth in crown and pinion gears, broken or bent shift fork in inter-axle differential lock, lack of lubrication, broken or bent axles

Task E-27 Services, diagnoses and repairs drive train retarders

Task Descriptor

Drive train retarders are an optional component used to assist and extend the life of the primary braking system. They can be separate or combined with another component of the drive train system.

Truck and transport mechanics service, diagnose and repair drive train retarders to ensure proper function and reduce down time.

E-27.01 Services drive train retarders

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

Skills

	Performance Criteria	Evidence of Attainment
E-27.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-27.01.02P	check fluid, component mountings and wiring	fluid is checked for leaks, component mountings are checked to be secure, and wiring is checked for damage and corrosion
E-27.01.03P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule

E-27.01.04P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
E-27.01.05P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

consumables include: oil, filters

Knowledge		
	Learning Outcomes	Learning Objectives
E-27.01.01L	demonstrate knowledge of drive train retarders, their components , consumables , characteristics, applications and operation	identify types of drive train retarders and their components and consumables , and describe their characteristics and applications
		describe operating principles of drive train retarders and their components
		interpret information pertaining to drive train retarders found in manufacturers' service information
E-27.01.02L	demonstrate knowledge of procedures to service drive train retarders and their components and consumables	identify tools and equipment used to service drive train retarders and their components and consumables , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to drive train retarders and their components
		describe procedures to inspect drive train retarder components and consumables
		describe procedures to service drive train retarders and their components
		describe procedures to remove, replace, recycle and dispose of drive train retarder consumables

Range of Variables

components include: rotors, electromagnets, valves, sensors, pressure switches, potentiometers, lines, wiring, connectors, ECMs

consumables include: oil, filters

types of drive train retarders include: electric, hydraulic

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: moving parts, heat, pressurized fluids, electric and electromagnetic hazards

E-27.02 Diagnoses drive train retarders

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

Skills

	Performance Criteria	Evidence of Attainment
E-27.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
E-27.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-27.02.03P	perform sensory inspections	sensory inspections are performed to identify external leaks and loose, broken, damaged and corroded wiring
E-27.02.04P	perform diagnostic procedures and tests	diagnostic procedures and tests are performed by following manufacturers' service information to determine failure
E-27.02.05P	assess components for wear, damage and defects	components are assessed for wear, damage and defects
E-27.02.06P	interpret fault codes and test results	fault codes and test results are interpreted to check operation against manufacturers' service information
E-27.02.07P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty
E-27.02.08P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: weak performance, intermittent operation, leaks, noises

tools and equipment include: pressure gauges, electronic service tools, multimeters, manufacturer-specific equipment

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: rotors, electromagnets, valves, sensors, pressure switches, potentiometers, lines, wiring, connectors, ECMs

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
E-27.02.01L	demonstrate knowledge of drive train retarders, their components , characteristics, applications and operation	identify types of drive train retarders and their components , and describe their characteristics and applications
		describe operating principles of drive train retarders and their components
		interpret information pertaining to drive train retarders found in manufacturers' service information
E-27.02.02L	demonstrate knowledge of procedures to diagnose drive train retarders and their components	identify tools and equipment used to diagnose drive train retarders and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to drive train retarders and their components
		describe procedures to inspect drive train retarders and their components
		describe procedures to test and diagnose drive train retarders and their components
		describe common causes and symptoms of problems

Range of Variables

components include: rotors, electromagnets, valves, sensors, pressure switches, potentiometers, lines, wiring, connectors, ECMs

types of drive train retarders include: electric, hydraulic

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: pressure gauges, electronic service tools, multimeters, manufacturer-specific equipment

hazards include: moving parts, heat, pressurized fluids

symptoms of problems include: weak performance, intermittent operation, leaks, noises

E-27.03 Repairs drive train retarders

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

Skills

	Performance Criteria	Evidence of Attainment
E-27.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
E-27.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
E-27.03.03P	update software	software is updated according to manufacturers' service information
E-27.03.04P	rebuild drive train retarder components	drive train retarder components are rebuilt to manufacturers' service information
E-27.03.05P	repair drive train retarder components	drive train retarder components are repaired according to manufacturers' service information
E-27.03.06P	verify repairs	repairs are verified they meet manufacturers' service information by performing road test
E-27.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: electronic service tools, multimeters, manufacturer-specific equipment

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: rotors, electromagnets, valves, sensors, pressure switches, potentiometers, lines, wiring, connectors, ECMs

Knowledge

	Learning Outcomes	Learning Objectives
E-27.03.01L	demonstrate knowledge of drive train retarders, their components , characteristics, applications and operation	identify types of drive train retarders and their components , and describe their characteristics and applications
		describe operating principles of drive train retarders and their components
		interpret information pertaining to drive train retarders found in manufacturers' service information

E-27.03.02L	demonstrate knowledge of procedures to repair drive train retarders and their components	identify tools and equipment used to repair drive train retarders and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to drive train retarders and their components
		describe procedures to remove, replace, and repair drive train retarders and their components
		describe procedures to perform software updates

Range of Variables

components include: rotors, electromagnets, valves, sensors, pressure switches, potentiometers, lines, wiring, connectors, ECMs

types of drive train retarders include: electric, hydraulic

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: electronic service tools, multimeters, manufacturer-specific equipment

hazards include: moving parts, heat, pressurized fluids, sharp edges, pinch/crush points, electric and electromagnetic hazards

Major Work Activity F

Services, diagnoses and repairs steering, chassis/frames, suspensions, tires, wheels and hubs

Task F-28 Services, diagnoses and repairs steering systems

Task Descriptor

Steering systems are designed to allow the driver to control the direction of the vehicle by turning the front wheels.

Truck and transport mechanics diagnose, service and repair steering systems and components in order to ensure the safe and correct operation of the vehicle.

F-28.01 Services steering systems

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

Skills

	Performance Criteria	Evidence of Attainment
F-28.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-28.01.02P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
F-28.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
F-28.01.04P	measure components	components are measured for end play to determine if they meet manufacturers' service information and jurisdictional requirements
F-28.01.04P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information and fleet/owner maintenance schedule to minimize breakdowns

F-28.01.05P	recycle or dispose of consumables	consumables are recycled or disposed of according to jurisdictional regulations
F-28.01.06P	lubricate components	components are lubricated according to manufacturers' service information
F-28.01.07P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: king pins, drag links, steering boxes, pitman arms, hydraulic cylinders, tie rods, power steering components, steering columns

components (to be measured) include: king pins, drag links, tie rods

consumables include: oil, filters

components (to be lubricated) include: tie rods, king pins, u-joints

Knowledge		
	Learning Outcomes	Learning Objectives
F-28.01.01L	demonstrate knowledge of steering systems, their components , consumables , characteristics, applications and operation	identify types of steering systems and their components and consumables , and describe their characteristics and applications describe operating principles of steering systems and their components interpret information pertaining to steering systems found in manufacturers' service information describe primary and secondary steering systems describe steering geometry and alignment
F-28.01.02L	demonstrate knowledge of procedures to service steering systems and their components and consumables	identify tools and equipment used to service steering systems, their components and consumables , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to steering systems and their components describe procedures to release or isolate stored energy describe procedures to inspect steering systems and their components and consumables

		describe procedures to measure steering system components
		describe procedures to lubricate steering system components
		describe procedures to remove, replace, recycle and dispose of steering system consumables
F-28.01.03L	demonstrate knowledge of inspection tolerances to jurisdictional requirements	identify inspection tolerances to jurisdictional requirements
F-28.01.04L	demonstrate knowledge of regulatory requirements pertaining to recycling and disposing of steering system consumables	identify and interpret standards and regulations pertaining to recycling and disposing of steering system consumables
F-28.01.05L	demonstrate knowledge of emerging technologies and practices pertaining to autonomous steering systems	identify technologies that address risk and reduce accidents, and describe their characteristics and applications

Range of Variables

components include: king pins, drag links, steering boxes, pitman arms, hydraulic cylinders, tie rods, power steering components, steering columns

consumables include: oil, filters

types of steering systems include: integral, linkage, rack and pinion

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

steering geometry and alignment includes: caster, camber, toe

hazards include: fluid under pressure, pinch/crush points

F-28.02 Diagnoses steering systems

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

Skills

	Performance Criteria	Evidence of Attainment
F-28.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
F-28.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-28.02.03P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
F-28.02.04P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis

F-28.02.05P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
F-28.02.06P	perform tests	tests are performed on components to assess for wear, damage and defects using tools and equipment
F-28.02.07P	compare test results to manufacturers' service information or expected pressure values	test results are compared to manufacturers' service information or expected pressure values to verify diagnosis
F-28.02.08P	perform failure analysis	failure analysis is performed to determine root cause of failure
F-28.02.09P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
F-28.02.10P	interpret tire wear patterns	tire wear patterns are interpreted
F-28.02.11P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: darting, drifting, hard steering, soft steering, oil leaks

tools and equipment include: pressure gauges, hydraulic pressure analyzers, dial indicators, pry bars, alignment tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: looking for leaks, feeling for vibrations during road testing, visually inspecting steering components

tests include: performance, pressure, flow

components include: king pins, drag links, steering boxes, pitman arms, hydraulic cylinders, tie rods, power steering components

next steps include: repairs, component replacement or adjustment

Knowledge

	Learning Outcomes	Learning Objectives
F-28.02.01L	demonstrate knowledge of steering systems, their components , characteristics, applications and operation	identify types of steering systems and their components , and describe their characteristics and applications
		describe operating principles of steering systems and their components
		interpret information pertaining to steering systems found in manufacturers' service information
		describe primary and secondary steering systems
		describe steering geometry and alignment

F-28.02.02L	demonstrate knowledge of procedures to diagnose steering systems and their components	identify tools and equipment used to diagnose steering systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to steering systems and their components
		describe procedures to release or isolate stored energy
		describe procedures to inspect steering systems and their components
		describe procedures to test steering systems and their components
		describe procedures to diagnose steering systems and their components
		describe common causes and symptoms of problems
		identify common faults found while diagnosing steering systems
F-28.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to autonomous steering systems	identify technologies that address risk and reduce accidents, and describe their characteristics and applications

Range of Variables

components include: king pins, drag links, steering boxes, pitman arms, hydraulic cylinders, tie rods, power steering components

types of steering systems include: integral, linkage, rack and pinion

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

steering geometry and alignment include: caster, camber, toe

tools and equipment include: pressure gauges, hydraulic pressure analyzers, dial indicators, pry bars, alignment tools

hazards include: fluid under pressure, pinch/crush points

symptoms of problems include: darting, drifting, hard steering, soft steering, oil leaks

faults include: tire wear, bent tie rods, worn drag link

F-28.03 Repairs steering systems

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

Skills

	Performance Criteria	Evidence of Attainment
F-28.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-28.03.02P	release or isolate stored energy	stored energy is released or isolated according to manufacturers' service information
F-28.03.03P	repair or replace components	components are repaired or replaced according to manufacturers' service information
F-28.03.04P	rebuild components	components are rebuilt according to manufacturers' service information
F-28.03.05P	adjust components	components are adjusted to ensure operation of components and equipment
F-28.03.06P	verify repairs	repairs are verified using methods
F-28.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be repaired or replaced) include: steering boxes, pumps, hoses, lines, seals, u-joints, reservoirs

components (to be rebuilt) include: power steering box, hydraulic cylinders

components (to be adjusted) include: poppet valves, pitman arms, worm gear, tie rod, casters

methods include: road testing, front end alignments, load testing, sensory observations

Knowledge

	Learning Outcomes	Learning Objectives
F-28.03.01L	demonstrate knowledge of steering systems, their components , characteristics, applications and operation	identify types of steering systems and their components , and describe their characteristics and applications
		describe operating principles of steering systems and their components
		interpret information pertaining to steering systems found in manufacturers' service information

		describe primary and secondary steering systems
		describe steering geometry and alignment
F-28.03.02L	demonstrate knowledge of procedures to repair steering systems and their components	identify tools and equipment used to repair steering systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to steering systems and their components
		describe procedures to release or isolate stored energy
		describe procedures to remove, replace, rebuild, adjust and repair steering system components
F-28.03.03L	demonstrate knowledge to verify repairs	identify industry standards pertaining to verification of repairs
F-28.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to autonomous steering systems	identify technologies that address risk and reduce accidents, and describe their characteristics and applications

Range of Variables

components include: king pins, drag links, steering boxes, pitman arms, hydraulic cylinders, pumps, hoses, lines, seals, u-joints, reservoirs, poppet valves, worm gear, tie rod, casters

types of steering systems include: integral, linkage, rack and pinion

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

steering geometry and alignment includes: caster, camber, toe

hazards include: fluid under pressure, pinch/crush points

Task F-29 Services, diagnoses and repairs chassis/frames

Task Descriptor

The purpose of the chassis/frame is to fasten all the vehicle components.

Truck and transport mechanics service, diagnose and repair chassis/frames to ensure vehicle integrity.

F-29.01 Services chassis/frames

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

Skills

	Performance Criteria	Evidence of Attainment
F-29.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-29.01.02P	clean components	components are cleaned
F-29.01.03P	perform sensory inspections	sensory inspections of components are performed to identify loose mounting hardware, cracks, distortions and corrosion
F-29.01.04P	measure frame rails	frame rails are measured to confirm alignment
F-29.01.05P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: frame rails, cross-members, gussets

Knowledge

	Learning Outcomes	Learning Objectives
F-29.01.01L	demonstrate knowledge of chassis/frames, their components , characteristics, applications and operation	identify chassis/frames and their components , and describe their characteristics and applications
		describe operating principles of chassis/frames and their components
		interpret information pertaining to chassis/frames found in manufacturers' service information

		identify chassis/frame fasteners
F-29.01.02L	demonstrate knowledge of procedures to service chassis/frames and their components	identify tools and equipment used to service chassis/frames and their components , and describe their applications and procedures for use
		describe procedures to clean scale and rust from chassis/frame components
		describe procedures to reduce corrosion and maintain structural integrity
		explain structural integrity and describe safe work practices and repairs

Range of Variables

components include: frame rails, cross-members, gussets

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

F-29.02 Diagnoses chassis/ frames

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

Skills

	Performance Criteria	Evidence of Attainment
F-29.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
F-29.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-29.02.03P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
F-29.02.04P	determine diagnosis	diagnosis is determined based on evidence
F-29.02.05P	perform failure analysis	failure analysis is performed to determine root cause of failure
F-29.02.06P	interpret diagnostic results	diagnostic results are interpreted to determine next steps
F-29.02.07P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

symptoms of problems include: tire wear, loose components

tools and equipment include: laser alignment tools, calipers, straight edges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: looking for cracked or damaged frames, corrosion and missing or loose hardware

next steps include: repairs, component replacement or adjustment

Knowledge		
	Learning Outcomes	Learning Objectives
F-29.02.01L	demonstrate knowledge of chassis/frames, their components , characteristics, applications and operation	identify chassis/frames and their components , and describe their characteristics and applications
		describe operating principles of chassis/frames and their components
		interpret information pertaining to chassis/frames found in manufacturers' service information
		describe chassis/frame fastening systems
F-29.02.02L	demonstrate knowledge of procedures to diagnose chassis/frames and their components	identify tools and equipment used to diagnose chassis/frames and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to chassis/frames and their components
		describe procedures to inspect chassis/frames and their components
		describe procedures to test chassis/frames and their components
		describe procedures to diagnose chassis/frames and their components
		describe common causes and symptoms of problems
		describe common faults found while diagnosing chassis/frames
F-29.02.03L	demonstrate knowledge of when to recommend specialty shops	identify specialty shops responsible for advanced alignment work

Range of Variables

components include: frame rails, cross-members, gussets

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: laser alignment tools, calipers, straight edges

hazards include: pinch/crush points

symptoms of problems include: tire wear, loose components

faults include: bending, cracking, corrosion, loose and missing fasteners

F-29.03 Repairs chassis/frames

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

Skills

	Performance Criteria	Evidence of Attainment
F-29.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-29.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
F-29.03.03P	repair and replace components	components are repaired and replaced by welding and plating according to manufacturers' service information
F-29.03.04P	verify repairs	repairs are verified using tools and equipment
F-29.03.05P	modify chassis/frame	chassis/frame is modified using methods
F-29.03.06P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: laser alignments, calipers, straight edges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: cross-members, gussets, frame rails

methods include: adding inserts, drilling frames, adjusting length

Knowledge

Learning Outcomes	Learning Objectives
F-29.03.01L demonstrate knowledge of chassis/frames, their components , characteristics, applications and operation	identify chassis/frames and their components , and describe their characteristics and applications
	describe operating principles of chassis/frames and their components
	interpret information pertaining to chassis/frames found in manufacturers' service information
F-29.03.02L demonstrate knowledge of procedures to repair chassis/frames and their components	describe chassis/frame fastening systems
	identify tools and equipment used to repair chassis/frames and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to chassis/frames and their components
F-29.03.03L demonstrate knowledge of welding training and certification requirements to modify or repair chassis/frame	describe procedures to remove, replace, modify and repair chassis/frames and their components
	identify training and certification requirements to weld modifications or repairs to chassis/frame

Range of Variables

components include: cross-members, gussets, frame rails

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: laser alignments, calipers, straight edges

hazards include: pinch/crush points

Task F-30 Services, diagnoses and repairs suspensions

Task Descriptor

Suspensions distribute load throughout the frame and withstand road hazards by absorbing energy. Truck and transport mechanics service, diagnose and repair suspensions to ensure smooth driving conditions.

