SKILLEDTRADESBC

PROGRAM OUTLINE

Heavy Mechanical Foundation

Implementation date: April 1, 2024

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SKILLED TRADES BC

HEAVY MECHANICAL FOUNDATION
PROGRAM OUTLINE

APPROVED BY INDUSTRY

MARCH 2023

IMPLEMENTATION DATE

APRIL 1, 2024

Developed by
SkilledTradesBC
Province of British Columbia

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Section 1

INTRODUCTION

Heavy Mechanical Foundation

Foreword

Upon successful completion of the Foundation Program, a Heavy Mechanical Foundation student will possess the full range of basic knowledge of the Heavy Duty Equipment Technician, Truck and Transport Mechanic, Diesel Engine Mechanic, and Transport Trailer Technician trades. Upon completion of the Foundation Program the student will have completed the technical in school training related to Level One apprenticeship in the particular trade. The student will possess the abilities and skills required to, safely, adjust, maintain, and operate the equipment or vehicles related to these trades at a Level One apprentice.

A Heavy Mechanical Foundation student inspects and repairs heavy trucks, commercial trucks, buses, diesel engines, transport trailers, cranes, graders, drills, bulldozers and other heavy equipment for proper performance. They also inspect the vehicles and equipment to detect, and to determine the extent of the repair required. These technicians service engines and engine support systems, hydraulic systems, pneumatics, and drive trains and perform general maintenance and repairs. Other duties include adjusting equipment, welding and cutting, repairing or replacing defective parts, components or systems, using hand and power tools and test equipment.

Upon completion of the program, the Heavy Mechanical Foundation student enters into an apprenticeship where they work in the full range of environmental conditions; from comfortable shops to remote sites where inclement weather can be a factor. Shift work is common. Good physical condition is important because the work often requires considerable standing, bending, crawling, lifting, climbing, pulling, and reaching.

Due to the size and complexity of the equipment, safety is of prime importance. The student must be conscious of the impact on people, equipment, work area, and environment when performing their work.

Some important attributes of the Heavy Mechanical Foundation student are:

- Reliability
- Analytical skills
- Ability to read and understand service manuals
- Mathematical aptitude

They also demonstrate the ability to:

- Communicate effectively
- Work with little or no supervision
- Contribute to a team approach
- Plan and work sequentially
- Adapt to changing technology
- Problem solve

Key attributes for people entering this trade are mechanical aptitude, manual dexterity, hand-eye coordination, stamina and agility. Communication skills and patience are also important. Other assets are good vision, hearing, and sense of smell to diagnose problems. This occupation may require a valid driver's license with air endorsement and/or a forklift operator's certificate.

This revised Program Outline is intended as a guide for instructors, apprentices, and employers of apprentices as well as for the use of industry organizations, regulatory bodies, and provincial and federal governments. It reflects updated standards by British Columbia industry and instructor subject matter experts.

Practical instruction by demonstration and student participation should be integrated with classroom sessions. Safe working practices, even though not always specified in each operation or topic, are an implied part of the program and should be stressed throughout the apprenticeship.

This Program Outline includes a list of recommended reference textbooks that are available to support the learning objectives and the minimum shop requirements needed to support instruction.

Competencies are to be evaluated through written exams and practical assessments. A passing grade is achieved by getting an overall mark of 70%. See the Assessment Guidelines in Section 4 for more details.

Achievement Criteria are included for competencies that require a practical assessment. The intent of including Achievement Criteria in the Program Outline is to ensure consistency in training across the many training institutions in British Columbia. Their purpose is to reinforce the theory and to provide a mechanism for evaluation of the learner's ability to apply the theory to practice. It is important that these performances be observable and measurable and that they reflect the skills spelled out in the competency. The conditions under which these performances will be observed and measured must be clear to the learner as well as the criteria by which the learner will be evaluated. The learner must also be given the evaluation criteria.

The performance spelled out in the Achievement Criteria is a suggested performance and is not meant to stifle flexibility of delivery. Training providers are welcome to substitute other practical performances that measure similar skills and attainment of the competency. Multiple performances may also be used to replace individual performances where appropriate.

SAFETY ADVISORY

Be advised that references to the WorkSafe BC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com). Please note that it is always the responsibility of any person using these materials to inform themselves about the Occupational Health and Safety Regulation pertaining to their work.

Acknowledgements

Industry and Instructor Subject Matter Experts retained to assist in the development and review of this Program Outline:

• L. Achtemichuk	Instructor	British Columbia Institute of Technology (BCIT)
• L. Babcock	Industry Expert	Babcock Consulting
• G. Barron	Industry Expert	Coast Mountain Bus Company
• B. Kozubski	Instructor	Thompson Rivers University (TRU)
• D. Noble	Instructor	Okanagan College (OC)
• M. Obal	Industry Expert	Oceanside Industrial

Previous Contributors

Industry and Instructor Subject Matter Experts retained to assist in the development and review of the 2013 Program Outline:

• L. Babcock	Chair	Thompson Rivers University (TRU)
• B. Holcik	Industry Expert	Finning
• B. Haugen	Co-chair	Vancouver Community College (VCC)
• P. Mottershead	Instructor	Vancouver Island University (VIU)
• T. Lockhart	Instructor	Okanagan College (OC)
• R. Tremblay	Instructor	Northern Lights College (NLC)
• C. Hull	Instructor	College of New Caledonia (CNC)
• G. Warne	Instructor	British Columbia Institute of Technology (BCIT)

SkilledTradesBC would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Heavy Mechanical Foundation program.

How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Program Credentialing Model	Communicates program length and structure, and all pathways to completion	Illustrates the length and structure of the program	Illustrates the length and structure of the program, and pathway to completion	Illustrates the challenger pathway to Certificate of Qualification
OAC	Communicates the competencies that industry has defined as representing the scope of the occupation	Displays the competencies that an apprentice is expected to demonstrate in order to achieve certification	Displays the competencies apprentices will achieve as a result of program completion	Displays the competencies challengers must demonstrate in order to challenge the program
Training Topics and Suggested Time Allocation	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Shows the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Shows the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Shows the relative weightings of various competencies of the occupation on which assessment is based
Program Content	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component	Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors	Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Appendix – Glossary of Acronyms			Defines program specific acronyms	

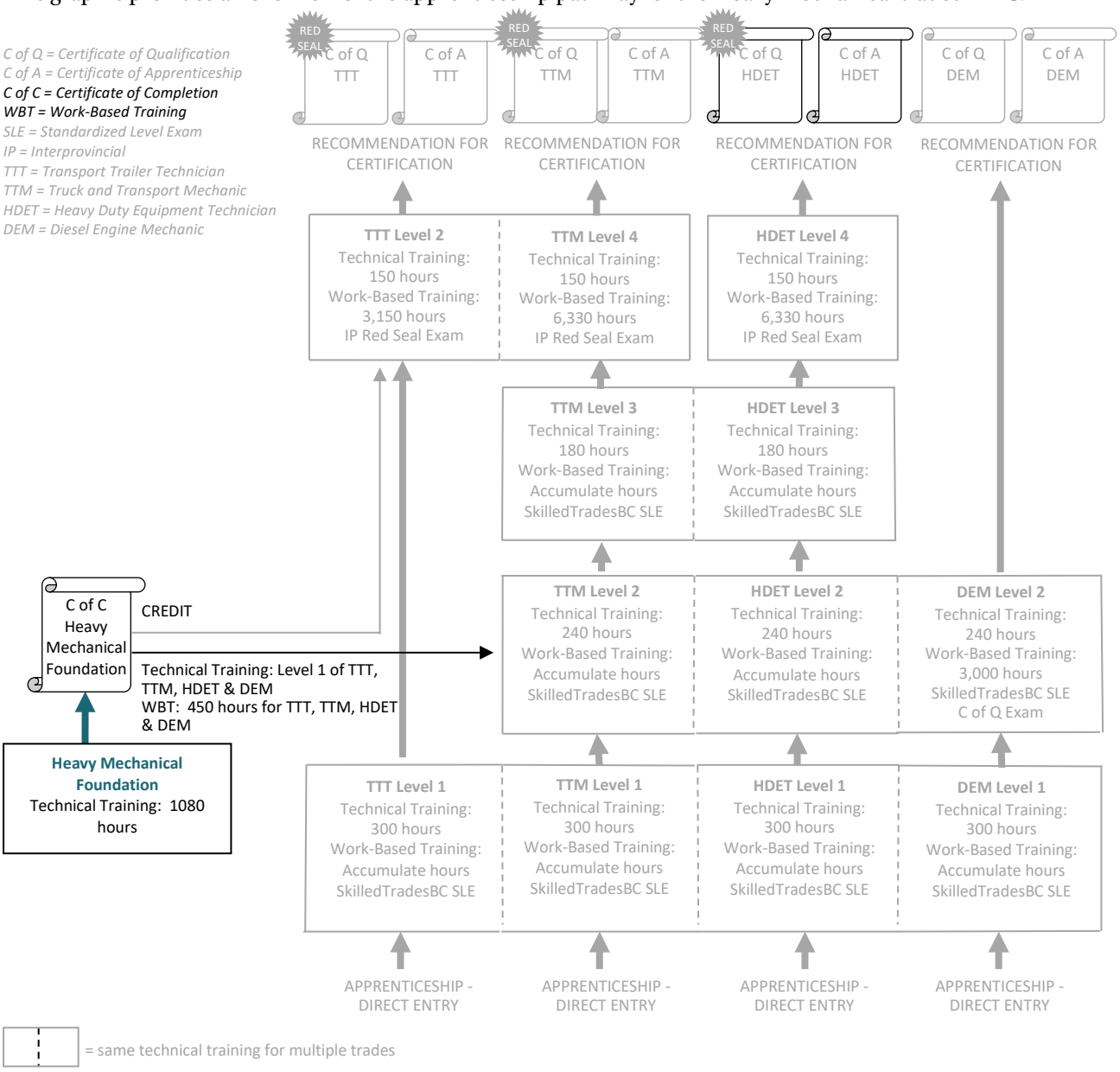
Section 2

PROGRAM OVERVIEW

Heavy Mechanical Foundation

Program Credentialing Model

This graphic provides an overview of the apprenticeship pathway for the Heavy Mechanical trades in BC.



CROSS-PROGRAM CREDITS

Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program

Occupational Analysis Chart

HEAVY MECHANICAL FOUNDATION

Occupation Description: The Heavy Mechanical Foundation program covers the scope of four occupations:

- **Heavy Duty Equipment Technician:** "Heavy Duty Equipment Technician" means a person who maintains, manufactures, overhauls, reconditions and repairs equipment powered by internal combustion engines or electricity and without limiting the foregoing, including graders, loaders, shovels, articulated trucks, haul trucks, forklifts, wheeled and tracked vehicles of all types used in construction, logging, sawmill, manufacturing, mining and other similar industry.
- **Truck and Transport Mechanic:** "Truck and Transport Mechanic" means a person who maintains, rebuilds, overhauls, reconditions, and does diagnostic troubleshooting of motorized commercial truck, bus, and road transport equipment.
- **Transport Trailer Technician:** "Transport Trailer Technician" means a person who maintains, rebuilds, overhauls, reconditions, and does diagnostic trouble shooting and repairs of commercial trailers. "
- **Diesel Engine Mechanic:** "Diesel Engine Mechanic" means a person who installs, repairs, and maintains all internal combustion diesel engines and components used in transport, construction and marine.

F = Foundation
X-FXX = Competency appearing **only** in the Foundation program. e.g. A-F12

PERFORM OCCUPATIONAL SKILLS **A**	Use safe work practices A1	1				F	Implement hybrid and electric vehicle (EV) safety protocols A2	1				F	Use hand tools, power tools, and shop equipment A3	1				F
	Use fasteners and fittings A4	1				F	Lift and support loads A5	1				F	Operate equipment A6	1				F
	Use documentation and reference materials A7	1				F	Services bearings and seals A8	1				F	Select and maintain lubricants A9	1				F
	Use cutting and welding equipment A10	1				F	Describe diagnostic procedures A11	1				F	Apply occupational health and safety skills A-F12					F

	Use environmental practices A-F13	Apply mathematics A-F14	Describe workplace expectations A-F15	Prepare for employment A-F16	
	F	F	F	F	
SERVICE, DIAGNOSE, AND REPAIR BRAKES **B**	Service and repair hydraulic brakes and parking brakes B1	Service and repair hydraulic power brakes and ABS systems B2	Service and repair air brakes B3		
	1 F	1 F	1 F		
SERVICE, DIAGNOSE, AND REPAIR HYDRAULICS **C**	Service hydraulic components C1				
	1 F				
SERVICE, DIAGNOSE, AND REPAIR ELECTRICAL AND ELECTRONIC SYSTEMS **D**	Describe electricity D1	Use electrical testing instruments D2	Service, diagnose, and repair battery systems D3	Service starting and charging systems D4	Service electrical circuits D5
	1 F	1 F	1 F	1 F	1 F
SERVICE, DIAGNOSE, AND REPAIR FRAMES, STEERING, AND SUSPENSION **E**	Service, diagnose, and repair tires, wheels, and hubs E1	Service steering systems E2	Service, diagnose, and repair suspension systems E3	Service, diagnose, and repair frames E5	Remove and install undercarriage E-F11
	1 F	1 F	1 F	1 F	F

SERVICE, DIAGNOSE, AND REPAIR TRAILERS **F**	Service, diagnose, and repair landing gear and trailer accessories F1	Service, diagnose, and repair coupling systems F2	Service, diagnose, and repair trailer body components F3	Service heating and refrigeration systems F4	
	1 F	1 F	1 F	1 F	
SERVICE, DIAGNOSE, AND REPAIR HEATING, VENTILATION, AND AIR CONDITIONING **G**	Describe heating and air conditioning fundamentals G1				
	1 F				
SERVICE, DIAGNOSE, AND REPAIR ENGINES AND SUPPORTING SYSTEMS **H**	Service engine support systems H2	Service diesel fuel supply systems H4	Remove and install diesel engines H-F12		
	2 F	2 F	F		
SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS **I**	Service clutches I-F13	Service manual transmissions I-F14	Service powershift and automatic transmissions I-F15	Service drivelines I-F16	Service drive axles I-F17	Service final drives I-F18
	F	F	F	F	F	F
	Remove and install transmissions I-F19	Remove and install drivelines and differentials I-F20	Remove and install final drives I-F21			
	F	F	F			