F-30.01 Services suspensions

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

Skills

	Performance Criteria	Evidence of Attainment
F-30.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-30.01.02P	clean components	components are cleaned according to manufacturers' service information
F-30.01.03P	perform sensory inspections	sensory inspections of suspension are performed to identify worn, damaged and defective components
F-30.01.04P	measure components	components are measured for ride height and bushings for excessive play to determine if they meet manufacturers' service information
F-30.01.05P	release stored energy	stored energy is released by draining air tank and spring tension
F-30.01.06P	adjust ride height valve	ride height valve is adjusted according to manufacturers' service information
F-30.01.07P	lubricate components	components are lubricated according to manufacturers' service information
F-30.01.08P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: bolster springs, I-beams, torque rods, ride height valves, air bags, spring hangers, shackles, saddles, shock absorbers, torsion bars, walking beams, U-bolts, leaf springs

Knowledge

	Learning Outcomes	Learning Objectives
F-30.01.01L	demonstrate knowledge of suspensions, their components , characteristics, applications and operation	identify types of suspensions and their components , and describe their characteristics and applications
		describe operating principles of suspensions and their components
F-30.01.02L	demonstrate knowledge of procedures to service suspensions and their components	identify tools and equipment used to service suspensions and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to suspensions and their components
		describe procedures to release stored energy
		describe procedures to inspect suspensions and their components
		describe procedures to clean, measure, adjust and lubricate suspension components

Range of Variables

components include: bolster springs, I-beams, torque rods, ride height valves, air bags, spring hangers, shackles, saddles, shock absorbers, torsion bars, walking beams, U-bolts, leaf springs

types of suspensions include: air ride (conventional, electronically controlled), spring, solid block, combination

hazards include: pinch/crush points, compressed air

F-30.02 Diagnoses suspensions

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

Skills

	Performance Criteria	Evidence of Attainment
F-30.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
F-30.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-30.02.03P	perform sensory inspections	sensory inspections of suspension are performed to confirm complaint and establish preliminary diagnosis

F-30.02.04P	interpret diagnostic results	diagnostic results are interpreted to determine next steps
F-30.02.05P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
F-30.02.06P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

symptoms of problems include: wandering, drifting, sagging, difficult steering, lack of stability

tools and equipment include: tape measures, soapy water, dial indicators

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
F-30.02.01L	demonstrate knowledge of suspensions, their components , characteristics, applications and operation	identify types of suspensions and their components , and describe their characteristics and applications
		describe operating principles of suspensions and their components
		interpret information pertaining to suspensions found in manufacturers' service information
		describe wear limits and load capacity
F-30.02.02L	demonstrate knowledge of procedures to diagnose suspensions and their components	describe axle applications
		identify tools and equipment used to diagnose suspensions and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to suspensions and their components
		describe procedures to inspect suspensions and their components
		describe procedures to test suspensions and their components
		describe procedures to diagnose suspensions and their components
		describe common causes and symptoms of problems

		identify common faults found while diagnosing suspensions
F-30.02.03L	demonstrate knowledge of inspection tolerances for rear suspension to industry requirements	identify rear suspension inspection tolerances to industry requirements

Range of Variables

components include: bolster springs, I-beams, torque rods, ride height valves, air bags, spring hangers, shackles, saddles, shock absorbers, torsion bars, walking beams, U-bolts

types of suspensions include: air ride (conventional, electronically controlled), spring, solid block, combination

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

axle applications include: steering, drive, auxiliary

tools and equipment include: tape measures, soapy water, dial indicators

hazards include: pinch/crush points, compressed air

symptoms of problems include: wandering, drifting, sagging, difficult steering, lack of stability

faults include: broken springs, air springs, U-bolts, leaking shocks, worn bushings

F-30.03 Repairs suspensions

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

Skills

	Performance Criteria	Evidence of Attainment
F-30.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-30.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
F-30.03.03P	repair components	components are repaired according to manufacturers' service information
F-30.03.04P	perform adjustment procedures	adjustment procedures are performed to ensure operation of component and equipment
F-30.03.05P	verify repairs	repairs are verified using methods
F-30.03.06P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be replaced) include: springs, spring guides, bushings, torque rods

components (to be repaired) include: air lines, air springs, leaf spring assemblies, shackles, axle stop, hangers

adjustment procedures include: setting ride height valves, aligning axles

methods include: road testing, load testing, sensory observations

Knowledge		
	Learning Outcomes	Learning Objectives
F-30.03.01L	demonstrate knowledge of suspensions, their components , characteristics, applications and operation	identify types of suspensions and their components , and describe their characteristics and applications
		describe operating principles of suspensions and their components
		interpret information pertaining to suspensions found in manufacturers' service information
F-30.03.02L	demonstrate knowledge of procedures to repair suspensions and their components	identify tools and equipment used to repair suspensions and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to suspensions and their components
		describe procedures to remove, replace, adjust and repair suspension components

Range of Variables

components include: bolster springs, I-beams, torque rods, ride height valves, air bags, spring hangers, shackles, saddles, shock absorbers, torsion bars, walking beams, U-bolts

types of suspensions include: air ride (conventional, electronically controlled), spring, solid block, combination

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: pinch/crush points, compressed air, compressed springs, heavy springs

Task F-31 Services, diagnoses and repairs hitches and couplers

Task Descriptor

Truck and transport mechanics service, diagnose and repair hitches and couplers to ensure that trailers stay coupled to the lead vehicle in a safe manner.

F-31.01 Services hitches and couplers

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

Skills

	Performance Criteria	Evidence of Attainment
F-31.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-31.01.02P	clean 5 th wheel, slide rails, pintle components and mounting components	5 th wheel, slide rails, pintle components and mounting components are cleaned before additional work is completed
F-31.01.03P	perform sensory inspections	sensory inspections of 5 th wheel and pintles are performed to identify worn, damaged or defective components
F-31.01.04P	measure components	components are measured for play to determine if they meet manufacturers' service information
F-31.01.05P	adjust 5 th wheel jaws and side rail locks	5 th wheel jaws and side rail locks are adjusted according to manufacturers' service information
F-31.01.06P	lubricate components	components are lubricated according to manufacturers' service information
F-31.01.07P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: bushings, jaws, slide rail locks, clevis pin

components (to be measured) include: 5th wheel plate, side rail locks, bushings, pins, jaws, pintle eye and hook

Knowledge

Learning Outcomes	Learning Objectives
F-31.01.01L	demonstrate knowledge of hitches and couplers, their components , characteristics, applications and operation
	identify types of hitches and couplers and their components , and describe their characteristics and applications
	describe operating principles of hitches and couplers, and their components
	describe wear limits and load capacities of hitch and coupler components
F-31.01.02L	demonstrate knowledge of procedures to service hitches and couplers, and their components
	identify tools and equipment used to service hitches and couplers, and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to hitches and couplers, and their components
	describe procedures to inspect hitches and couplers, and their components
	describe procedures to clean, measure, lubricate and adjust hitch and coupler components
F-31.01.03L	demonstrate knowledge of inspection requirements pertaining to measurements and wear
	identify inspection requirements pertaining to measurements and wear

Range of Variables

components include: bushings, jaws, slide rail locks, clevis pin

types of hitches and couplers include: pintle hitch, 5th wheel hitch, ball hitch

hazards include: sharp edges, pinch/crush points

F-31.02 Diagnoses hitches and couplers

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

Skills

	Performance Criteria	Evidence of Attainment
F-31.02.01P	identify <i>symptoms of problems</i>	<i>symptoms of problems</i> are identified by consulting with customer or operator
F-31.02.02P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to task and <i>manufacturers' service information</i>
F-31.02.03P	perform sensory inspections	sensory inspections of hitches and couplers are performed to confirm complaint and establish preliminary diagnosis
F-31.02.04P	perform <i>tests</i>	<i>tests</i> are performed to assess components for wear, damage and defects
F-31.02.05P	test hitch and coupler operation	hitch and coupler operation are tested
F-31.02.06P	compare <i>test</i> results to <i>manufacturers' service information</i> or expected values	<i>test</i> results are compared to <i>manufacturers' service information</i> or expected values to verify diagnosis
F-31.02.07P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

symptoms of problems include: excess slack, noises, difficulty opening or closing, difficulty steering

tools and equipment include: king pin tool, wear plate (for tolerances)

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tests include: testing for play, wear, function

Knowledge

	Learning Outcomes	Learning Objectives
F-31.02.01L	demonstrate knowledge of hitches and couplers, their <i>components</i> , characteristics, applications and operation	identify <i>types of hitches and couplers</i> and their <i>components</i> , and describe their characteristics and applications
		describe operating principles of hitches and couplers, and their <i>components</i>
		interpret tolerance information pertaining to hitches and couplers

		describe wear limits and load capacities of hitch and coupler components
F-31.02.02L	demonstrate knowledge of procedures to diagnose hitches and couplers, and their components	identify tools and equipment used to diagnose hitches and couplers, and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hitches and couplers and their components
		describe procedures to inspect hitches and couplers, and their components
		describe procedures to test hitches and couplers, and their components
		describe procedures to diagnose hitches and couplers, and their components
		describe common causes and symptoms of problems

Range of Variables

components include: bushings, jaws, slide rail locks, clevis pin

types of hitches and couplers include: pintle hitch, 5th wheel hitch, ball hitch

tools and equipment include: king pin tool, wear plate (for tolerances)

hazards include: sharp edges, pinch/crush points

symptoms of problems include: excess slack, noises, difficulty opening or closing, difficulty steering

F-31.03 Repairs hitches and couplers

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

Skills

	Performance Criteria	Evidence of Attainment
F-31.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-31.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
F-31.03.03P	repair and rebuild 5th wheel components	5th wheel components are repaired and rebuilt by using rebuild kits according to manufacturers' service information
F-31.03.04P	adjust 5 th wheel	5 th wheel is adjusted according to manufacturers' service information to ensure operation of components and equipment

F-31.03.05P	verify repairs	repairs are verified using methods
F-31.03.06P	lubricate components	components are lubricated according to manufacturers' service information
F-31.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: jaws, 5th wheels, springs, pins, pintle eye and hook

5th wheel components include: jaws, pins, springs, bushings, mounting components

methods include: coupling, uncoupling

Knowledge		
	Learning Outcomes	Learning Objectives
F-31.03.01L	demonstrate knowledge of hitches and couplers, their components , characteristics, applications and operation	identify types of hitches and couplers and their components , and describe their characteristics and applications
		describe operating principles of hitches and couplers, and their components
		describe wear limits and load capacities of hitch and coupler components
F-31.03.02L	demonstrate knowledge of procedures to repair hitches and couplers, and their components	identify tools and equipment used to repair hitches and couplers, and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hitches and couplers, and their components
		describe procedures to remove, replace, adjust, lubricate and repair hitches and couplers, and their components

Range of Variables

components include: jaws, 5th wheels, springs, pins, pintle eye and hook

types of hitches and couplers include: pintle hitch, 5th wheel hitch, ball hitch

hazards include: sharp edges, pinch/crush points

Task F-32 Services, diagnoses and repairs tires, wheels and hubs

Task Descriptor

Truck and transport mechanics service, diagnose and repair tires, wheels and hubs to ensure that the truck performs properly on the road.