SERVICE, DIAGNOSE, AND REPAIR STRUCTURAL COMPONENTS AND ACCESSORIES **J**	Describe protective structures J1	1				F	Service, diagnose, and repair cab structures J2	1				F
USE COMMUNICATION AND MENTORING TECHNIQUES **L**	Use communication techniques L1	1				F						

Training Topics and Suggested Time Allocation

HEAVY MECHANICAL FOUNDATION

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**PERFORM OCCUPATIONAL SKILLS**	**28%**	**70%**	**30%**	**100%**
A1	Use safe work practices		✓	✓	
A2	Implement hybrid and electric vehicle (EV) safety protocols		✓	✓	
A3	Use hand tools, power tools, and shop equipment		✓	✓	
A4	Use fasteners and fittings		✓	✓	
A5	Lift and support loads		✓	✓	
A6	Operate equipment		✓	✓	
A7	Use documentation and reference materials		✓	✓	
A8	Service bearings and seals		✓	✓	
A9	Select and maintain lubricants		✓	✓	
A10	Use cutting and welding equipment		✓	✓	
A11	Describe diagnostic procedures		✓		
A-F12	Apply occupational health and safety skills		✓		
A-F13	Use environmental practices		✓		
A-F14	Apply mathematics		✓		
A-F15	Describe workplace expectations		✓		
A-F16	Prepare for employment		✓		
Line B	**SERVICE, DIAGNOSE, AND REPAIR BRAKES**	**12%**	**47%**	**53%**	**100%**
B1	Service and repair hydraulic brakes and parking brakes		✓	✓	
B2	Service and repair hydraulic power brakes and ABS systems		✓	✓	
B3	Service and repair air brakes		✓	✓	
Line C	**SERVICE, DIAGNOSE, AND REPAIR HYDRAULICS**	**6%**	**71%**	**29%**	**100%**
C1	Service hydraulic components		✓	✓	
Line D	**SERVICE, DIAGNOSE, AND REPAIR ELECTRICAL AND ELECTRONIC SYSTEMS**	**10%**	**45%**	**55%**	**100%**
D1	Describe electricity		✓		
D2	Use electrical testing instruments		✓	✓	
D3	Service, diagnose, and repair battery systems		✓	✓	
D4	Service starting and charging systems		✓	✓	
D5	Service electrical circuits		✓	✓	
Line E	**SERVICE, DIAGNOSE, AND REPAIR FRAMES, STEERING, AND SUSPENSION**	**15%**	**50%**	**50%**	**100%**
E1	Service, diagnose, and repair tires, wheels, and hubs		✓	✓	
E2	Service steering systems		✓	✓	
E3	Service, diagnose, and repair suspension systems		✓	✓	
E5	Service, diagnose, and repair frames		✓	✓	
E-F11	Remove and install undercarriage		✓	✓	

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line F	**SERVICE, DIAGNOSE, AND REPAIR TRAILERS**	**8%**	**35%**	**65%**	**100%**
F1	Service, diagnose, and repair landing gear and trailer accessories		✓	✓	
F2	Service, diagnose, and repair coupling systems		✓	✓	
F3	Service, diagnose, and repair trailer body components		✓	✓	
F4	Service heating and refrigeration systems		✓	✓	
Line G	**SERVICE, DIAGNOSE, AND REPAIR HEATING, VENTILATION, AND AIR CONDITIONING**	**2%**	**100%**	**0%**	**100%**
G1	Describe heating and air conditioning fundamentals		✓		
Line H	**SERVICE, DIAGNOSE, AND REPAIR ENGINES AND SUPPORTING SYSTEMS**	**9%**	**32%**	**68%**	**100%**
H2	Service engine support systems		✓		
H4	Service diesel fuel supply systems		✓	✓	
H-F12	Remove and install diesel engines		✓	✓	
Line I	**SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS**	**8%**	**36%**	**64%**	**100%**
I-F13	Service clutches		✓	✓	
I-F14	Service manual transmissions		✓	✓	
I-F15	Service powershift and automatic transmissions		✓	✓	
I-F16	Service drivelines		✓	✓	
I-F17	Service drive axles		✓	✓	
I-F18	Service final drives		✓	✓	
I-F19	Remove and install transmissions		✓	✓	
I-F20	Remove and install drivelines and differentials		✓	✓	
I-F21	Remove and install final drives		✓	✓	
Line J	**SERVICE, DIAGNOSE, AND REPAIR STRUCTURAL COMPONENTS AND ACCESSORIES**	**1%**	**60%**	**40%**	**100%**
J1	Describe protective structures		✓		
J2	Service, diagnose, and repair cab structures		✓	✓	
Line L	**USE COMMUNICATION AND MENTORING TECHNIQUES**	**1%**	**50%**	**50%**	**100%**
L1	Use communication techniques		✓	✓	
	Total Percentage for Heavy Mechanical Foundation	**100%**			

Section 3

PROGRAM CONTENT

Heavy Mechanical Foundation

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A1 Use safe work practices

Objectives

To be competent in this area, the individual must be able to:

- Apply personal safety measures
- Demonstrate knowledge of jurisdictional safety certifications and requirements
- Perform risk assessment
- Identify and use shop emergency equipment
- Prevent, identify and extinguish various classes of fires

LEARNING TASKS	CONTENT

1. Apply personal safety precautions and procedures	• Personal apparel
	  ○ Clothing
	  ○ Hair and beards
	  ○ Jewellery
	• Personal protective equipment (PPE)
	  ○ Maintenaning PPE
	• Safety meetings
	• Housekeeping
	• Ventilation systems
	• Respect for others' safety
	• Situational awareness
	• Ergonomics

2. Perform applicable lock out procedures	• WorkSafeBC requirements • Electrical isolation (Night switch) • Tag • Key storage • Equipment and machine lock-out
3. Demonstrate knowledge of jurisdictional safety certifications and requirements	• Compressed gas certifications • Refrigerant handler certificate • WorkSafeBC requirements • Commercial Vehicle Safety Enforcement regulations (CVSE) • Environmental regulations
4. Perform risk assessment	• Workplace hazards • Job task hazards • Environmental hazards

LEARNING TASKS	CONTENT
	• Hazard documentation and reporting

5. Locate shop emergency equipment and procedures	• Site safety plan
	  ○ Emergency shutoffs
	  ○ Fire control systems
	  ○ Eye wash facilities
	  ○ Emergency exits
	  ○ First aid facilities
	  ○ Emergency contact/phone numbers
	  ○ Muster points

6. Describe fire safety	• Conditions necessary to support a fire • Classes of fires • Symbols and colours
7. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials, and electrical apparatus	• Liquid and compressed fuels • Ventilation • Purging • Lubricants • Combustible materials • Aerosols
8. Describe the considerations taken to fight a fire	• Warning others and the Fire Department • Evacuation of others • Fire containment • Escape route • Training • Describe the procedure for using a fire extinguisher ○ P.A.S.S.
9. Describe equipment fire suppression systems	• Types • Construction • Operation • Disarming