F-32.01 Services tires, wheels and hubs

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

Skills

	Performance Criteria	Evidence of Attainment
F-32.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-32.01.02P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
F-32.01.03P	perform measurements on tire components	measurements on tire components are performed to determine if they meet manufacturers' service information
F-32.01.04P	perform measurements on hub components	measurements on hub components are performed to determine if they meet manufacturers' service information and jurisdictional requirements
F-32.01.05P	torque wheel nuts	wheel nuts are torqued according to manufacturers' service information
F-32.01.06P	release stored energy	stored energy is released by draining air from tires
F-32.01.07P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information
F-32.01.08P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
F-32.01.09P	adjust tire pressure	tire pressure is adjusted according to manufacturers' service information
F-32.01.10P	identify mismatched tires	mismatched tires are identified by casing and tread depth
F-32.01.11P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: dial indicators, torque wrenches, air gauges, tire pressure/heat warning devices, tread depth gauges, tire pressure gauge, inflation tool, sockets, tire irons

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

worn, damaged and defective components include: oil leaks from hubs, air leaks from tires, tire wear, damaged retreading, cracked rims, broken studs, worn locks, worn spacers

measurements on tire components include: tread depth for wear, air pressure for air leaks

measurements on hub components include: bearing end play, alignment of pilot to rim

Knowledge		
	Learning Outcomes	Learning Objectives
F-32.01.01L	demonstrate knowledge of tires, their components , characteristics, applications and operation	identify types of tires and their components , and describe their characteristics and applications
		describe operating principles of tires and their components
		describe tire load ranges, pressures, profiles and sizes
		describe steering and drive tires
F-32.01.02L	demonstrate knowledge of wheels, their components , characteristics, applications and operation	identify types of wheels and their components , and describe their characteristics and applications
		describe operating principles of wheels and their components
F-32.01.03L	demonstrate knowledge of hubs, their components , consumables, characteristics, applications and operation	identify types of hubs and their components and consumables, and describe their characteristics and applications
		describe operating principles of hubs and their components
F-32.01.04L	demonstrate knowledge of procedures to service tires, wheels and hubs, and their components	identify tools and equipment used to service tires, wheels and hubs, and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to inflation and removal of tires
		describe procedures to release stored energy
		describe procedures to inspect tires, wheels and hubs, and their components
		describe procedures to measure tire and hub components
		describe procedures to service tire, wheel and hub components

		describe procedures to remove, replace, recycle and dispose of hub consumables
		describe torque values according to manufacturers' service information
		identify tires and materials that can be reconditioned, reused or recycled
F-32.01.05L	demonstrate knowledge of training requirements to remove, inspect and mount tires, wheels and hubs	identify training requirements to remove, inspect and mount tires, wheels and hubs
F-32.01.06L	demonstrate knowledge of regulatory requirements pertaining to inspection and mounting of tires, wheels and hubs	identify and interpret standards and regulations pertaining to inspection and mounting of tires, wheels and hubs
F-32.01.07L	demonstrate knowledge of air pressure monitoring and air regulating systems	describe operation of air pressure monitoring and air regulating systems

Range of Variables

components (tires) include: belts, tread, tubes, sidewall

types of tires include: radial, bias

components (wheels) include: rims, spacers, wedges, valve stems

types of wheels include: aluminum, steel, multi-piece rims

components (hubs) include: studs, nuts, spacers

types of hubs include: spoked, hub pilot, stud pilot

tools and equipment include: dial indicators, torque wrenches, air gauges, tire pressure/heat warning devices, tread depth gauges, tire pressure gauge, inflation tool, sockets, tire irons

hazards include: spoke wheels, wedges, pressurized air, over inflation

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

F-32.02 Diagnoses tires, wheels and hubs

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

Skills

	Performance Criteria	Evidence of Attainment
F-32.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
F-32.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-32.02.03P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis

F-32.02.04P	perform diagnostic procedures	diagnostic procedures are performed by following manufacturers' service information
F-32.02.05P	measure components for wear, damage and defects	components are measured for wear, damage and defects
F-32.02.06P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
F-32.02.07P	perform failure analysis	failure analysis is performed to determine root cause of failure
F-32.02.08P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

symptoms of problems include: wandering, drifting, sagging, difficult steering, lack of stability, shaking, wheel hop, shimmy, harmonic and dynamic vibrations or movement

tools and equipment include: dial indicators, torque wrenches, air gauges, tire pressure/heat warning devices, tread depth gauges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

Knowledge

	Learning Outcomes	Learning Objectives
F-32.02.01L	demonstrate knowledge of tires, their components , characteristics, applications and operation	identify types of tires and their components , and describe their characteristics and applications
		describe operating principles of tires and their components
		describe tire load ranges, pressures, profiles and sizes
		describe steering and drive tires
F-32.02.02L	demonstrate knowledge of wheels, their components , characteristics, applications and operation	identify types of wheels and their components , and describe their characteristics and applications
		describe operating principles of wheels and their components
F-32.02.03L	demonstrate knowledge of hubs, their components , characteristics, applications and operation	identify types of hubs and their components , and describe their characteristics and applications
		describe operating principles of hubs and their components
F-32.02.04L	demonstrate knowledge of procedures to diagnose tires, wheels and hubs, and their components	identify tools and equipment used to diagnose tires, wheels and hubs, and their components , and describe their applications and procedures for use

		identify hazards and describe safe work practices pertaining to tires, wheels and hubs, and their components
		interpret information pertaining to tires, wheels and hubs, and their components found in manufacturers' service information
		describe procedures to inspect tires, wheels and hubs, and their components
		describe procedures to test tires, wheels and hubs, and their components
		describe procedures to diagnose tires, wheels and hubs, and their components
		describe common causes and symptoms of problems
F-32.02.05L	demonstrate knowledge of jurisdictional regulations regarding out-of-service specifications	describe jurisdictional regulations regarding out-of-service specifications

Range of Variables

components (tires) include: belts, tread, sidewall

types of tires include: radial, bias

components (wheels) include: rims, spacers, wedges, valve stems

types of wheels include: aluminum, steel, multi-piece rims

components (hubs) include: studs, nuts, spacers

types of hubs include: spoked, hub pilot, stud pilot

tools and equipment include: dial indicators, torque wrenches, air gauges, tire pressure/heat warning devices, tread depth gauges

hazards include: spoke wheels, wedges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

symptoms of problems include: wandering, drifting, sagging, difficult steering, lack of stability, shaking, wheel hop, shimmy, harmonic and dynamic vibrations or movement

F-32.03 Repairs tires, wheels and hubs

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

Skills

	Performance Criteria	Evidence of Attainment
F-32.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
F-32.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
F-32.03.03P	rebuild components	components are rebuilt by replacing bearings and races according to manufacturers' service information
F-32.03.04P	repair components	components are repaired by replacing seals, bearings, races, patches and plugs, according to manufacturers' service information
F-32.03.05P	adjust bearing and oil level	bearing and oil level are adjusted according to manufacturers' service information to ensure operation of components and equipment
F-32.03.06P	adjust air pressure, run-out and torque on spoke wheels	air pressure, run-out and torque are adjusted on spoke wheels according to manufacturers' service information
F-32.03.07P	verify repairs	repairs are verified using methods according to manufacturers' service information
F-32.03.08P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: dial indicators, torque wrenches, air gauges, tire pressure/heat warning devices, tread depth gauges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be replaced) include: tires, rims, bearings, studs

components (to be repaired) include: tire assemblies, hub assemblies

methods include: wheel alignment, road testing, checking for end play

Knowledge

Learning Outcomes	Learning Objectives
F-32.03.01L demonstrate knowledge of tires, their components , characteristics, applications and operation	identify types of tires and their components , and describe their characteristics and applications
	describe operating principles of tires and their components
	describe tire load ranges, pressures, profiles and sizes describe steering and drive tires
F-32.03.02L demonstrate knowledge of wheels, their components , characteristics, applications and operation	identify types of wheels and their components , and describe their characteristics and applications
	describe operating principles of wheels and their components
F-32.03.03L demonstrate knowledge of hubs, their components , characteristics, applications and operation	identify types of hubs and their components , and describe their characteristics and applications
	describe operating principles of hubs and their components
F-32.03.04L demonstrate knowledge of procedures to repair tires, wheels and hubs, and their components	identify tools and equipment used to repair tires, wheels and hubs, and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to tires, wheels and hubs, and their components
	interpret information pertaining to tires, wheels and hubs, and their components found in manufacturers' service information
	describe procedures to remove, replace, rebuild, adjust and repair tires, wheels and hubs, and their components
F-32.03.05L demonstrate knowledge of training requirements to remove, inspect and mount tires, wheels and hubs	identify training requirements to remove, inspect and mount tires, wheels and hubs
F-32.03.06L demonstrate knowledge of inspection requirements pertaining to tire size	identify inspection requirements pertaining to tire size

Range of Variables

components (tires) include: belts, tread, sidewall

types of tires include: radial, bias

components (wheels) include: rims, spacers, wedges, valve stems

types of wheels include: aluminum, steel, multi-piece rims

components (hubs) include: studs, nuts, spacers

types of hubs include: spoked, hub pilot, stud pilot

tools and equipment include: dial indicators, torque wrenches, air gauges, tire pressure/heat warning devices, tread depth gauges

hazards include: spoke wheels, wedges, pinch/crush points, pressurized air

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

Major Work Activity G

Services, diagnoses and repairs cabs

Task G-33 Services, diagnoses and repairs interior cab components

Task Descriptor

The vehicle is made up of interior components surrounding the occupants. Service, diagnostics and repair of components as well as routine maintenance is a necessity.

G-33.01 Services interior cab components

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

Skills

	Performance Criteria	Evidence of Attainment
G-33.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-33.01.02P	clean, adjust and lubricate components	components are cleaned, adjusted and lubricated according to manufacturers' service information
G-33.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
G-33.01.04P	release stored energy	stored energy is released by disconnecting power sources, draining air reservoirs and allowing capacitors to discharge in SRS modules
G-33.01.04P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: scan tools, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be cleaned, adjusted and lubricated) include: brake, throttle and clutch pedal pivot points, bed lifts, seat tracks, steering columns, shift mechanisms

components include: pedals, seats, seat belts, safety equipment, gauges, warning devices, driver controls (lighting, horns, switches), wheelchair accessories, SRSs (air bags), pneumatics, air-powered accessories, side windows, electrical accessories, cabinetry, safety netting, bunk air conditioning, heating and lighting systems

Knowledge		
Learning Outcomes	Learning Objectives	
G-33.01.01L	demonstrate knowledge of interior cab components , their characteristics, applications and operation	identify interior cab components , and describe their characteristics and applications
		describe operating principles of interior cab components
		interpret information pertaining to interior cab components found in manufacturers' service information
G-33.01.02L	demonstrate knowledge of procedures to service interior cab components	identify tools and equipment used to service interior cab components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to interior cab components
		describe procedures to release stored energy
		describe procedures to inspect interior cab components
		describe procedures to clean, adjust and lubricate interior cab components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
G-33.01.03L	demonstrate knowledge of manufacturer training requirements pertaining to SRS	identify manufacturer training requirements to service SRS
G-33.01.04L	demonstrate knowledge of regulatory requirements pertaining to SRS	identify and interpret standards and regulations pertaining to SRS

G-33.01.05L	demonstrate knowledge of technologies and practices pertaining to interior cab components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify other emerging technologies

Range of Variables

components include: pedals, seats, seat belts, safety equipment, gauges, warning devices, driver controls (lighting, horns, switches), wheelchair accessories, SRSs (air bags), pneumatics, air-powered accessories, side windows, electrical accessories, cabinetry, safety netting, bunk air conditioning, heating and lighting systems

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: scan tools, electronic service tools

hazards include: shocks, pressure injection injuries, explosive SRS, pinch/crush points, frost bite and burns from HVAC systems

technologies include: engine circulation heaters, cab air heaters, idle-free systems (auxiliary power unit [APU]), fuel cell APU, solar

G-33.02 Diagnoses interior cab components

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

Skills

	Performance Criteria	Evidence of Attainment
G-33.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
G-33.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-33.02.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
G-33.02.04P	perform diagnostic procedures	diagnostic procedures are performed by following manufacturers' service information to determine failure
G-33.02.05P	interpret diagnostic results	diagnostic results are interpreted according to manufacturers' service information to determine next steps

Range of Variables

symptoms of problems include: sticking pedals; air leak on seat; malfunctioning window controls; stiff, loose or binding steering column

tools and equipment include: electronic service tools, force meters, temperature measuring devices, multimeters, hand tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: pedals, seats, seat belts, safety equipment, gauges, warning devices, driver controls (lighting, horns, switches), wheelchair accessories, SRSs (air bags), pneumatics, air-powered accessories, side windows, electrical accessories, cabinetry, safety netting, bunk air conditioning, heating and lighting systems

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
G-33.02.01L	demonstrate knowledge of interior cab components , their characteristics, applications and operation	identify interior cab components , and describe their characteristics and applications
		describe operating principles of interior cab components
		interpret information pertaining to interior cab components found in manufacturers' service information
G-33.02.02L	demonstrate knowledge of procedures to diagnose interior cab components	identify tools and equipment used to diagnose interior cab components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to interior cab components
		describe procedures to inspect interior cab components
		describe procedures to test interior cab components
		describe procedures to diagnose interior cab components
		describe common causes and symptoms of problems
		identify materials that can be reconditioned, reused or recycled
G-33.02.03L	demonstrate knowledge of manufacturer training requirements pertaining to SRS	identify practices that reduce material waste
		identify manufacturer training requirements to diagnose SRS

G-33.02.04L	demonstrate knowledge of technologies and practices pertaining to interior cab components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify other emerging technologies

Range of Variables

components include: pedals, seats, seat belts, safety equipment, gauges, warning devices, driver controls (lighting, horns, switches), wheelchair accessories, SRSs (air bags), pneumatics, air-powered accessories, side windows, electrical accessories, cabinetry, safety netting, bunk air conditioning, heating and lighting systems

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: electronic service tools, force meters, temperature measuring devices, multimeters, hand tools

hazards include: shocks, pressure injection injuries, explosive SRS, pinch/crush points, frost bite and burns from HVAC systems

symptoms of problems include: sticking pedals; air leak on seat; malfunctioning window controls; stiff, loose or binding steering column

technologies include: engine circulation heaters, cab air heaters, idle-free systems (APU), fuel cell APU, solar

G-33.03 Repairs interior cab components

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

Skills

	Performance Criteria	Evidence of Attainment
G-33.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-33.03.02P	repair and replace components	components are repaired and replaced according to manufacturers' service information
G-33.03.03P	adjust components	components are adjusted according to manufacturers' service information

G-33.03.04P	verify repairs	repairs are verified under normal operating conditions to ensure it is within manufacturers' service information
G-33.03.05P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: electronic service tools, force meters, temperature measuring devices, multimeters, hand tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be repaired and replaced) include: door panels, seat belts, seats, window regulators, motors, switches, dash valves

components (to be adjusted) include: brakes, clutches, brake switches

Knowledge		
	Learning Outcomes	Learning Objectives
G-33.03.01L	demonstrate knowledge of interior cab components , their characteristics, applications and operation	identify interior cab components , and describe their characteristics and applications
		describe operating principles of interior cab components
		interpret information pertaining to interior cab components found in manufacturers' service information
G-33.03.02L	demonstrate knowledge of procedures to repair interior cab components	identify tools and equipment used to repair interior cab components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to interior cab components
		describe procedures to remove, replace, adjust and repair interior cab components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
G-33.03.03L	demonstrate knowledge of manufacturer training requirements pertaining to SRS	identify manufacturer training requirements to repair SRS

G-33.03.04L	demonstrate knowledge of technologies and practices pertaining to interior cab components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify other emerging technologies

Range of Variables

components include: door panels, seat belts, seats, window regulators, motors, switches, dash valves
manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: electronic service tools, force meters, temperature measuring devices, multimeters, hand tools

hazards include: shocks, pressure injection injuries, explosive SRS, pinch/crush points, frost bite and burns from HVAC systems

technologies include: engine circulation heaters, cab air heaters, idle-free systems (APU), fuel cell APU, solar

Task G-34 Services, diagnoses and repairs exterior cab components

Task Descriptor

The vehicle is made up of exterior components surrounding the occupants. Service, diagnostics and repair of components as well as routine maintenance is a necessity.

G-34.01 Services exterior cab components

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

Skills

	Performance Criteria	Evidence of Attainment
G-34.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-34.01.02P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
G-34.01.03P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information

G-34.01.04P	clean, lubricate and adjust exterior cab components	exterior cab components are cleaned, lubricated and adjusted according to manufacturers' service information
G-34.01.05P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
G-34.01.05P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: headlight adjusting tools, hand tools, multimeters, test lights, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: windshields, wipers, mirrors, door handles, door hinges, door strikers, steps, wind deflectors, engine hood cables, lockdown straps, mouldings, fenders, horns, tilt mechanisms, hood pivot points, hood-assist cylinders, cab suspension

consumables include: lights, wipers, washer fluids, cab air filters

Knowledge		
	Learning Outcomes	Learning Objectives
G-34.01.01L	demonstrate knowledge of exterior cab components and consumables , their characteristics, applications and operation	identify exterior cab components and consumables , and describe their characteristics and applications
		describe operating principles of exterior cab components and consumables
G-34.01.02L	demonstrate knowledge of procedures to service exterior cab components and consumables	identify tools and equipment used to service exterior cab components and consumables , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to exterior cab components and consumables
		describe procedures to inspect exterior cab components and consumables
		describe procedures to remove, replace, recycle and dispose of consumables
		describe procedures to clean, lubricate and adjust exterior cab components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste

G-34.01.03L	demonstrate knowledge of emerging technologies and practices pertaining to exterior cab components	identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify technologies in aerodynamics that address fuel economy, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: windshields, wipers, mirrors, door handles, door hinges, door strikers, steps, wind deflectors, engine hood cables, lockdown straps, mouldings, fenders, horns, tilt mechanisms, hood pivot points, hood-assist cylinders, cab suspension

consumables include: lights, wipers, washer fluids, cab air filters

tools and equipment include: headlight adjusting tools, hand tools, multimeters, test lights, electronic service tools

hazards include: pinch/crush points, sharp edges, noises, falls, pressurized air

G-34.02 Diagnoses exterior cab components

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

Skills

	Performance Criteria	Evidence of Attainment
G-34.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
G-34.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-34.02.03P	perform sensory inspections	perform sensory inspections of components to identify defects
G-34.02.04P	perform tests	tests are performed according to manufacturers' service information
G-34.02.05P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
G-34.02.06P	perform failure analysis	failure analysis is performed to determine root cause of failure

G-34.02.07P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
G-34.02.08P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: cab tilted, rough ride, loose components, doors not functional, noises, poor visibility

tools and equipment include: hand tools, multimeters, test lights, electronic service tools, headlight adjusting tools

manufacturers' service information include: specifications, recommendations, procedures, standards, logic diagrams

components include: windshields, wipers, mirrors, door handles, door hinges, door strikers, steps, wind deflectors, engine hood cables, lockdown straps, mouldings, fenders, horns, tilt mechanisms, hood pivot points, hood-assist cylinders, cab suspension

defects include: cracks in cab frame, loose fasteners and fairings, worn and damaged bushings, leaking or damaged shocks and valves, inoperative windshield wipers, damaged glass, inoperative horns, failed air bags

tests include: checking cab ride height, checking electronic control parameters

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
G-34.02.01L	demonstrate knowledge of exterior cab components , their characteristics, applications and operation	identify exterior cab components , and describe their characteristics and applications
		describe operating principles of exterior cab components
		interpret information pertaining to exterior cab components found in manufacturers' service information
G-34.02.02L	demonstrate knowledge of procedures to diagnose exterior cab components	identify tools and equipment used to diagnose exterior cab components and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to exterior cab components
		describe procedures to inspect exterior cab components
		describe procedures to test exterior cab components
		describe procedures to diagnose exterior cab components
		describe common causes and symptoms of problems

		identify defects found while diagnosing exterior cab components
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
G-34.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to exterior cab components	identify technologies that address emissions and pollution, and describe their characteristics and applications
		identify technologies in aerodynamics that address fuel economy, and describe their characteristics and applications
		identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: windshields, wipers, mirrors, door handles, door hinges, door strikers, steps, wind deflectors, engine hood cables, lockdown straps, mouldings, fenders, horns, tilt mechanisms, hood pivot points, hood-assist cylinders, cab suspension

manufacturers' service information include: specifications, recommendations, procedures, standards, logic diagrams

tools and equipment include: hand tools, multimeters, test lights, electronic service tools, headlight adjusting tools

hazards include: pinch/crush points, sharp edges, noises, falls, pressurized air

symptoms of problems include: cab tilted, rough ride, loose components, doors not functional, noises, poor visibility

defects include: cracks in cab frame, loose fasteners and fairings, worn and damaged bushings, leaking or damaged shocks and valves, inoperative windshield wipers, damaged glass, inoperative horns, failed air bags

G-34.03 Repairs exterior cab components

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

Skills

	Performance Criteria	Evidence of Attainment
G-34.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
G-34.03.02P	adjust doors, hood and cab	doors, hood and cab are adjusted to ensure operation of component and equipment

G-34.03.03P	replace and repair worn, damaged and faulty components	worn, damaged and faulty components are replaced and repaired according to manufacturers' service information
G-34.03.04P	verify repair	repair is verified to ensure it is within manufacturers' service information
G-34.03.05P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: hand tools, multimeters, test lights, electronic service tools, headlight adjusting tools, glass repair tools, ride height tools, welding and cutting equipment

manufacturers' service information include: specifications, recommendations, procedures, standards

components include: windshields, wipers, mirrors, door handles, door hinges, door strikers, steps, wind deflectors, engine hood cables, lockdown straps, mouldings, fenders, horns, tilt mechanisms, hood pivot points, hood-assist cylinders, cab suspension

Knowledge		
	Learning Outcomes	Learning Objectives
G-34.03.01L	demonstrate knowledge of exterior cab components , their characteristics, applications and operation	identify exterior cab components , and describe their characteristics and applications describe operating principles of exterior cab components
G-34.03.02L	demonstrate knowledge of procedures to repair exterior cab components	identify tools and equipment used to repair exterior cab components , and describe their applications and procedures for use identify hazards and describe safe work practices pertaining to exterior cab components describe procedures to remove, replace, adjust and repair exterior cab components identify materials that can be reconditioned, reused or recycled identify practices that reduce material waste
G-34.03.03L	demonstrate knowledge of emerging technologies and practices pertaining to exterior cab components	identify technologies that address emissions and pollution, and describe their characteristics and applications identify technologies in aerodynamics that address fuel economy, and describe their characteristics and applications identify emerging technologies pertaining to other non-green technologies

Range of Variables

components include: windshields, wipers, mirrors, door handles, door hinges, door strikers, steps, wind deflectors, engine hood cables, lockdown straps, mouldings, fenders, horns, tilt mechanisms, hood pivot points, hood-assist cylinders, cab suspension

tools and equipment include: hand tools, multimeters, test lights, electronic service tools, headlight adjusting tools, glass repair tools, ride height tools, welding and cutting equipment

hazards include: pinch/crush points, sharp edges, noises, falls, burns, pressurized air

Major Work Activity H

Services, diagnoses and repairs trailers

Task H-35 Services, diagnoses and repairs trailer components and accessories

Task Descriptor

Truck and transport mechanics must be able to service, diagnose and repair trailer components and accessories.

H-35.01 Services trailer components and accessories

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

Skills

	Performance Criteria	Evidence of Attainment
H-35.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-35.01.02P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
H-35.01.03P	clean, lubricate and test movement of components and interior of trailer	components and interior of trailer are cleaned and lubricated according to manufacturers' service information , and tested for movement
H-35.01.04P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: king pins, hitches, couplers, doors, handles, bogie rails, cross members, body panels, flooring, roof, wall studs, lift axles, kick plates, landing gear (legs, feet, gearing, handles, cross tubes, brackets, bracing), refrigeration panels, electronic lift axles

Knowledge

Learning Outcomes	Learning Objectives
H-35.01.01L demonstrate knowledge of trailer components and accessories , their characteristics, applications and operation	identify trailer components and accessories , and describe their characteristics and applications
	describe operating principles of trailer components and accessories
	identify required signage, lighting and reflective material for safety
	identify landing gear components, and describe their characteristics and applications
H-35.01.02L demonstrate knowledge of procedures to service trailer components and accessories	identify tools and equipment used to service trailer components and accessories , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to trailer components and accessories
	describe procedures to inspect trailer components and accessories
	describe procedures to clean, lubricate and test movement of trailer components
H-35.01.03L demonstrate knowledge of training and certification requirements to trailer components and accessories	identify materials that can be reconditioned, reused or recycled
	identify training and certification requirements pertaining to trailer components and accessories
H-35.01.04L demonstrate knowledge of regulatory requirements pertaining to signage, lighting and reflective materials	identify and interpret standards and regulations pertaining to signage, lighting and reflective materials
H-35.01.05L demonstrate knowledge of emerging technologies and practices pertaining to trailer components and accessories	identify technologies that address emissions and pollution, and describe their characteristics and applications
	identify types of tires that reduce material waste

Range of Variables

components include: king pins, hitches, couplers, doors, handles, bogie rails, cross members, body panels, flooring, roof, wall studs, lift axles, kick plates, landing gear (legs, feet, gearing, handles, cross tubes, brackets, bracing), refrigeration panels, electronic lift axles

accessories include: canvas air chute, wind deflectors

hazards include: pinch/crush points, frostbite, burns, fuel spills, grease injection

H-35.02 Diagnoses trailer components and accessories

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

Skills

	Performance Criteria	Evidence of Attainment
H-35.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
H-35.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-35.02.03P	perform sensory inspections	perform sensory inspections to identify worn, damaged and defective components
H-35.02.04P	determine faults	faults are determined
H-35.02.05P	perform failure analysis	failure analysis is performed to determine root cause of failure
H-35.02.06P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
H-35.02.07P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: loose or broken wind deflectors, bent or worn king pins, malfunctioning landing gear, malfunctioning lights

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: king pins, hitches, couplers, doors, bogie rails, cross members, body panels, flooring, roof, wall studs, lift axles, kick plates, landing gear (legs, feet, gearing, handles, cross tubes, brackets, bracing), refrigeration panels, electronic lift axles

faults include: wear, corrosion, overloading, loose fasteners, lack of lubrication, seized gear boxes, stripped gears, broken handles, bent legs and pads, bent and broken cross tubes

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
H-35.02.01L	demonstrate knowledge of trailer components and accessories , their characteristics, applications and operation	identify trailer components and accessories , and describe their characteristics and applications
		describe operating principles of trailer components and accessories

		interpret information pertaining to trailer components and accessories found in manufacturers' service information
		identify required signage, lighting and reflective material for safety
		identify types of landing gear components and describe their characteristics and applications
H-35.02.02L	demonstrate knowledge of procedures to diagnose trailer components and accessories	identify tools and equipment used to diagnose trailer components and accessories , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to trailer components and accessories
		describe procedures to inspect trailer components and accessories
		describe procedures to test trailer components and accessories
		describe procedures to diagnose trailer components and accessories
		describe common causes and symptoms of problems
		identify steps for failure analysis
		identify materials that can be reconditioned, reused or recycled
H-35.02.03L	demonstrate knowledge of regulatory requirements pertaining to signage, lighting and reflective materials	identify and interpret standards and regulations pertaining to signage, lighting and reflective materials
H-35.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to trailer components and accessories	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: king pins, hitches, couplers, doors, bogie rails, cross members, body panels, flooring, roof, wall studs, lift axles, kick plates, landing gear (legs, feet, gearing, handles, cross tubes, brackets, bracing), refrigeration panels, electronic lift axles

accessories include: canvas air chute, wind deflectors

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: pinch/crush points, frostbite, burns, fuel spills, grease injection

symptoms of problems include: loose or broken wind deflectors, bent or worn king pins, malfunctioning landing gear, malfunctioning lights

H-35.03 Repairs trailer components and accessories

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

Skills

	Performance Criteria	Evidence of Attainment
H-35.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-35.03.02P	replace and repair components and accessories	components and accessories are replaced and repaired according to manufacturers' service information
H-35.03.03P	adjust locks and doors	locks and doors are adjusted according to manufacturers' service information
H-35.03.04P	rebuild components	components are rebuilt according to manufacturers' service information
H-35.03.05P	verify repair	repairs are verified using methods
H-35.03.06P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: bucking bars, rivet guns, winding bars, thermal cameras, smoke bombs
manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components and accessories include: king pins, hitches, couplers, doors, bogie rails, cross members, canvas air chute, body panels, flooring, roof, wall studs, lift axles, kick plate, landing gear (legs, feet, gearing, handles, cross tubes, brackets, bracing), refrigeration panels, electronic lift axles

components (to be rebuilt) include: floors, walls, cross members, scuff rails, gear box

methods include: road testing, load testing, sensory observations

Knowledge

	Learning Outcomes	Learning Objectives
H-35.03.01L	demonstrate knowledge of trailer components and accessories , their characteristics, applications and operation	identify trailer components and accessories , and describe their characteristics and applications
		describe operating principles of trailer components and accessories
		interpret information pertaining to trailer components and accessories found in manufacturers' service information
		identify required signage, lighting and reflective material for safety

		identify types of landing gear components and describe their characteristics and applications
H-35.03.02L	demonstrate knowledge of procedures to repair trailer components and accessories	identify tools and equipment used to repair trailer components and accessories , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to trailer components and accessories
		describe procedures to remove, replace, adjust, rebuild and repair trailer components and accessories
		identify materials that can be reconditioned, reused or recycled
H-35.03.03L	demonstrate knowledge of regulatory requirements pertaining to trailer components and accessories	identify codes, standards and regulations pertaining to trailer components and accessories
H-35.03.04L	demonstrate knowledge of regulatory requirements pertaining to signage, lighting and reflective materials	identify and interpret standards and regulations pertaining to signage, lighting and reflective materials
H-35.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to trailer components and accessories	identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components and accessories include: king pins, hitches, couplers, doors, bogie rails, cross members, canvas air chute, body panels, flooring, roof, wall studs, lift axles, kick plate, landing gear (legs, feet, gearing, handles, cross tubes, brackets, bracing), refrigeration panels, electronic lift axles

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: bucking bars, rivet guns, winding bars, thermal cameras, smoke bombs

hazards include: pinch/crush points, frostbite, burns, fuel spills, grease injection

Task H-36 Services, diagnoses and repairs heating and refrigeration systems

Task Descriptor

Truck and transport mechanics service, diagnose and repair fuel, charging and starting systems as part of trailer heating and refrigeration systems. Special training or licenses are required to work on refrigeration, propane heating and high-voltage systems. Specialty equipment is required for some tasks.