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A2 Implement hybrid and electric vehicle (EV) safety protocols

Objectives

To be competent in this area, the individual must be able to:

- Identify hybrid and electric vehicle (EV) safety hazards
- Select and use high voltage PPE, tools, and equipment
- Implement and follow hybrid and EV safety protocols

LEARNING TASKS	CONTENT
1. Identify hybrid and electric vehicle (EV) safety hazards	• Arc flash • Electrocution • Burns • High voltage sources • Stored energy • Environmental conditions
2. Select and use high voltage PPE	• Arc flash suits • Insulated gloves • Non-conductive boots • High voltage signage • Insulated safety rescue hook • Lock-out and tag-out devices
3. Select and use high voltage tools and equipment	• Insulated high voltage tools • Specialized lifting equiment • Specizlied testing equipment
4. Implement and follow hybrid and EV safety protocols	• High voltage work procedures • Manufacturer procedures • Facility requirements • Knowledge of jurisdictional hybrid / EV safety certifications and requirements

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A3 Use hand tools, power tools, and shop equipment

Objectives

To be competent in this area, the individual must be able to:

- Select, use, and maintain tools and shop equipment
- Select, use, and maintain safety equipment

LEARNING TASKS	CONTENT
1. Use protective equipment associated with the use of tools and shop equipment	• PPE • Screening • Guarding • Ventilation • Clean up
2. Apply lock-out procedures to shop equipment	• WorkSafeBC lock-out procedures • Electrical isolation • Tags • Locks

3. Select, use, and maintain hand tools	• Hand tool safety
	  ○ Safety practices
	  ○ Hazards
	  ○ Organizing work area
	  ○ Maintaining hand tools
	  ○ Safe tool handling and storage
	• Hand tool selection
	  ○ Fastener tools
	  ○ Cutting tools
	  ○ Clamping tools
	  ○ Pullers
	  ○ Multipliers
	• Grease gun

4. Select, use, and maintain measuring instruments	• Layout tools • Imperial and metric precision measuring and calibration • Micrometer • Veriner • Bore gauges • Dial indicator

LEARNING TASKS	CONTENT
	• Feeler/thickness gauges • Torque wrenches

5. Select, use, and maintain power tools	• Pneumatic
	  ○ Lubrication
	• Electric
	  ○ Corded
	  ○ Cordless
	• Hydraulic

6. Select, use, and maintain drill bits	• Types • Sharpening • Cutting speeds • Lubricants

7. Select, use, and maintain shop equipment	• Presses
	• Parts cleaning equipment
	  ○ Hot tank
	  ○ Cold solution
	  ○ Hot agitator
	  ○ Solvent tank
	  ○ Pressure washer
	  ○ Steam cleaner
	  ○ Chemical cleaners
	• Drill press
	• Glass beader
	• Sand blaster
	• Grinders
	• Compressor
	• Cut-off saws

Achievement Criteria

Performance	The learner will be able to use hand tools, power tools, and shop equipment.
Conditions	The learner will be given • Hand tools, power tools, and shop equipment • Test equipment • Manufacturer's Specifications • A work place or training environment
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A4 Use fasteners and fittings

Objectives

To be competent in this area, the individual must be able to:

- Select and use imperial and metric fasteners
- Select and use pipe, tubing, hose, and fittings

LEARNING TASKS	CONTENT

1. Select and use imperial and metric fasteners	• Thread systems
	• Fastener types
	  ○ Installation
	• Washers
	  ○ Types
	  ○ Applications
	• Locking devices
	  ○ Types
	  ○ Applications

2. Cut and repair internal and external threads	• Taps • Dies • Thread repair • Broken fastener extraction
3. Select, use, and repair tubing, pipe and fittings	○ Tubing ○ Types ○ Sizing ○ Applications • Pipe ○ Types ○ Sizing • Threads ○ Applications • Fitting ○ Types ○ Sizing ○ Applications • Assembly procedures • Sealants • Cutting, bending, and flaring

LEARNING TASKS	CONTENT

4. Select and use hose and hose fittings	• Hose
	  ○ Types
	  ○ Sizing
	  ○ Applications
	• Assembly
	• Hose fittings
	  ○ Types

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A5 Lift and support loads

Objectives

To be competent in this area, the individual must be able to:

- Apply the WorkSafeBC Safety Regulations to lifting and blocking applications
- Select, use, and maintain lifting and blocking equipment
- Select, use, and maintain staging and access equipment
- Inspect and service wire rope
- Lift and move loads

LEARNING TASKS	CONTENT

1. Apply the Occupational Health and Safety Regulations	• Refer to regulations
	  ○ PPE
	  ○ Clothing
	  ○ Housekeeping
	  ○ Safe lifting and carrying
	  ○ Safe handling with cranes
	  ○ Maintenance and service documentation

2. Determine load weight	• Manufacturer's specification • Estimation
3. Select, use, and maintain jacks	• Types • Capacities
4. Select, use, and maintain stands and blocking	• Manufacturer's procedures • Types • Capacities • Bridging

5. Select, use, and maintain staging and access equipment	• Types
	  ○ Aerial work platforms
	  ○ Scissor lifts
	  ○ Scaffolding
	  ○ Mobile steps and ladders
	  ○ Fall arrest systems
	• Capacities

LEARNING TASKS	CONTENT
6. Select, use, and maintain wire slings, chains and lifting straps	• Types • Capacities • Rating tags • Rigging and lifting attachments

7. Select, use, and maintain wire rope	• Types
	  ○ Regular lay
	  ○ Lang lay
	• Construction
	• Application
	• Safe working load
	• Inspection frequency
	• Damage and wear
	• Removal
	• Repair/replacement
	• Lubrication
	• Scheduled maintenance

8. Use visual and sound signals	• WorkSafeBC Safety Regulations
	  ○ Hand
	  ○ Sound

9. Select, use, and maintain hoisting equipment	• Types • Capacities • Operation
10. Lift, hoist, and move loads	• Determine safe working load • Lifting and rigging procedures • Jurisdictional regulations and certifications

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A6 Operate equipment

Objectives

To be competent in this area, the individual must be able to:

- Perform pre-start and walk around inspections
- Start, move, secure, and stop equipment

LEARNING TASKS	CONTENT
1. Describe pre-start and walk around inspections	• Checklist • Operator's manuals
2. Describe starting aids	• Glow plug systems • Intake preheater systems • Starting fluids • Block/circulating heaters • Battery warmers
3. Describe start up procedures	• Controls • Cranking • Monitoring • Jump starting

4. Describe emergency shut down procedures	• Cut-off
	  ○ Fuel
	  ○ Air

5. Start, operate, and shut down selected equipment	• Pre-start and walk around • Use of starting aids • Moving • Securing and shutting down • Electrical isolation (Night switch)

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A7 Use documentation and reference materials

Objectives

To be competent in this area, the individual must be able to:

- Communicate using forms and reports.
- Use computers and written media to locate service and maintenance information.