H-36.01 Services heating and refrigeration systems

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

Skills

	Performance Criteria	Evidence of Attainment
H-36.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-36.01.02P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
H-36.01.03P	clean or replace electrical connections on starters, alternators and batteries	electrical connections on starters, alternators and batteries are cleaned or replaced
H-36.01.04P	lubricate cleaned electrical connections	cleaned electrical connections are lubricated using dielectric grease
H-36.01.05P	adjust belt tension	belt tension is adjusted with belt tension gauge according to manufacturers' service information
H-36.01.06P	perform preventative maintenance checks	preventative maintenance checks are performed
H-36.01.07P	drain water from fuel tank and add stabilizer or conditioner	water from fuel tank is drained and stabilizer or conditioner is added according to seasonal requirements
H-36.01.08P	secure fuel lines	fuel lines are secured using fasteners to prevent chafing or kinking of lines
H-36.01.09P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information

H-36.01.10P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
H-36.01.11P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: refrigerant leak detectors, electrical contact cleaners, terminal brushes
manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: batteries, wires, starters, alternators, compressors, fuel tanks

preventative maintenance checks includes: battery load test, checking for water in tank, checking codes, inspecting belts, checking fluid and fuel levels, checking seals

fasteners include: insulated clamps, separators

consumables include: oil, fuel, coolant, filters

Knowledge		
	Learning Outcomes	Learning Objectives
H-36.01.01L	demonstrate knowledge of heating systems, their components , consumables , characteristics, applications and operation	identify types of heating systems and their components and consumables , and describe their characteristics and applications
		describe operating principles of heating systems and their components
		identify fuel systems , and describe their characteristics and applications
		identify power supplies , and describe their characteristics and applications
		identify high-voltage systems , and describe their characteristics and applications
		identify mounting structures, fasteners and reinforcements, and describe their characteristics and applications
		identify fluid levels, and describe their characteristics and applications
H-36.01.02L	demonstrate knowledge of refrigeration systems, their components , consumables , characteristics, applications and operation	identify types of refrigeration systems and their components and consumables , and describe their characteristics and applications
		describe operating principles of refrigeration systems and their components

H-36.01.03L	demonstrate knowledge of procedures to service heating and refrigeration systems and their components and consumables	identify tools and equipment used to service heating and refrigeration systems and their components and consumables , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to heating and refrigeration systems, and their components and consumables
		describe procedures to inspect heating and refrigeration systems, and their components and consumables
		describe procedures to clean, lubricate and adjust heating and refrigeration system components
		describe procedures to remove, replace, recycle and dispose of heating and refrigeration system consumables
		identify materials that can be reconditioned, reused or recycled
H-36.01.04L	demonstrate knowledge of training and certification requirements pertaining to heating and refrigeration systems	identify training and certification requirements pertaining to heating and refrigeration systems
H-36.01.05L	demonstrate knowledge of regulatory requirements pertaining to heating and refrigeration systems	identify and interpret standards and regulations pertaining to heating and refrigeration systems
H-36.01.06L	demonstrate knowledge of regulatory requirements pertaining to recycling and disposal of heating and refrigeration system consumables	identify and interpret standards and regulations pertaining to recycling and disposal of heating and refrigeration system consumables
H-36.01.07L	demonstrate knowledge of emerging technologies and practices pertaining to heating and refrigeration systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: batteries, wires, starters, alternators, compressors, fuel tanks

consumables include: oil, fuel, coolant, filters

fuel systems include: diesel, propane, natural gas

power supplies include: electric, diesel, propane, natural gas

high-voltage systems include: genset, hybrid

fasteners include: insulated clamps, separators

fluids include: antifreeze, motor oil, fuel

tools and equipment include: refrigerant leak detectors, electrical contact cleaners, terminal brushes

hazards include: high-pressure injection, carcinogenic and toxic refrigerant gases, burns, skin irritations, shocks

H-36.02 Diagnoses heating and refrigeration systems

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

Skills

	Performance Criteria	Evidence of Attainment
H-36.02.01P	identify <i>symptoms of problems</i>	<i>symptoms of problems</i> are identified by consulting with customer or operator
H-36.02.02P	select and use <i>tools and equipment</i>	<i>tools and equipment</i> are selected and used according to task and <i>manufacturers' service information</i>
H-36.02.03P	perform sensory inspections of starting and charging system	sensory inspections of starting and charging system are performed to identify worn, damaged and defective components
H-36.02.04P	determine <i>faults</i>	<i>faults</i> are determined
H-36.02.05P	load test battery	battery is load tested for CCA and operating condition (state of charge)
H-36.02.06P	test starting and charging systems	starting and charging systems are tested for voltage and amperage draw according to <i>manufacturers' service information</i>
H-36.02.07P	perform sensory inspections of fuel lines	sensory inspections of fuel lines are performed to identify <i>problems</i>
H-36.02.08P	check operation of <i>fuel delivery system components</i> on heating units	<i>fuel delivery system components</i> on heating units are checked for operation
H-36.02.09P	perform sensory inspections of fuel tank	sensory inspections of fuel tank are performed to identify <i>conditions</i>
H-36.02.10P	perform sensory inspections of fuel system mounting hardware	sensory inspections of fuel system mounting hardware are performed to identify <i>wear and damage</i>
H-36.02.11P	compare test results to <i>manufacturers' service information</i> or expected values	test results are compared to <i>manufacturers' service information</i> or expected values to verify diagnosis
H-36.02.12P	perform failure analysis	failure analysis is performed to determine root cause of failure
H-36.02.13P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
H-36.02.14P	interpret diagnostic results	diagnostic results are interpreted to determine <i>next steps</i>

Range of Variables

symptoms of problems include: no heat, no cooling, noises, smells, leaks

tools and equipment include: multimeters, ammeters, load testers, chargers, leak detectors

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

faults include: corroded electric connectors, broken or loose belts, frayed or chafed wires

problems include: loose fittings, chafed or kinked lines, leaks

fuel delivery system components include: fuel pumps, gas regulators, filters

conditions includes: tank expiry date, physical damage

wear and damage includes: loose, worn or missing tank straps; cracked mounting brackets; broken fasteners

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
H-36.02.01L	demonstrate knowledge of heating systems, their components, characteristics, applications and operation	identify types of heating systems and their components, and describe their characteristics and applications
		describe operating principles of heating systems and their components
		identify fuel systems , and describe their characteristics and applications
		identify power supplies , and describe their characteristics and applications
		identify high-voltage systems , and describe their characteristics and applications
		identify mounting structures, fasteners and reinforcements, and describe their characteristics and applications
H-36.02.02L	demonstrate knowledge of refrigeration systems, their components, characteristics, applications and operation	identify fluid levels, and describe their characteristics and applications
		identify types of refrigeration systems and their components, and describe their characteristics and applications
H-36.02.03L	demonstrate knowledge of procedures to diagnose heating and refrigeration systems, and their components	describe operating principles of refrigeration systems and their components
		identify tools and equipment used to diagnose heating and refrigeration systems, and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to heating and refrigeration systems, and their components

		interpret information pertaining to heating and refrigeration systems, and their components found in manufacturers' service information
		describe procedures to inspect heating and refrigeration systems, and their components
		describe procedures to test heating and refrigeration systems, and their components
		describe procedures to diagnose heating and refrigeration systems, and their components
		describe common causes and symptoms of problems
		identify steps for failure analysis
		identify materials that can be reconditioned, reused or recycled
H-36.02.04L	demonstrate knowledge of training and certification requirements pertaining to heating and refrigeration systems	identify training and certification requirements pertaining to heating and refrigeration systems
H-36.02.05L	demonstrate knowledge of regulatory requirements pertaining to heating and refrigeration systems	identify and interpret standards and regulations pertaining to heating and refrigeration systems
H-36.02.06L	demonstrate knowledge of emerging technologies and practices pertaining to heating and refrigeration systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

fuel systems include: diesel, propane, natural gas

power supplies include: electric, diesel, propane, natural gas

high-voltage systems include: genset, hybrid

fasteners include: insulated clamps, separators

fluids include: antifreeze, motor oil, fuel

components include: fuel tank, burner, blower motor, heater core, batteries, radiator, wires, alternators, engines, compressors, electronic sensing equipment, condensers, evaporators, belts, hoses

tools and equipment include: multimeters, ammeters, load testers, chargers, leak detectors

hazards include: high-pressure injection injury, carcinogenic and toxic refrigerant gases, burns, skin irritations, shocks

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

symptoms of problems include: no heat, no cooling, noises, smells, leaks

H-36.03 Repairs heating and refrigeration systems

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

Skills

	Performance Criteria	Evidence of Attainment
H-36.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
H-36.03.02P	replace defective components	defective components are replaced according to manufacturers' service information
H-36.03.03P	remove and reinstall fuel tanks and brackets	fuel tanks and brackets are removed and reinstalled according to manufacturers' service information
H-36.03.04P	prime fuel system after repair or replacement of components	fuel system is primed after repair or replacement of components
H-36.03.05P	operate and adjust heating and refrigeration unit temperature controls	heating and refrigeration unit temperature controls are operated and adjusted according to load requirements and manufacturers' service information
H-36.03.06P	adjust belt tension	belt tension is adjusted using belt tension gauge according to manufacturers' service information
H-36.03.07P	verify repairs	repairs are verified using methods
H-36.03.08P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: multimeters, ammeters, load testers, chargers, manifold gauges, leak detectors

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: fuel lines, starters, alternators, pulleys, idler pulleys, belts, batteries

methods include: load testing, performing sensory observations, using gauges

Knowledge

	Learning Outcomes	Learning Objectives
H-36.03.01L	demonstrate knowledge of heating systems, their components , characteristics, applications and operation	identify types of heating systems and their components , and describe their characteristics and applications
		describe operating principles of heating systems and their components

		identify <i>fuel systems</i> , and describe their characteristics and applications
		identify <i>power supplies</i> , and describe their characteristics and applications
		identify <i>high-voltage systems</i> , and describe their characteristics and applications
		identify mounting structures, <i>fasteners</i> and reinforcements, and describe their characteristics and applications
		identify <i>fluid</i> levels, and describe their characteristics and applications
H-36.03.02L	demonstrate knowledge of refrigeration systems, their <i>components</i> , characteristics, applications and operation	identify types of refrigeration systems and their <i>components</i> , and describe their characteristics and applications
		describe operating principles of refrigeration systems and their <i>components</i>
H-36.03.03L	demonstrate knowledge of procedures to repair heating and refrigeration systems and their <i>components</i>	identify <i>tools and equipment</i> used to repair heating and refrigeration systems and their <i>components</i> , and describe their applications and procedures for use
		identify <i>hazards</i> and describe safe work practices pertaining to heating and refrigeration systems and their <i>components</i>
		interpret information pertaining to heating and refrigeration systems and their components found in <i>manufacturers' service information</i>
		describe procedures to remove, replace, adjust and repair heating and refrigeration systems and their <i>components</i>
		identify materials that can be reconditioned, reused or recycled
H-36.03.04L	demonstrate knowledge of training and certification requirements pertaining to heating and refrigeration systems	identify training and certification requirements pertaining to heating and refrigeration systems
H-36.03.05L	demonstrate knowledge of regulatory requirements pertaining to heating and refrigeration systems	identify and interpret standards and regulations pertaining to heating and refrigeration systems
H-36.03.06L	demonstrate knowledge of emerging technologies and practices pertaining to heating and refrigeration systems	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

components include: fuel lines, starters, alternators, pulleys, idler pulleys, belts, batteries

fuel systems include: diesel, propane, natural gas

power supplies include: electric, diesel, propane, natural gas

high-voltage systems include: genset, hybrid

fasteners include: insulated clamps, separators

fluids include: antifreeze, motor oil, fuel

tools and equipment include: multimeters, ammeters, load testers, chargers, manifold gauges, leak detectors

hazards include: high-pressure injection injury, carcinogenic and toxic refrigerant gases, burns, skin irritations, shocks

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

Major Work Activity I

Services, diagnoses and repairs climate control systems

Task I-37 Services, diagnoses and repairs heating and ventilation systems

Task Descriptor

Truck and transport mechanics service, diagnose and repair heating and ventilation systems for the comfort of the vehicle occupants.

I-37.01 Services heating and ventilation systems

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

Skills

	Performance Criteria	Evidence of Attainment
I-37.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
I-37.01.02P	clean components	components are cleaned according to manufacturers' service information
I-37.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
I-37.01.04P	measure air temperature and flow	air temperature and flow are measured to determine if they meet manufacturers' service information
I-37.01.05P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information

I-37.01.06P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
I-37.01.07P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be cleaned) include: filters, heater cores, ducting

sensory inspections include: visual check of levels, listening for motor noise and solenoid engagement, feeling air flow and temperature, smelling coolant leaks

components include: fins, heater controls, flow valves, blowers, pumps, resistors, modules, heater cores, ducting

consumables include: coolant, filters

Knowledge		
	Learning Outcomes	Learning Objectives
I-37.01.01L	demonstrate knowledge of heating and ventilation systems, their components , consumables , characteristics, applications and operation	identify types of heating and ventilation systems, their components and consumables , and describe their characteristics and applications
		describe operating principles of heating and ventilation systems, and their components
		interpret information pertaining to heating and ventilation systems, and their components found in manufacturers' service information
I-37.01.02L	demonstrate knowledge of procedures to service heating and ventilation systems, and their components and consumables	identify tools and equipment used to service heating and ventilation systems, and their components and consumables , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to heating and ventilation systems, and their components
		describe procedures to inspect heating and ventilation systems, and their components and consumables
		describe procedures to clean heating and ventilation system components
		describe procedures to measure air flow and temperature

		describe procedures to remove, replace, recycle and dispose of heating and ventilation system consumables
I-37.01.03L	demonstrate knowledge of emerging technologies and practices pertaining to heating and ventilation systems	identify emerging technologies pertaining to heating and ventilation systems

Range of Variables

components include: fins, heater controls, flow valves, blowers, pumps, resistors, modules, heater cores, ducting

consumables include: coolant, filters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: hot surfaces, sharp edges, hot coolants

emerging technologies include: alternative auxiliary heaters

I-37.02 Diagnoses heating and ventilation systems

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

Skills

	Performance Criteria	Evidence of Attainment
I-37.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
I-37.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
I-37.02.03P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
I-37.02.04P	perform diagnostic procedures and tests	diagnostic procedure and tests are performed by following manufacturers' service information to determine failure
I-37.02.05P	perform failure analysis	failure analysis is performed to determine root cause of failure
I-37.02.06P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
I-37.02.07P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: malfunctioning heat controls, steaming windshield, coolant smell, no heat

tools and equipment include: breakout harnesses, multimeters, thermometers, air flow gauges, vacuum cleaners, electronic service tools

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: visual check of levels, listening for motor noise and solenoid engagement, feeling air flow and temperature, smelling coolant leaks

tests include: operational, air flow, temperature

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
I-37.02.01L	demonstrate knowledge of heating and ventilation systems, their components , characteristics, applications and operation	identify types of heating and ventilation systems, and their components , and describe their characteristics and applications
		describe operating principles of heating and ventilation systems, and their components
		interpret information pertaining to heating and ventilation systems, and their components found in manufacturers' service information
I-37.02.02L	demonstrate knowledge of procedures to diagnose heating and ventilation systems, and their components	identify tools and equipment used to diagnose heating and ventilation systems, and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to heating and ventilation systems, and their components
		describe procedures to inspect heating and ventilation systems, and their components
		describe procedures to diagnose and test heating and ventilation systems, and their components
		describe common causes and symptoms of problems
I-37.02.03L	demonstrate knowledge of emerging technologies and practices pertaining to heating and ventilation systems	identify emerging technologies pertaining to heating and ventilation systems

Range of Variables

components include: fins, heater controls, flow valves, blowers, pumps, resistors, modules, heater cores, ducting

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

tools and equipment include: breakout harnesses, multimeters, thermometers, air flow gauges, vacuum cleaners, electronic service tools

hazards include: hot surfaces, sharp edges, hot coolants

symptoms of problems include: malfunctioning heat controls, steaming windshield, coolant smell, no heat

emerging technologies include: alternative auxiliary heaters

I-37.03 Repairs heating and ventilation systems

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

Skills

	Performance Criteria	Evidence of Attainment
I-37.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
I-37.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
I-37.03.03P	repair components	components are repaired by changing worn, damaged and defective parts according to manufacturers' service information
I-37.03.04P	clean components	components are cleaned according to manufacturers' service information
I-37.03.05P	verify repairs	repairs are verified using methods
I-37.03.06P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be replaced) include: thermostats, blowers, flow valves, heater cores, radiators, heater boxes, actuators, filters

components (to be repaired) include: flow valves, solenoids, auxiliary heaters

components (to be cleaned) include: blowers, heater cores, radiators, heater boxes, filters

methods include: road testing, sensory observations, air flow and temperature testing

Knowledge

Learning Outcomes	Learning Objectives
I-37.03.01L	demonstrate knowledge of heating and ventilation systems, their components , characteristics, applications and operation
	identify types of heating and ventilation systems, and their components , and describe their characteristics and applications
	describe operating principles of heating and ventilation systems, and their components
	interpret information pertaining to heating and ventilation systems, and their components found in manufacturers' service information
I-37.03.02L	demonstrate knowledge of procedures to repair heating and ventilation systems, and their components
	identify tools and equipment used to repair heating and ventilation systems, and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to heating and ventilation systems, and their components
	describe procedures to remove, replace, clean and repair heating and ventilation systems, and their components
I-37.03.03L	demonstrate knowledge of practices and emerging technologies pertaining to heating and ventilation systems
	identify emerging technologies pertaining to heating and ventilation systems

Range of Variables

components include: thermostats, blowers, flow valves, heater cores, radiators, heater boxes, actuators, filters, solenoids, auxiliary heaters

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hazards include: hot surfaces, sharp edges, hot coolants

emerging technologies include: alternative auxiliary heaters

Task I-38 Services, diagnoses and repairs air conditioning systems

Task Descriptor

Truck and transport mechanics service, diagnose and repair air conditioning systems for the comfort of the vehicle occupants.