LEARNING TASKS	CONTENT

1. Use documentation forms	• Business forms
	  ○ Work order
	  ○ Parts requisition
	  ○ Purchase order
	• Record keeping forms
	  ○ Time sheets and daily time card
	  ○ Equipment log
	  ○ Maintenance log
	  ○ Personal log
	  ○ Maintenance schedule
	  ○ Warranty
	• Confidentiality guidelines

2. Describe the requirements for report writing	• Types of reports
	  ○ Service
	  ○ Structure
	  ○ Attachments
	  ○ Shift end
	  ○ Maintenance log
	  ○ Accident
	  ○ Safety
	  ○ Digital media

3. Use manuals	• Technical
	  ○ Service
	  ○ Repair
	• Parts
	• Systems
	• Operators
	• Service bulletins/updates
	• Digital media

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A8 Service bearings and seals

Objectives

To be competent in this area, the individual must be able to:

- Select bearing and seals
- Service bearings and seals

LEARNING TASKS	CONTENT

1. Describe bearings	• Purpose
	• Types
	  ○ Friction
	  ○ Antifriction
	• Terminology
	• Applications
	• Loads
	  ○ Axial
	  ○ Radial

2. Select and service bearings	• Removal
	• Clean
	• Inspection
	  ○ Pitting
	  ○ Scoring
	  ○ Brinelling
	• Lubrication
	• Storage
	• Installation
	  ○ Heating
	  ○ Cooling
	• Adjustments

3. Describe seals and sealants	• Types
	  ○ Static
	  ○ Dynamic
	• Applications

4. Select and service seals and sealants	• Removal • Inspection • Fabrication • Installation

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A9 Select and maintain lubricants

Objectives

To be competent in this area, the individual must be able to:

- Describe lubricants
- Identify lubricants
- Select lubricants
- Perform fluid analysis

LEARNING TASKS	CONTENT
1. Describe the theory of lubrication	• Friction • Purpose

2. Describe the properties of lubricants	• Viscosity
	• Viscosity Index
	• Additives
	• Types
	  ○ Oils
	  ○ Greases
	  ○ Dry lubricants
	  ○ Synthetics
	  ○ Environmentally Friendly Liquids
	• Ratings
	  ○ American Petroleum Institute (API)
	  ○ Society of Automotive Engineers (SAE)
	  ○ International Organization for Standardization (ISO)
	  ○ Military Standards
	  ○ International Lubricant Standardization Approval Committee

3. Describe the use of lubricants	• Applications • Oils • Greases • Dry lubricants • Synthetics • Manufacturer's specifications • Minimum requirements • Warranty issues

LEARNING TASKS	CONTENT
4. Handle and maintain lubricants	• Storage • Disposal • Personal protection

5. Perform fluid analysis	• Procedures
	• Safety
	• Reports
	  ○ Interpretation of test results
	  ○ Contamination
	  ○ Condition
	  ○ Recommendations

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A10 Use cutting and welding equipment

Objectives

To be competent in this area, the individual must be able to:

- Identify metals
- Describe different welding procedures
- Cut, weld, and braze using oxy-acetylene
- Perform shielded metal arc weld
- Weld using wire feed processes
- Solder tubing and sheet metal

LEARNING TASKS	CONTENT
1. Identify regulations with respect to welding	• WorkSafeBC Safety Regulations • Transportation of Dangerous Goods Act (TDG) • Required certifications

2. Identify metals	• Metals
	  ○ Steel
	  ○ Aluminum

3. Identify oxy-acetylene components	• Safety precautions • Gases • Valves and regulators • Cylinders • Hoses and fittings • Cutting torches and tips • Flashback valves • Check valves
4. Use oxy-acetylene equipment	• Assembly procedures • Operation procedures • Lighting • Pressures • Adjusting • Shut down procedures • Leak testing • Storage

LEARNING TASKS	CONTENT
5. Cut mild steel with oxy-acetylene equipment	• Set-up • Freehand cuts • Guided cuts • Hole piercing
6. Braze with oxy-acetylene equipment	• Brazing set-up • Brazing techniques
7. Describe the shielded metal arc welding (SMAW) process	• Process • Applications ○ Safety requirements

8. Identify shielded metal arc welding equipment	• AC/DC machines
	• Components
	• Electrodes
	  ○ Classifications
	  ○ Selection
	  ○ Storage and handling
	• Electrode holder
	• Ground clamps
	• Cables
	• Connectors

9. Weld mild steel with shielded metal arc	• Procedures • Weld ground placement • Settings • Positions • Joints • Types of welds
10. Weld mild steel using wire feed processes	• Procedures • Settings • Safety • Weld types and positions • Wire type
11. Select and use air-arc and plasma cutting equipment	• Purpose • Procedure • Safety • Maintain

Achievement Criteria

Performance	The learner will be able to use cutting and welding equipment.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Cutting and welding equipment
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A11 Describe diagnostic procedures

Objectives

To be competent in this area, the individual must be able to:

- Describe the importance of following a diagnostic procedure.
- Describe diagnostic procedures used for troubleshooting.

LEARNING TASKS	CONTENT
1. Describe the importance of following a diagnostic process	• Cost of improper diagnosis • Unhappy customers • Lost business • Damage to components • Time management • Efficiency
2. Describe general diagnostic procedures	• Understanding system • Understanding complaint • Communicating with operator • Operational test • Visual inspection • Forming all possible conclusions • Test conclusions • System component isolation
3. Describe the importance of following manufacturer's diagnostic procedures where available	• Warranty requirement • Warranty claims • Diagnostic effieicncy
4. Describe the importance of failure analysis	• Repeat failure • Extend life • Cost • Customer satisfaction

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A-F12 Apply occupational health and safety skills

Objectives

To be competent in this area, the individual must be able to:

- Describe WorkSafeBC policies and procedures

LEARNING TASKS	CONTENT

1. Describe the "Core Requirements" of the Occupational Health and Safety Regulations	• Definitions
	• Application
	• Rights and responsibilties
	  ○ Health and safety programs
	  ○ Investigations and reports
	  ○ Workplace inspections
	  ○ Right to refuse work
	• General conditions
	  ○ Building and equipment safety
	  ○ Emergency preparedness
	  ○ Preventing violence
	  ○ Working alone
	  ○ Ergonomics
	  ○ Illumination
	  ○ Indoor air quality
	  ○ Smoking and lunchrooms

2. Locate the "General Hazard Requirements" of the Occupational Health and Safety Regulations	• Types ○ Chemical and biological substances • Substance specific requirements • Noise, vibration, radiation and temperature • Personal protective equipment (PPE) • Confined spaces • De-energization and lockout • Fall protection • Tools, machinery, and equipment • Ladders, scaffolds, and temporary work platforms • Cranes and hoists • Rigging • Mobile equipment • Transportation of workers • Traffic control • Electrical safety

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A-F13 Use environmental practices

Objectives

To be competent in this area, the individual must be able to:

- Describe the purpose of the Workplace Hazourdous Materials Information System (WHMIS) Regulations
- Describe the contents of the Safety Data Sheets (SDS)
- Describe the content of a WHMIS label
- Apply WHMIS regulations

LEARNING TASKS	CONTENT
1. Describe SDS legislation and requirements	• Hazardous Product Act • Controlled Products Regulations • Ingredients Disclosure List • Hazardous Materials Information Review Act • Hazardous Materials Information Review Regulations

2. Describe Workplace Hazardous Materials Information System (WHMIS)	• Protection of workers from the adverse effects of hazardous materials through the provision of relevant information while minimizing the economic impact on industry and the disruption of trade
	• Recognition of rights
	  ○ Workers
	  ○ Employers
	  ○ Suppliers
	  ○ Regulators

3. Describe the key elements of WHMIS	• Safety data sheets (SDSs) • Labelling of containers of hazardous materials • Worker education programs

4. Describe the responsibilities of suppliers under WHMIS	• Provide
	  ○ SDSs
	  ○ Labels

5. Describe the responsibilities of employers under WHMIS	• Provide
	  ○ SDSs
	  ○ Labeling
	  ○ Worker education

LEARNING TASKS	CONTENT
6. Describe the contents of an SDS label	• Hazardous ingredients • Preparation information • Product information • Physical data • Fire or explosion • Reactivity data • Toxicological properties • Preventive measures • First-aid measures

7. Describe symbols found on WHMIS labels and their meaning	• Compressed gases
	• Flammable and combustible materials
	• Oxidizing materials
	• Poisonous and infectious materials
	  ○ Materials causing immediate and serious toxic effects
	  ○ Materials causing other toxic effects
	  ○ Bio-hazardous infectious materials
	• Corrosive materials
	• Dangerously reactive materials

8. Apply WHMIS regulations in the shop	• Use, storage, and disposal of
	  ○ Solvents
	  ○ Caustic cleaners
	  ○ Cleaning solutions
	  ○ Alcohol used for cleaning
	  ○ Gasoline
	  ○ Diesel fuel
	  ○ L.P.G.
	  ○ C.N.G.
	  ○ Asbestos
	  ○ Battery acid
	  ○ Refrigerants
	  ○ Brake fluid
	  ○ Antifreeze
	  ○ Lubricants
	  ○ Tracer dyes

9. Identify current environmental standards	• Canadian Environmental Protection Act (CEPA) • Hazardous Materials (HAZMAT) • Industry Standards

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A-F14 Apply mathematics

Objectives

To be competent in this area, the individual must be able to:

- Use mathematics to solve problems

LEARNING TASKS	CONTENT

1. Perform mathematical operations	• Operations
	  ○ Addition
	  ○ Subtraction
	  ○ Multiplication
	  ○ Division
	  ▪ Decimals
	  ▪ Fractions
	  ○ Formula
	  ○ Order of operations
	• Percentage

2. Apply mathematics to solve equations	• Equations
	  ○ Angles
	  ○ Perimeter
	  ○ Area
	  ○ Circumference
	  ○ Volume
	  ○ Mass
	  ○ Ratios
	• Conversions
	  ○ Metric
	  ○ Imperial

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A-F15 Describe workplace expectations

Objectives

To be competent in this area, the individual must be able to:

- Describe workplace expectations
- Describe the importance of soft skills on the job

LEARNING TASKS	CONTENT

1. Describe workplace expectations	• Following safety regulations
	• Professionalism
	  ○ Punctuality
	  ○ Attitude
	  ○ Housekeeping
	  ○ Personal care
	• Prioritizing
	• Adaptibility
	• Following direction
	• Working with others
	• Working independently
	• Continuous learning

2. Describe the importance of soft skills on the job	• Communication
	  ○ Active listening
	  ○ Clear communication
	• Teamwork
	• Leadership
	• Creativity
	• Problem solving
	• Critical thinking

Line (GAC): A PERFORM OCCUPATIONAL SKILLS

Competency: A-F16 Prepare for employment

Objectives

To be competent in this area, the individual must be able to:

- Describe the areas and types of vehicles and equipment maintained and repaired
- Describe different business types
- Describe relationships between business, labour, and government
- Demonstrate postive employee attributes
- Describe employer responsibilities
- Prepare a resume and identify job search resources
- Prepare for an interview

LEARNING TASKS	CONTENT

1. Describe the areas and types of vehicles and equipment maintained and repaired	• Types of equipment for heavy mechanical trades
	  ○ Buses
	  ○ Excavators
	  ○ Trucks
	  ○ Loaders
	  ○ Tractors
	  ○ Trailers
	  ○ Dozers

2. Describe the current heavy mechanics trade	• Current apprenticeship training • Physical and mental requirements

3. Describe the range of working conditions	• Job opportunites
	  ○ Locations
	  ○ Advancement
	  ○ Specialization
	• Types of employment opportunities
	  ○ Dealerships
	  ○ Fleets
	  ○ Independents
	• Pay scales
	• Hours of work
	• Working environments
	• Quality control

4. Describe types of businesses	• Independent

LEARNING TASKS	CONTENT
	• Dealerships • Fleets
5. Describe labour groups	• Union • Non-union
6. Describe legislation affecting employment	• Federal Jurisdiction • Employment Standards • Labour Relations Code • Workers' Compensation Act • Other Health and Safety Regulations • Human Rights Acts • Occupational Environmental Regulations • WHMIS • Motor Vehicle Act • ICBC
7. Describe employer responsibility	• Respect • Trust • Fairness • Safe work site • Timely payment • Follow applicable legislations

8. Prepare a resume	• Gathering information
	  ○ Goals
	  ○ Skills
	  ○ Education
	  ○ Experience
	  ○ Personal information
	  ○ References
	• Organization of the resume
	• Types of resumes
	  ○ Chronological
	  ○ Functional
	  ○ Combination

9. Prepare a cover letter	• Composition
	  ○ Opening Paragraph
	  ○ Middle Paragraph

LEARNING TASKS	CONTENT
10. Identify job search sources	○ Closing Paragraph • Newspapers • Internet • Networking • Industry publications • Direct approach
11. Prepare for an interview	• Research of the organization • Review of job qualifications • Prepare for broad personal questions • Review of resume • Interview practice • Personal appearance • Arriving ahead of time
12. Follow up on an interview	• Written ○ Letter of appreciation • Verbal

Line (GAC): B SERVICE, DIAGNOSE, AND REPAIR BRAKES

Competency: B1 Service and repair hydraulic brakes and parking brakes

Objectives

To be competent in this area, the individual must be able to:

- Service hydraulic brake systems
- Diagnose hydraulic brake systems
- Repair hydraulic brake systems

LEARNING TASKS	CONTENT

1. Describe the principles of braking	• Coefficient of friction
	• Heat
	  ○ Absorption
	  ○ Dissipation
	• Effects of speed and weight
	• Brake fade

2. Describe the foundation brake	• Types
	  ○ Disk
	  ○ Drum
	  ○ Multidisc
	• Components
	  ○ Calipers
	  ○ Wheel cylinder
	  ○ Lines
	  ○ Shoes/pads
	• Operation
	  ○ Self energizing and non-self energizing
	  ○ Servo/non-servo