I-38.01 Services air conditioning systems

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

Skills

	Performance Criteria	Evidence of Attainment
I-38.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
I-38.01.02P	clean components	components are cleaned according to manufacturers' service information
I-38.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
I-38.01.04P	measure air temperature and flow	air temperature and flow are measured to determine if they meet manufacturers' service information
I-38.01.05P	remove, replace, recycle and dispose of filters	filters are removed, replaced, recycled and disposed of according to manufacturers' service information
I-38.01.06P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be cleaned) include: condensers, evaporator cores, filters, blower motors

sensory inspections include: performing visual check of levels, feeling air flow and temperature, listening for motor noise, checking for frost, listening for compressor engagement, looking for signs of leakage

components include: evaporators, condensers, compressors, receiver dryers, expansion valves, orifice tubes, accumulators, sensors, controls, lines, filters, blower motors

Knowledge

Learning Outcomes	Learning Objectives
I-38.01.01L demonstrate knowledge of air conditioning systems, their components , characteristics, applications and operation	identify air conditioning systems and their components , and describe their characteristics and applications
	describe operating principles of air conditioning systems and their components
	identify types of refrigerants and describe their characteristics and applications
I-38.01.02L demonstrate knowledge of procedures to service air conditioning systems and their components	identify tools and equipment used to service air conditioning systems and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to air conditioning systems and their components
	describe procedures to inspect air conditioning systems and their components
	describe procedures to clean air conditioning systems and their components
I-38.01.03L demonstrate knowledge of training and certification requirements pertaining to air conditioning systems	identify training and certification requirements pertaining to air conditioning systems
I-38.01.04L demonstrate knowledge of regulatory requirements pertaining to air conditioning systems	identify and interpret standards and regulations pertaining to air conditioning systems
I-38.01.05L demonstrate knowledge of emerging technologies and practices pertaining to air conditioning systems	identify technologies that address ozone depletion and pollution, and describe their characteristics and applications
	identify emerging technologies pertaining to air conditioning systems

Range of Variables

components include: evaporators, condensers, compressors, receiver dryers, expansion valves, orifice tubes, accumulators, sensors, controls, lines, filters, blower motors

types of refrigerants include: R-12, R-134a, R-1234yf

hazards include: high pressure, flammable, sharp edges, pinch/crush points, moving parts, corrosive materials, irritants

training and certification requirements include: refrigerant handling training and certification

standards and regulations include: reclaiming, recycling and disposal regulations

emerging technologies include: auxiliary air conditioning units, refrigerant technology

I-38.02 Diagnoses air conditioning systems

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

Skills

	Performance Criteria	Evidence of Attainment
I-38.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
I-38.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
I-38.02.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
I-38.02.04P	confirm complaint and establish preliminary diagnosis	complaint is confirmed and preliminary diagnosis is established
I-38.02.05P	perform diagnostic procedures and tests	diagnostic procedures and tests are performed by following manufacturers' service information to determine failure
I-38.02.06P	compare test results to manufacturers' service information or expected values	test results are compared to manufacturers' service information or expected values to verify diagnosis
I-38.02.07P	perform failure analysis	failure analysis is performed to determine root cause of failure
I-38.02.08P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
I-38.02.09P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: poor cooling, noises, windows fogging

tools and equipment include: air conditioning recovery machines, pressure gauges, nitrogen, multimeters, electronic service tools, temperature and flow gauges, leak detectors

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: performing visual check of levels, feeling air flow and temperature, listening for motor noise, checking for frost, listening for compressor engagement, looking for signs of leakage

components include: evaporators, condensers, compressors, receiver dryers, expansion valves, orifice tubes, accumulators, sensors, controls, lines, filters, blower motors

tests include: pressure, electrical, leakage, vacuum

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

Learning Outcomes	Learning Objectives
I-38.02.01L demonstrate knowledge of air conditioning systems, their components , characteristics, applications and operation	identify air conditioning systems and their components , and describe their characteristics and applications
	describe operating principles of air conditioning systems and their components
	interpret information pertaining to air conditioning systems found in manufacturers' service information
	identify types of refrigerants and describe their characteristics and applications
I-38.02.02L demonstrate knowledge of procedures to diagnose air conditioning systems and their components	identify tools and equipment used to diagnose air conditioning systems and their components , and describe their applications and procedures for use
	identify hazards and describe safe work practices pertaining to air conditioning systems and their components
	describe procedures to inspect air conditioning systems and their components
	describe procedures to test air conditioning systems and their components
	describe procedures to diagnose air conditioning systems and their components
	describe common causes and symptoms of problems
I-38.02.03L demonstrate knowledge of training and certification requirements pertaining to air conditioning systems	identify training and certification requirements pertaining to air conditioning systems
I-38.02.04L demonstrate knowledge of regulatory requirements pertaining to air conditioning systems	identify and interpret standards and regulations pertaining to air conditioning systems
I-38.02.05L demonstrate knowledge of emerging technologies and practices pertaining to air conditioning systems	identify technologies that address ozone depletion and pollution, and describe their characteristics and applications
	identify emerging technologies pertaining to air conditioning systems

Range of Variables

components include: evaporators, condensers, compressors, receiver dryers, expansion valves, orifice tubes, accumulators, sensors, controls, lines, filters, blower motors

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

types of refrigerants include: R-12, R-134a, R-1234yf

tools and equipment include: air conditioning recovery machines, pressure gauges, nitrogen, multimeters, electronic service tools, temperature and flow gauges, leak detectors

hazards include: high pressure, flammable, sharp edges, pinch/crush points, moving parts, corrosive materials, irritants

symptoms of problems include: poor cooling, noises, windows fogging

training and certification requirements include: refrigerant handling training and certification

standards and regulations include: reclaiming, recycling and disposal regulations

emerging technologies include: auxiliary air conditioning units, refrigerant technology

I-38.03 Repairs air conditioning systems

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

Skills

	Performance Criteria	Evidence of Attainment
I-38.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
I-38.03.02P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced
I-38.03.03P	adjust refrigerant pressures	refrigerant pressures are adjusted to ensure proper operation of components and equipment
I-38.03.04P	braze or solder lines	lines are brazed or soldered using welding equipment
I-38.03.05P	evacuate, clean and recharge system refrigerant	system refrigerant is evacuated, cleaned and recharged according to manufacturers' service information
I-38.03.06P	recycle refrigerant	refrigerant is recycled according to jurisdictional regulations
I-38.03.07P	verify repair	repair is verified by running air conditioning system
I-38.03.08P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: air conditioning recovery system, pressure and temperature gauges, vacuum pumps, refrigerant identifiers, welding equipment

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: evaporators, condensers, compressors, receiver dryers, expansion valves, orifice tubes, accumulators, sensors, controls, lines, filters, blower motors

Knowledge		
Learning Outcomes	Learning Objectives	
I-38.03.01L	demonstrate knowledge of air conditioning systems, their components , characteristics, applications and operation	identify air conditioning systems and their components , and describe their characteristics and applications
		describe operating principles of air conditioning systems and their components
		identify types of refrigerants and describe their characteristics and applications
I-38.03.02L	demonstrate knowledge of procedures to repair air conditioning systems and their components	identify tools and equipment used to repair air conditioning systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to air conditioning systems and their components
		describe procedures to remove, replace, adjust and repair air conditioning systems and their components
I-38.03.03L	demonstrate knowledge of training and certification requirements pertaining to air conditioning systems	identify training and certification requirements pertaining to air conditioning systems
I-38.03.04L	demonstrate knowledge of regulatory requirements pertaining to air conditioning systems	identify and interpret standards and regulations pertaining to air conditioning systems
I-38.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to air conditioning systems	identify technologies that address ozone depletion and pollution, and describe their characteristics and applications
		identify emerging technologies pertaining to air conditioning systems

Range of Variables

components include: evaporators, condensers, compressors, receiver dryers, expansion valves, orifice tubes, accumulators, sensors, controls, lines, filters, blower motors

types of refrigerants include: R-12, R-134a, R-1234yf

tools and equipment include: air conditioning recovery system, pressure and temperature gauges, vacuum pumps, refrigerant identifiers, welding equipment

hazards include: high pressure, flammable, sharp edges, pinch/crush points, moving parts, corrosive materials, irritants

training and certification requirements include: refrigerant handling training and certification

standards and regulations include: reclaiming, recycling and disposal regulations

emerging technologies include: auxiliary air conditioning units, refrigerant technology

Major Work Activity J

Services, diagnoses and repairs hydraulic systems

Task J-39 Services, diagnoses and repairs hydraulic systems

Task Descriptor

Hydraulic systems pump confined fluid to transfer energy smoothly from one component to another. Advantages of using hydraulics include smooth and quiet operation, and adjustability of speed and force to prevent damage, which allows for a versatile and adaptable system.

Truck and transport mechanics must service, diagnose and repair hydraulic systems to ensure proper function and reduce down time.

J-39.01 Services hydraulic systems

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

Skills

	Performance Criteria	Evidence of Attainment
J-39.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
J-39.01.02P	clean components	components are cleaned according to manufacturers' service information
J-39.01.03P	perform sensory inspections	sensory inspections are performed to identify worn, damaged and defective components
J-39.01.04P	release stored energy	stored energy is released in a controlled manner without releasing fluid from system
J-39.01.05P	support raised components mechanically	raised components are supported mechanically to prevent accidental dropping of component or load
J-39.01.06P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information

J-39.01.07P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
J-39.01.08P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components (to be cleaned) include: inlet screens, reservoirs

sensory inspections include: listening for noises, looking for leaks, feeling for hot spots, smelling for burnt oil

components include: gaskets, seals, hoses, fittings, pumps, actuators, relief valves, control valves, reservoirs, PTO, drop boxes (transfer case), ECMs, solenoids, sensors, harnesses

consumables include: filters, oil

Knowledge		
	Learning Outcomes	Learning Objectives
J-39.01.01L	demonstrate knowledge of hydraulic systems, their components , consumables , characteristics, applications and operation	identify hydraulic systems and their components and consumables , and describe their characteristics and applications
		describe operating principles of hydraulic systems and their components
		identify pressure limits of hoses, tubing and fittings
		identify types of hydraulically powered applications
J-39.01.02L	demonstrate knowledge of procedures to service hydraulic systems and components	identify tools and equipment used to service hydraulic systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hydraulic systems and their components
		describe procedures to release stored energy
		describe procedures to inspect hydraulic systems and their components
		describe procedures to clean hydraulic systems and their components
		describe procedures to remove, replace, recycle and dispose of hydraulic consumables
		identify oil sampling procedures

J-39.01.03L	demonstrate knowledge of training and certification requirements pertaining to hydraulic systems and hydraulically powered applications	identify training and certification requirements pertaining to hydraulic systems and hydraulically powered applications
J-39.01.04L	demonstrate knowledge of regulatory requirements pertaining to hydraulic systems and hydraulically powered applications	identify codes, standards and regulations pertaining to hydraulic systems and hydraulically powered applications

Range of Variables

components include: gaskets, seals, hoses, fittings, pumps, actuators, relief valves, control valves, reservoirs, PTO, drop boxes (transfer case), ECMs, solenoids, sensors, harnesses

consumables include: filters, oil

hydraulically powered applications include: cement mixers, dump boxes, compactors, snow removal equipment, lift gates, aerial lifts, mobile cranes

hazards include: stored high pressure, skin and eye irritation, flammability, high heat

J-39.02 Diagnoses hydraulic systems

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

Skills

	Performance Criteria	Evidence of Attainment
J-39.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
J-39.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
J-39.02.03P	release stored energy	stored energy is released in a controlled manner without releasing fluid from system
J-39.02.04P	support raised components mechanically	raised components are supported mechanically to prevent accidental dropping of component or load
J-39.02.05P	perform sensory inspections	sensory inspections are performed to confirm complaint and establish preliminary diagnosis
J-39.02.06P	perform diagnostic procedure	diagnostic procedure is performed by following manufacturers' service information to determine failure
J-39.02.07P	perform tests	tests are performed to assess components for wear, damage or defects

J-39.02.08P	compare test results to manufacturers' service information or expected values to verify diagnosis	test results are compared to manufacturers' service information or expected values to verify diagnosis
J-39.02.09P	perform failure analysis	failure analysis is performed to determine root cause of failure
J-39.02.10P	record test results and inspection findings	test results and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking
J-39.02.11P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: fail to raise or lower, slow operation, leaking, intermittent or erratic operation, noisy operation

tools and equipment include: pressure gauges, flow meters, temperature gauges, restriction gauges

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

sensory inspections include: listening for noises, looking for leaks, feeling for hot spots, smelling for burnt oil

tests include: pressure, flow, restriction, cycle time

components include: gaskets, seals, hoses, fittings, pumps, actuators, relief valves, control valves, reservoir, PTO, drop boxes (transfer case), ECMs, solenoids, sensors, harnesses

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge

	Learning Outcomes	Learning Objectives
J-39.02.01L	demonstrate knowledge of hydraulic systems, their components , consumables , characteristics, applications and operation	identify hydraulic systems and their components and consumables , and describe their characteristics and applications
		describe operating principles of hydraulic systems and their components
		identify pressure limits of hoses, tubing and fittings
		identify types of hydraulically powered applications
J-39.02.02L	demonstrate knowledge of procedures to diagnose hydraulic systems and their components	identify tools and equipment used to diagnose hydraulic systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hydraulic systems and their components
		describe procedures to release stored energy

		describe procedures to inspect hydraulic systems and their components
		describe procedures to test hydraulic systems and their components
		describe procedures to diagnose hydraulic systems and their components
		describe common causes and symptoms of problems
		identify oil sampling procedures
J-39.02.03L	demonstrate knowledge of training and certification requirements pertaining to hydraulic systems and hydraulically powered applications	identify training and certification requirements pertaining to hydraulic systems and hydraulically powered applications
J-39.02.04L	demonstrate knowledge of regulatory requirements pertaining to hydraulic systems and hydraulically powered applications	identify codes, standards and regulations pertaining to hydraulic systems and hydraulically powered applications