3. Review hydraulic principles	• Pressure • Force • Area

4. Describe the hydraulics of a brake system	• Types
	  ○ Disk
	  ○ Drum
	  ○ Multidisc
	• Components
	  ○ Master cylinder
	  ○ Metering valve

LEARNING TASKS	CONTENT
	○ Proportioning valve ○ Switches • Operation
5. Select and maintain brake fluids	• Requirements • Types ○ DOT 3 ○ DOT 4 ○ DOT 5 • Characteristics ○ Hygroscopic ○ Boiling point ○ Viscosity • Identification
6. Describe parking brake systems	• Types ○ Integral ○ Driveline ○ Hydraulic ○ Mechanical • Components • Operation
7. Diagnose hydraulic brake systems	• Measurements • Diagnostic procedures ○ Operational checks ○ Fluid condition/level • Inspection • Failure analysis
8. Repair hydraulic brake systems	• Components ○ Hydraulic ○ Mechanical • Inspection • Removal • Repair/replacement • Installation • Flushing/bleeding
9. Service parking brake systems	• Inspection • Removal

LEARNING TASKS	CONTENT
	• Repair/replacement • Installation
10. Perform preventive maintenance	• Inspection • Operational tests • Fluid level checks • Adjustment • Lubrication

Achievement Criteria

Performance — The learner will be able to service and repair hydraulic brakes and parking brakes.

Conditions — The learner will be given

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with hydraulic brakes with park brakes

Criteria — The learner will be evaluated on

- Following safe work practices throughout entire task including lock out procedures
- Conducting task in a logical manner
- Conducting task according to manufacturer's specifications
- Conducting task according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts

Line (GAC): B SERVICE, DIAGNOSE, AND REPAIR BRAKES

Competency: B2 Service and repair hydraulic power brakes and ABS systems

Objectives

To be competent in this area, the individual must be able to:

- Diagnose hydraulic assisted power brake systems
- Repair hydraulic assisted power brake systems
- Describe hydraulic anti-lock braking (ABS) systems
- Diagnose hydraulic anti-lock braking (ABS) systems
- Repair hydraulic anti-lock braking (ABS) systems

LEARNING TASKS	CONTENT

1. Describe power brake systems	• Types
	  ○ Vacuum boosters
	  ○ Hydro-boost
	  ○ Hydro-max
	  ○ Hydraulic
	• Components
	• Operation

2. Diagnose power brake systems	• Sensory inspection • Testing ○ Operational • Failure analysis
3. Repair power brake systems	• Inspection • Removal • Repair/replacement/rebuild • Installation • Bleeding • Adjustments and calibrations • Verification of system operation

4. Describe hydraulic anti-lock braking systems	• Types
	  ○ Single channel
	  ○ Multi channel
	• Components
	• Operation
	• Precautions

LEARNING TASKS	CONTENT
5. Diagnose hydraulic anti-lock braking systems	• Manufacturer's diagnostic procedures • Road test • Diagnostic codes • Components • Inspection • Testing
6. Repair hydraulic anti-lock braking systems	• Inspection • Removal • Repair/replacement/rebuild • Installation • Bleeding • Adjustments and calibrations • Verification of system operation • Diagnostic codes

Achievement Criteria

Performance	The learner will be able to service and repair hydraulic power brakes and ABS systems.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with hydraulic ABS and power brakes
Criteria	The learner will be evaluated on • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): B SERVICE, DIAGNOSE, AND REPAIR BRAKES

Competency: B3 Service and repair air brakes

Objectives

To be competent in this area, the individual must be able to:

- Describe the principles of braking
- Describe the principles of pneumatics
- Describe air brake schedules and components
- Service air brake systems
- Repair a wheel brake assembly

LEARNING TASKS	CONTENT

1. Describe the principles of braking	• Coefficient of friction
	• Heat
	  ○ Absorption
	  ○ Dissipation
	• Effects of speed and weight
	• Brake fade

2. Describe the principles of pneumatics	• Characteristics of air • Relationship between force, pressure and area • Effects of heat on air • Time lag • Pneumatic balance

3. Describe a basic air brake system	• Sub systems
	  ○ Supply
	  ○ Delivery
	• Foundation brakes
	  ○ Drum
	  ○ Disc
	• Components
	  ○ Compressor
	  ○ Governor
	  ○ Treadle
	  ○ Relay
	  ○ Brake chamber
	• Operation

4. Describe air over hydraulic braking systems	• Components

LEARNING TASKS	CONTENT
	• Operation
5. Describe the basics of air brake schedules	• 121 • X • SX • Operation and routine maintenance
6. Repair foundation brake assembly	• Inspection • Disassembly • Replacement • Measurement • Assembly • Adjustment

7. Service and inspect air brakes	• Tractor and trailer
	• Caging brakes
	• Components
	  ○ Foundation brakes
	  ○ Reservoirs
	  ○ Lines
	  ○ Disc/Drum
	  ○ Valves
	• Adjustment
	• Scheduled maintenance

Achievement Criteria

Performance: The learner will be able to service and repair air brakes.

Conditions: The learner will be given

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with air disc and drum brakes

Criteria: The learner will be evaluated on

- Following safe work practices throughout entire task including lock out procedures
- Conducting task in a logical manner
- Conducting task to manufacturer's specifications
- Conducted task according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts

Line (GAC): C SERVICE, DIAGNOSE, AND REPAIR HYDRAULICS

Competency: C1 Service hydraulic components

Objectives

To be competent in this area, the individual must be able to:

- Describe the principles of hydraulics.
- Describe the basic components of a hydraulic system.
- Describe the types of hydraulic systems.
- Identify hydraulic components.
- Select hydraulic fluids for applications.
- Select and assemble hydraulic hoses and fittings.
- Demonstrate safe work procedures for hydraulic systems service.
- Perform scheduled maintenance on hydraulic systems.

LEARNING TASKS	CONTENT
1. Describe the principles of hydraulics	• Terminology • Advantages/disadvantages • Fluid characteristics • Pascal's Law • Calculations • Bernoulli's Principle
2. Perform calculations	• Area • Volume • Force • Pressure • Flow rate • Pascal's law

3. Describe the basic operation of a hydraulic system and components	• Filters
	• Accumulators
	• Seals
	• Fittings
	• Reservoir
	  ○ Vented
	  ○ Pressurized
	• Pump
	  ○ Positive displacement
	  ▪ Gear
	  ▪ Vane

LEARNING TASKS	CONTENT
	▪ Piston ○ Ratings ▪ Pressure ▪ Flow • Control valves ○ Pressure ○ Directional ○ Volume • Actuators ○ Cylinder ○ Motor • Connecting lines • Hydraulic fluids
4. Describe types of hydraulic systems	• Open-centre • Closed-centre • Self-contained • Auxillary-powered
5. Demonstrate safe work procedures	• Safety blocking equipment and attachments • Relieve pressure • Reservoir venting • Actuator neutralization • Temperature hazards
6. Service hydraulic systems	• Visual inspection • Leaks • Hose rubs • External damage • Fluid level check • Filter change, fluid change, and fluid analysis • Strainers • Flushing system
7. Interpret basic hydraulic diagrams	• Types ○ Pictorial ○ Schematic • Basic symbols

LEARNING TASKS	CONTENT
8. Select hydraulic fluids	• Requirements • SAE viscosity ratings • ISO viscosity ratings • API service ratings • Manufacturer's specifications • Synthetic/Non-synthetic • Component/System compatibility • Eco-friendly

9. Select hydraulic hoses and fittings	• Hose construction
	• Ratings
	• Compatability
	• Hose application
	• Fitting types
	  ○ National Pipe Thread (NPT)
	  ○ Joint Industry Conference (JIC)
	  ○ O-ring Boss (ORB)
	  ○ O-ring Face (ORFS)
	  ○ Split flange
	  ○ Society of Automotive Engineers (SAE)
	  ○ Reusable/Permanent

10. Assemble hydraulic hoses and fittings	• Permanent • Reusable

Achievement Criteria

Performance: The learner will be able to service hydraulic components.