Range of Variables

components include: gaskets, seals, hoses, fittings, pumps, actuators, relief valves, control valves, reservoir, PTO, drop boxes (transfer case), ECMs, solenoids, sensors, harnesses

consumables include: filters, oil

hydraulically powered applications include: cement mixers, dump boxes, compactors, snow removal equipment, lift gates, aerial lifts, mobile cranes

tools and equipment include: pressure gauges, flow meters, temperature gauges, restriction gauges

hazards include: stored high pressure, skin and eye irritation, flammability, high heat

symptoms of problems include: fail to raise or lower, slow operation, leaking, intermittent or erratic operation, noisy operation

J-39.03 Repairs hydraulic systems

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

Skills

	Performance Criteria	Evidence of Attainment
J-39.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
J-39.03.02P	release stored energy	stored energy is released in a controlled manner without releasing fluid from system
J-39.03.03P	support raised components mechanically	raised components are supported mechanically to prevent accidental dropping of component or load

J-39.03.04P	remove and replace worn, damaged and faulty components	worn, damaged and faulty components are removed and replaced according to manufacturers' service information
J-39.03.05P	rebuild components	components are rebuilt according to manufacturers' service information
J-39.03.06P	repair components	components are repaired by replacing parts causing failure according to manufacturers' service information
J-39.03.07P	perform adjustments	adjustments are performed to ensure proper operation of components and equipment
J-39.03.08P	verify repairs	repairs are verified using methods according to manufacturers' service information
J-39.03.09P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

components include: gaskets, seals, hoses, fittings, oil, pumps, actuators, relief valves, control valves, reservoirs, PTO, drop boxes (transfer case), ECMs, solenoids, sensors, harnesses

adjustments include: setting pressure and flow

methods include: operational tests, verifying pressures and flow

Knowledge		
	Learning Outcomes	Learning Objectives
J-39.03.01L	demonstrate knowledge of hydraulic systems, their components , consumables , characteristics, applications and operation	identify hydraulic systems and their components and consumables , and describe their characteristics and applications
		describe operating principles of hydraulic systems and their components
		interpret information pertaining to hydraulic systems and their components found in manufacturers' service information
		identify pressure limits of hoses, tubing and fittings
		identify types of hydraulically powered applications
J-39.03.02L	demonstrate knowledge of procedures to repair hydraulic systems and their components	identify tools and equipment used to repair hydraulic systems and their components , and describe their applications and procedures for use

		identify hazards and describe safe work practices pertaining to hydraulic systems and their components
		describe procedures to release stored energy
		describe procedures to remove, replace, adjust and repair hydraulic systems and their components
J-39.03.03L	demonstrate knowledge of training and certification requirements pertaining to hydraulic systems and hydraulically powered applications	identify training and certification requirements pertaining to hydraulic systems and hydraulically powered applications
J-39.03.04L	demonstrate knowledge of regulatory requirements pertaining to hydraulic systems and hydraulically powered applications	identify codes, standards and regulations pertaining to hydraulic systems and hydraulically powered applications

Range of Variables

components include: gaskets, seals, hoses, fittings, oil, pumps, actuators, relief valves, control valves, reservoirs, PTO, drop boxes (transfer case), ECMs, solenoids, sensors, harnesses

consumables include: filters, oil

manufacturers' service information include: maintenance schedule, specifications, recommendations, procedures, standards

hydraulically powered applications include: cement mixers, dump boxes, compactors, snow removal equipment, lift gates, aerial lifts, mobile cranes

hazards include: stored high pressure, skin and eye irritation, flammability, high heat

Major Work Activity K

Services, diagnoses and repairs hybrid and electric vehicles (EV)

Task K-40 Services, diagnoses and repairs hybrid vehicles

Task Descriptor

Truck and transport mechanics service, diagnose and repair electric motors, inverters, converters, high-voltage batteries and associated support systems in hybrid vehicles.

K-40.01 Services hybrid vehicles

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

Skills

	Performance Criteria	Evidence of Attainment
K-40.01.01P	select and use tools and equipment	tools and equipment are selected and used according to manufacturers' service information
K-40.01.02P	deactivate and lock out high- and low-voltage electrical system, and engine operating system	high- and low-voltage electrical system, and engine operating system are deactivated and locked out according to vehicle training and manufacturers' service information
K-40.01.03P	perform sensory inspections	sensory inspections of components are performed to identify defects
K-40.01.04P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information
K-40.01.05P	read and clear fault codes, and update software	fault codes are read and cleared, and software is updated according to manufacturers' service information
K-40.01.6P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: specialized PPE, safety devices, specialized digital multimeters (DMM), electronic service tools, specialized hand tools (insulated tools)

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

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring

defects include: loose components, damaged wiring, leaks, inoperable drive motors, damaged components

consumables include: filters, fluids

Knowledge		
Learning Outcomes	Learning Objectives	
K-40.01.01L	demonstrate knowledge of hybrid vehicle systems , their components , characteristics, applications and operation	identify types of hybrid vehicle systems and their components , and describe their characteristics and applications
		describe operating principles of hybrid vehicle systems and their components
		interpret information pertaining to hybrid vehicle systems and their components found in manufacturers' service information
K-40.01.02L	demonstrate knowledge of procedures to service hybrid vehicle systems and their components	identify tools and equipment used to service hybrid vehicle systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hybrid vehicle systems and their components
		describe procedures to release or lock out stored energy
		describe procedures to disconnect and reconnect high-voltage systems in hybrid vehicles
		describe procedures to service hybrid vehicle systems and their components
		describe procedures to perform software updates and read and clear fault codes
		identify defects found in hybrid vehicle systems
		identify materials that can be reconditioned, reused or recycled
K-40.01.03L	demonstrate knowledge of training requirements to service hybrid vehicle systems and their components	identify practices that reduce material waste
		identify training requirements to service hybrid vehicle systems and their components

K-40.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to hybrid vehicle systems and their components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

hybrid vehicle systems include: series, parallel, series/parallel

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring

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

tools and equipment include: specialized PPE, safety devices, specialized digital multimeters (DMM), electronic service tools, specialized hand tools (insulated tools)

hazards include: shocks, arc flash, sparks, heavy weights, falls, high working temperatures

defects include: loose components, damaged wiring, leaks, inoperable drive motors, damaged components

K-40.02 Diagnoses hybrid vehicles

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

Skills

	Performance Criteria	Evidence of Attainment
K-40.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
K-40.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
K-40.02.03P	deactivate and lock out high- and low-voltage electrical system, and engine operating system	high- and low-voltage electrical system, and engine operating system are deactivated and locked out according to manufacturers' service information
K-40.02.04P	perform sensory inspections	sensory inspections of components are performed to identify defects
K-40.02.05P	retrieve fault codes	fault codes are retrieved according to manufacturers' service information

K-40.02.06P	perform tests	tests are performed according to manufacturers' service information to pinpoint failure
K-40.02.07P	interpret diagnostic results	diagnostic results are interpreted according to manufacturers' service information to determine next steps

Range of Variables

symptoms of problems include: lack of power, no vehicle movement, no start, noises, indicator lights, components not functioning, intermittent operation

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

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

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring

defects include: loose components, damaged wiring, leaks, inoperable drive motors, damaged components

tests include: active, voltage and amperage, resistance check, voltage isolation, insulation, road

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
K-40.02.01L	demonstrate knowledge of hybrid vehicle systems , their components , characteristics, applications and operation	identify types of hybrid vehicle systems and their components , and describe their characteristics and applications
		describe operating principles of hybrid vehicle systems and their components
		interpret information pertaining to hybrid vehicle systems and their components found in manufacturers' service information
K-40.02.02L	demonstrate knowledge of procedures to diagnose hybrid vehicle systems and their components	identify tools and equipment used to diagnose hybrid vehicle systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hybrid vehicle systems and their components
		describe procedures to release or lock out stored energy
		describe procedures to inspect hybrid vehicle systems and their components
		describe procedures to test hybrid vehicle systems and their components
		describe procedures to diagnose hybrid vehicle systems and their components

		describe procedures to perform software updates, and read and clear fault codes
		describe common causes and symptoms of problems
		identify defects found while diagnosing hybrid vehicle systems
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
K-40.02.03L	demonstrate knowledge of training requirements to service hybrid vehicle systems and their components	identify training requirements to service hybrid vehicle systems and their components
K-40.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to hybrid vehicle systems and their components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

hybrid vehicle systems include: series, parallel, series/parallel

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring

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

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

hazards include: shocks, arc flash, sparks, falls

symptoms of problems include: lack of power, no vehicle movement, no start, noises, indicator lights, components not functioning, intermittent operation

defects include: loose components, damaged wiring, leaks, inoperable drive motors, damaged components

K-40.03 Repairs hybrid vehicles

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

Skills

Performance Criteria		Evidence of Attainment
K-40.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
K-40.03.02P	deactivate and lock out high- and low-voltage electrical system, and engine operating system	high- and low-voltage electrical system, and engine operating system are deactivated and locked out according to manufacturers' service information
K-40.03.03P	remove and inspect components	components are removed and inspected according to manufacturers' service information
K-40.03.04P	replace or repair components	components are replaced or repaired according to manufacturers' service information
K-40.03.05P	clear fault codes	fault codes are cleared according to manufacturers' service information
K-40.03.06P	verify repairs	repairs are verified under normal operating conditions to ensure they are within manufacturers' service information
K-40.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers, lift-assist tools, hand tools

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

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring

Knowledge

Learning Outcomes		Learning Objectives
K-40.03.01L	demonstrate knowledge of hybrid vehicle systems , their components , characteristics, applications and operation	identify types of hybrid vehicle systems and their components , and describe their characteristics and applications
		describe operating principles of hybrid vehicle systems and their components

		interpret information pertaining to hybrid vehicle systems and their components found in manufacturers' service information
K-40.03.02L	demonstrate knowledge of procedures to repair hybrid vehicle systems and their components	identify tools and equipment used to repair hybrid vehicle systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to hybrid vehicle systems and their components
		describe procedures to release or lock out stored energy
		describe procedures to disconnect and reconnect high-voltage systems in hybrid vehicles
		describe procedures to replace and repair hybrid vehicle system components
		describe procedures to perform software updates, and read and clear fault codes
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
K-40.03.03L	demonstrate knowledge of training requirements to service hybrid vehicle systems and their components	identify training requirements to service hybrid vehicle systems and their components
K-40.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to hybrid vehicle systems and their components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

hybrid vehicle systems include: series, parallel, series/parallel

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring

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

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers, lift-assist tools, hand tools

hazards include: shocks, arc flash, sparks, heavy weights, falls, burns, high working temperatures

Task K-41 Services, diagnoses and repairs electric vehicles (EV)

Task Descriptor

Truck and transport mechanics work on electric motors, inverters, converters, high-voltage batteries and associated support systems in electric vehicles (EV).

K-41.01 Services electric vehicles (EV)

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

Skills

	Performance Criteria	Evidence of Attainment
K-41.01.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
K-41.01.02P	clean components	components are cleaned according to manufacturers' service information
K-41.01.03P	measure charging rails	charging rails are measured according to manufacturers' service information
K-41.01.04P	perform sensory inspections	sensory inspections of components are performed to identify defects
K-41.01.05P	deactivate and lock out high- and low-voltage electrical system, and charging devices	high- and low-voltage electrical system, and charging devices are deactivated and locked out according to vehicle training and manufacturers' service information
K-41.01.06P	remove and replace consumables	consumables are removed and replaced according to manufacturers' service information
K-41.01.07P	recycle and dispose of consumables	consumables are recycled and disposed of according to jurisdictional regulations
K-41.01.08P	replace components	components are replaced according to manufacturers' service information
K-41.01.09P	read and clear fault codes, and update software	fault codes are read and cleared, and software is updated according to manufacturers' service information
K-41.01.10P	record service information and inspection findings	service information and inspection findings are recorded according to manufacturers' requirements for warranty, and for future reference and tracking

Range of Variables

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools)

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

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring, charging systems

defects include: loose components, damaged wiring, leaks, inoperable drive motors, damaged components

consumables include: filters, fluids

Knowledge		
Learning Outcomes	Learning Objectives	
K-41.01.01L	demonstrate knowledge of EV systems , their components , consumables , characteristics, applications and operation	identify types of EV systems and their components and consumables , and describe their characteristics and applications
		describe operating principles of EV systems and their components
K-41.01.02L	demonstrate knowledge of procedures to service EV systems and their components	identify tools and equipment used to service EV systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to EV systems and their components
		describe procedures to release or lock out stored energy
		describe procedures to service EV systems and their components
		describe procedures to inspect EV systems and their components
		describe procedures to clean EV system components
		describe procedures to measure charging rails
		describe procedures to remove, replace, recycle and dispose of consumables
		describe procedures to perform software updates, and read and clear fault codes
		identify defects found in EV systems
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste

K-41.01.03L	demonstrate knowledge of training requirements to service EV systems and their components	identify training requirements to service EV systems and their components
K-41.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to EV systems and their components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

EV systems include: A/C drives, fast charge, plug-in, extended range

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring, charging systems

consumables include: filters, fluids

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools)

hazards include: shocks, arc flash, sparks, heavy weights, falls, high working temperatures

defects include: loose components, damaged wiring, leaks, inoperable drive motors, damaged components

K-41.02 Diagnoses electric vehicles (EV)

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

Skills

	Performance Criteria	Evidence of Attainment
K-41.02.01P	identify symptoms of problems	symptoms of problems are identified by consulting with customer or operator
K-41.02.02P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
K-41.02.03P	deactivate and lock out high- and low-voltage electrical system and charging devices	high- and low-voltage electrical system and charging devices are deactivated and locked out according to manufacturers' service information
K-41.02.04P	perform sensory inspections	sensory inspections of components are performed to identify defects
K-41.02.05P	retrieve fault codes	fault codes are retrieved according to manufacturers' service information

K-41.02.06P	perform tests	tests are performed according to manufacturers' service information to pinpoint failure
K-41.02.07P	interpret diagnostic results	diagnostic results are interpreted to determine next steps

Range of Variables

symptoms of problems include: lack of power, no vehicle movement, noises, indicator lights, components not functioning, intermittent operation

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

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

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring, charging systems

defects include: loose components, damaged wiring, leaks, inoperable drive motors, damaged components

tests include: active, voltage and amperage, resistance check, voltage isolation, insulation, road

next steps include: repairs, component replacement or adjustment, further diagnosis

Knowledge		
	Learning Outcomes	Learning Objectives
K-41.02.01L	demonstrate knowledge of EV systems , their components , characteristics, applications and operation	identify types of EV systems and their components , and describe their characteristics and applications
		describe operating principles of EV systems and their components
K-41.02.02L	demonstrate knowledge of procedures to diagnose EV systems and their components	identify tools and equipment used to diagnose EV systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to EV systems and their components
		describe procedures to inspect EV systems and their components
		describe procedures to test EV systems and their components
		describe procedures to diagnose EV systems and their components
		describe common causes and symptoms of problems
		identify defects found in EV systems
		identify materials that can be reconditioned, reused or recycled

		identify practices that reduce material waste
K-41.02.03L	demonstrate knowledge of training requirements to service EV systems and their components	identify training requirements to service EV systems and their components
K-41.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to EV systems and their components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

EV systems include: A/C drives, series, parallel, fast charge, plug-in, extended range

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring, charging systems

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers

hazards include: shocks, arc flash, sparks, falls, high working temperatures

symptoms of problems include: lack of power, no vehicle movement, noises, indicator lights, components not functioning, intermittent operation

defects include: loose components, damaged wiring, leaks, inoperable drive motors, damaged components

K-41.03 Repairs electric vehicles (EV)

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

Skills

	Performance Criteria	Evidence of Attainment
K-41.03.01P	select and use tools and equipment	tools and equipment are selected and used according to task and manufacturers' service information
K-41.03.02P	deactivate and lock out high- and low-voltage electrical system, and engine operating system	high- and low-voltage electrical system, and engine operating system are deactivated and locked out according to manufacturers' service information
K-41.03.03P	remove and inspect components	components are removed and inspected according to manufacturers' service information
K-41.03.04P	replace or repair components	components are replaced or repaired according to manufacturers' service information

K-41.03.05P	clear fault codes	fault codes are cleared according to manufacturers' service information
K-41.03.06P	verify repairs	repairs are verified under normal operating conditions to ensure it is within manufacturers' service information
K-41.03.07P	document repairs and verifications performed	repairs and verifications performed are documented for warranty, liability, future reference and tracking

Range of Variables

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers, lifting tools

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

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring, charging systems

Knowledge		
	Learning Outcomes	Learning Objectives
K-41.03.01L	demonstrate knowledge of EV systems , their components , characteristics, applications and operation	identify types of EV systems and their components , and describe their characteristics and applications
		describe operating principles of EV systems and their components
K-41.03.02L	demonstrate knowledge of procedures to repair EV systems and their components	identify tools and equipment used to repair EV systems and their components , and describe their applications and procedures for use
		identify hazards and describe safe work practices pertaining to EV systems and their components
		describe procedures to release or lock out stored energy
		describe procedures to repair and replace EV system components
		describe procedures to perform software updates, and read and clear fault codes
		identify materials that can be reconditioned, reused or recycled
		identify practices that reduce material waste
K-41.03.03L	demonstrate knowledge of training requirements to service EV systems and their components	identify training requirements to service EV systems and their components

K-41.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to EV systems and their components	identify technologies and practices that contribute to net zero and carbon neutral commitments
		identify technologies that address emissions and pollution, and describe their characteristics and applications

Range of Variables

EV systems include: A/C drives, series, parallel, fast charge, plug-in, extended range

components include: modules, inverters, high-voltage batteries, drive motors, converters, wiring, charging systems

tools and equipment include: specialized PPE, safety devices, specialized DMMs, electronic service tools, specialized hand tools (insulated tools), manufacturer-specific tools and equipment, insulation testers, lifting tools

hazards include: shocks, arc flash, sparks, falls, heavy weights, high working temperatures

Appendix A

Acronyms

ABS	anti-lock braking system
AED	automated external defibrillator
AGM	absorbed glass mat
API	American Petroleum Institute
APU	auxiliary power unit
CA	cranking amps
CAC	charge air cooler
CCA	cold cranking amps
DEF	diesel exhaust fluid
DMM	digital multimeters
DPF	diesel particulate filter
DRL	daytime running lights
ECM	electronic control module
EGR	exhaust gas recirculation
EPU	electronic processing unit
EV	electric vehicle
HVAC	heating, ventilation and air conditioning
MIG	metal inert gas
NO _x	nitric oxide and nitrogen dioxide
OEM	original equipment manufacturer
OH&S	Occupational Health and Safety
PPE	personal protective equipment
PTO	power take-off
RC	reserve capacity
SAE	Society of Automotive Engineers
SCR	selective catalytic reduction
SDS	safety data sheets
SRS	supplemental restraint system
TCM	transmission control module
TDG	Transportation of Dangerous Goods
VECU	vehicle electronic control unit
VGT	variable geometry turbocharger
VIN	vehicle identification number
WHMIS	Workplace Hazardous Materials Information System

Appendix B

Tools and Equipment/Outils et équipement

Personal Protective Equipment (PPE) and Safety Equipment/Équipement de protection individuelle (EPI) et équipement de sécurité

aprons	tablier
carbon monoxide sensors	détecteurs de monoxyde de carbone
coveralls (fire rated, high visibility)	combinaisons de travail
automated external defibrillator (AED)	défibrillateur externe automatisé (DEA)
emergency shower	douche d'urgence
exhaust ventilation	installation de ventilation
eye wash station	douche oculaire
face shields	écran facial
fall protection system	dispositifs antichute
fire blanket	couverture anti-feu
fire extinguisher	extincteurs
first aid kit	trousse de premiers soins
gloves (chemical, welding, latex, nitrile, heavy duty, cut resistant)	gants (de protection contre les produits chimiques, de soudeur, de latex, de caoutchouc nitrile, de qualité industrielle)
goggles	lunettes
guard rails	garde-corps
hard hats	casque de sécurité
hearing protection	protecteurs d'oreilles
high voltage protection (insulated gloves, clothing, tools)	équipement de protection contre la haute tension (gants, manteaux et outils isolés)
masks (dust, particulate, medical)	masques
respirators (organic materials, asbestos, other chemicals)	respirateur
safety boots	bottes
safety glasses	lunettes de sécurité
vehicle lock-out systems (tags and locks)	systèmes de verrouillage (étiquettes et verrous)
welding curtain	écran de soudeur
welding helmets	masque de soudeur
welding personal protective gear	équipement de protection personnel pour le soudage
wheel chocks	cale de roue

Hand Tools/Outils à main

air blow gun	soufflette
bushing drivers	outil d'installation de coussinet
clamps	pincés
cutting equipment (side cutter, tube cutter, wire cutter, scissors, shears, razor knives)	outils de coupe (tranchant, coupe-tube, coupe-fil, ciseaux, cisailles, rasoirs)
emery paper/cloth	papier d'éméri
feeler gauges	calibres d'épaisseur
files	limes
filter wrenches	clés à filtre
flashlight	lampe de poche
hacksaw	scie métallique
hammers	marteaux
insulated tools	outils isolés
magnets	aimants
magnifying glass	loupes
mirrors	miroirs
pick set	extracteur à inertie
pipe wrench	serre-joints
pliers	pincés
pry bars	barre-leviers
pullers	extracteurs
punches and chisels	poinçons et ciseaux
saws	scies
scribes	pointes à tracer
scrapers	grattoirs
screwdrivers	tournevis
slide hammer	marteaux-piqueurs
sockets and ratchets	douilles et clés à cliquet
strong-arm / flex bar	bras de force/bras articulé
terminal tool set	ensemble d'outils pour extrémité de câbles
torque multiplier	multiplicateur de couple
torque wrench	clé dynamométrique
wire brush	brosse métalliques
wrenches	clés

Power Tools/Outils mécaniques

air cut-off tools	outil à tronçonner pneumatique
air hammers	marteaux pneumatiques
ratchets (air, battery-operated)	cliquets pneumatiques
drills (air, battery-operated)	perceuses
impact gun (air, electric, battery-operated)	pistolet cloueur
grinders (air, electric, battery-operated)	meules
lighting devices (trouble lights, flood lights)	appareils d'éclairage (lampes baladeuses, projecteur pour illumination)
sanders (air, electric, battery-operated)	ponceuses
power saws (circular, hacksaws)	scie électrique
vacuum cleaner	aspirateur

Shop Equipment/Équipement d'atelier

drill press	perceuse à colonne
headlight aimer	appareil de réglage des phares
oil catches	collecteur d'huile
parts washers	bac de dégraissage
pressure washer	laveuse à pression
presses (hydraulic, mechanical, portable hydraulic)	presses (hydrauliques, mécaniques, hydrauliques portables)
shop carts	chariots d'atelier
vice	étau
wheel alignment machine	machines de réglage de la géométrie des roues
wire wheel / bench grinder	brosse métallique à touret/meuleuse d'établi
work benches	établis

Measuring, Testing and Diagnostic Equipment/Appareils de mesure, d'essai et de diagnostic

air conditioning recovery machines	station de récupération de réfrigérant
antifreeze tester	vérification d'antigel
back pressure tester	outil d'essai de contre-pression
battery load tester	testeur de batterie
black light	lumière noire
boost gauge	manomètre d'admission
brake drum gauge	jauge de tambour de frein
braking force test equipment	appareil d'essai de force de freinage
calipers (disc brake, inside, outside, Vernier)	compas (frein à disque, d'intérieur, d'extérieur, pied à coulisse)
circuit tester	vérificateur de circuit
compression gauges	compressiomètres
electronic service tools (computer, handheld)	équipement informatisé de diagnostic (ordinateur, portatif)
continuity tester	vérificateur de continuité
dial indicators	indicateur à cadrans
dynamometer	banc dynamométrique
electronic blowby tester	appareil d'essai électronique de gaz soufflé dans le carter
feeler gauge	jauges d'épaisseur
hydrometer	hydromètre
inductive pickup (amp clamp)	prise de position inductive
laser alignment tools	outil d'alignement laser
liner height protrusion gauge	indicateur de la hauteur de dépassement des chemises
micrometre (inside, outside, depth)	micromètre
multimeter	multiplicateur
opacity meter	opacimètre
plumb bob	fil à plomb
refractometer	réfractomètre
refrigerant identifier	identificateur de réfrigérant
pressure gauges	jauge de pression de gonflage
test light	lampe témoin
spark plug tester	vérificateur de bougies d'allumage
squares	équerres
straight edges	règles droites
tape measure	ruban à mesurer

telescopic gauge
temperature gauge (infrared, mechanical and electrical)
timing light
tire gauge
torque wrench
trammel gauge
tread depth gauge
vacuum gauge
video borescope

water manometer

jauge télescopique
indicateur de température (infrarouge, mécanique et électrique)
lampe stroboscopique
manomètres
clé dynamométrique
indicateur à compas
jauge de hauteur de filet
vacuomètre
caméra vidéo sur un câble ou un trépied amovible
manomètre à colonne d'eau

Welding and Cutting Equipment/Équipement de soudage et de coupage

air arc welding equipment
MIG welding equipment
oxyacetylene equipment
plasma cutter
propane torch
soldering gun
SMAW welding equipment
TIG welding equipment

équipement de soudage arc-air
soudeuse MIG
appareil d'oxycoupage
machine de découpe plasma
chalumeau à propane
pistolet à souder
soudeuses à baguette
soudeuse TIG

Hoisting, Lifting and Staging Equipment/Équipement de lavage et d'accès

axle lifts
blocking
cranes (overhead, mobile)
creepers
fork lifts
hoists
jacks
ladders
scaffolding/work platforms
safety stands
steps
stools

lève-palette
cales
grues
sommier roulant
chandelles
palans
crics
échelles
échafaudages
supports
escabeaux
tabourets

Appendix C

Glossary/Glossaire

accessories	components for the vehicle which enhance the operation or extend longevity; for example: greasing systems, radio, air conditioning and extra lights. Although some accessories are non-essential to the vehicle operation, they are sometimes required in extreme operating environments.	accessoires	composants du véhicule permettant d'en améliorer le fonctionnement ou d'en augmenter la durée de vie, par exemple : systèmes de lubrification, radio, climatisation et feux supplémentaires; même si certains accessoires ne sont pas essentiels au fonctionnement du véhicule, ils peuvent être requis dans des conditions d'utilisation extrêmes
base engine	assembled block and head including internal components and gear trains.	moteur standard	assemblage comprenant le bâti, la culasse, les composants internes et les trains d'engrenages
diagnose	tasks involved in inspecting, testing and determining faults in vehicle systems and components.	effectuer un diagnostic	tâches accomplies lors de l'inspection, des essais et de la détermination des défauts des systèmes et des composants du véhicule
drive train	portion that transfers power from the power source to the tires.	transmission	ensemble mécanique transmettant la puissance du volant d'inertie jusqu'aux pneus
driveline	part of the drive train that couples the power source to the driven component.	arbre de transmission	arbre reliant la source d'énergie au composant entraîné
electrical systems	starting, charging, lighting and accessory circuits without computer control modules.	système électrique	ensemble des circuits de démarrage, de charge, d'éclairage et d'accessoires non pourvus de modules de commande informatisés
electronic control module (ECM)	module which controls functions of a vehicle; some common ECMs are EPU (electronic processing units), ECUs (electronic control units), VECUs (vehicle electronic control units), TCMS (transmission control modules), ABS (anti-lock braking systems).	module de commande électronique	module électronique commandant les fonctions d'un véhicule; parmi les modules de commande électronique les plus courants figurent les blocs de traitement électronique, les blocs de commande électronique et les blocs de commande électronique du véhicule
electronic systems	electrical systems operated via computerized electronic control modules and related sensors and wiring.	système électronique	ensemble des dispositifs électriques commandés par l'entremise de modules de commande électronique informatisés, de leurs capteurs et de leurs câbles

high voltage	any voltage that is 50 V and above	haute tension	toute tension de 50 V et plus
landing gear	components which are used to support the weight of a semi-trailer when disconnected from the vehicle.	stabilisateur	composants utilisés pour supporter le poids de la remorque lorsque celle-ci n'est pas fixée à un véhicule
power take-off (PTO)	device that couples and uncouples a power source to transfer power to auxiliary systems.	prise de force	dispositif qui relie une source d'énergie aux systèmes auxiliaires ou qui les sépare pour transmettre de l'énergie à ces systèmes
repair	activities which include replacement, rebuild, or repairing of truck and transport vehicles and components.	réparation	ensemble des activités comprenant le remplacement, la remise en état ou la réparation des composants des camions et véhicules de transport
sensory inspection	diagnosing or inspecting using sight, sound, smell and feel.	inspection sensorielle	diagnostiquer ou inspecter en utilisant les sens de la vision, de l'ouïe, de l'odorat et du toucher
service	activities which include adjustment, lubricating and general maintenance of truck and transport vehicles and components.	maintenance	ensemble des activités comprenant la réparation, le remplacement, la reconstruction, l'ajustement et l'entretien de camions, de véhicules de transport et de leurs composants
spark ignition system	system which controls a small amount of electrical power to create and transmit, through a step-up transformer, a high voltage to a sparking device which in turn begins ignition.	allumage par étincelle	circuit commandant un faible courant électrique pour produire et transmettre, par l'entremise d'un transformateur élévateur, un courant haute tension à un dispositif créant des étincelles pour lancer la séquence d'allumage
suspension	components which absorb road surface irregularities to smooth vehicle ride; it is designed to permit controlled wheel movement over irregular surfaces; basic types include spring, air and rubber block.	suspension	ensemble des composants qui absorbent les irrégularités de la route pour permettre au véhicule de rouler en douceur; elle est conçue pour permettre le mouvement contrôlé des roues sur des surfaces irrégulières; les principaux types de suspension sont les suspensions à ressorts, pneumatiques et à bloc en caoutchouc