Conditions: The learner will be given

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with mobile hydraulic systems

Criteria: The learner will be evaluated on

- Following safe work practices throughout entire task including lock out procedures
- Conducting task in a logical manner
- Conducting task according to manufacturer's specifications
- Conducting task according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts

Line (GAC): D SERVICE, DIAGNOSE, AND REPAIR ELECTRICAL AND ELECTRONIC SYSTEMS

Competency: D1 Describe electricity

Objectives

To be competent in this area, the individual must be able to:

- Define electrical terminology.
- Explain basic circuit concepts.
- Perform circuit calculations.
- Describe magnetic theory.
- Identify common electrical and electronic components.
- Interpret wiring diagrams and symbols.

LEARNING TASKS	CONTENT
1. Define electrical terminology	• Electrical quantities and their units and prefixes • Voltage • Current • Resistance • Power/Watts • Circuit terminology • Open circuit • Closed circuit • Short circuit • Continuity • Ground circuit • Ground fault • Series circuit • Parallel circuit • Series parallel circuit
2. Explain basic circuit concepts and	• Sources of electricity • Atomic theory • Current flow • Electrons • Protons • Neutron • Conductors • Insulators • Semiconductors • Ohm's Law

LEARNING TASKS	CONTENT
	• Watt's Law • Basic circuit • Series circuits • Parallel circuits • Series parallel circuits • Source • Load • Closed circuit • Electrical relationships
3. Perform calculations	• Ohm's Law • Watt's Law • Series circuits • Parallel circuits • Series parallel circuits

4. Describe magnetic theory	• Properties of magnetic lines of force
	• Terminology
	• Relationship to electric current
	• Electromagnetic induction
	  ○ Types
	  ○ Requirements
	• Factors affecting magnitude

5. Identify common electrical components	• Lamps
	• Switches
	• Relays
	• Solenoids
	• Resistors
	  ○ Fixed
	  ○ Variable
	• Capacitors
	• Motors
	• Alternators
	• Fuses

6. Describe the basic function of common electronic components	• Diodes • Transistors

LEARNING TASKS	CONTENT
7. Interpret basic electrical wiring diagrams	• Types • Wiring schematic and diagrams • Symbols • Abbreviations

Line (GAC): D SERVICE, DIAGNOSE, AND REPAIR ELECTRICAL AND ELECTRONIC SYSTEMS

Competency: D2 Use electrical testing instruments

Objectives

To be competent in this area, the individual must be able to:

- Use electrical measuring devices

LEARNING TASKS	CONTENT
1. Describe how to use electrical measuring devices	• Analog vs. digital • Voltmeters • Ammeters • Ohmmeters • Multimeters (VOM) • Amp clamp • Load tester • Capacitance tester • Continuity testers • Test lights • Safety precautions
2. Diagnose electrical circuits	• Voltage drops • Shorts • Grounds • Opens • Resistance • Amperage draw

Line (GAC): D SERVICE, DIAGNOSE, AND REPAIR ELECTRICAL AND ELECTRONIC SYSTEMS

Competency: D3 Service, diagnose, and repair battery systems

Objectives

To be competent in this area, the individual must be able to:

- Describe battery design and operation
- Select batteries
- Test batteries
- Maintain batteries
- Diagnose causes of battery failure
- Remove and replace batteries
- Use booster equipment and chargers
- Repair battery systems

LEARNING TASKS	CONTENT

1. Describe safety considerations when working with batteries	• Personal protection
	  ○ Face shield
	  ○ Apron
	• Hydrogen gassing
	• Acid
	• Frozen batteries
	• Short circuit (arcing)
	• Environmental considerations
	  ○ Recycling
	  ○ Disposal

2. Describe the design and construction of the various types of batteries	• Types
	  ○ Vented
	  ○ Sealed
	  ○ Deep-cycle
	  ○ Gel
	  ○ Absorbed Glass Matt (AGM)
	  ○ Lithium
	  ○ Capacitor
	• Plates
	  ○ Grid material
	  ○ Active material
	• Plate straps
	• Separators
	• Electrolyte/Gel

LEARNING TASKS	CONTENT
	• Case • Terminals
3. Describe the chemical action that takes place in a battery during charging and discharging	• Charging cycle • Discharging cycle

4. Select batteries	• Battery rating methods
	  ○ Cold cranking amperes (CCA)
	  ○ Cranking amperes (CA)
	  ○ Reserve capacity
	  ○ Amp hour
	• Physical dimensions

5. Service batteries	• Safety precautions • Inspection • Cleaning • Terminal servicing • Charging • Replacement • Scheduled maintenance • Storage and handling
6. Diagnose batteries	• Specific gravity • Open circuit voltage test • Load test • 3 minute fast charge test • Battery Impedance test
7. Repair battery systems	• Battery securement • Cable connectors • Battery cable • Isolation devices • Battery enclosure
8. Use booster equipment and chargers	• Safety • Voltage • Polarity • Amperage • Battery maintainers

LEARNING TASKS	CONTENT

	• Smart chargers
	• Boosters
	  ○ Battery
	  ○ Jumper pack

Achievement Criteria

Performance	The learner will be able to service, diagnose, and repair battery systems.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with battery systems
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): D SERVICE, DIAGNOSE, AND REPAIR ELECTRICAL AND ELECTRONIC SYSTEMS

Competency: D4 Service starting and charging systems

Objectives

To be competent in this area, the individual must be able to:

- Describe starting and charging circuits.
- Identify starting and charging circuit components.
- Service starting and charging circuits.

LEARNING TASKS	CONTENT

1. Describe starting and charging circuits	• Purpose
	• Operation
	• Connections
	• System voltage
	• Battery configuration
	  ○ Series
	  ○ Parallel
	• Series parallel
	• Isolation switches
	• Starter motor assembly
	• Alternator assembly
	• Solenoids and relays
	• Magnetic switch
	• Thermal switch
	• Ignition switch
	• Neutral safety switch/clutch pedal switch
	• Cables and terminals

2. Identify components of starting circuits	• Battery • Starter motor assembly • Solenoids and relays • Ignition switch • Neutral safety switch/clutch pedal switch • Cables and terminals

3. Identify components of charging circuits	• Alternator Types
	  ○ Brushless
	  ○ Brushed

LEARNING TASKS	CONTENT
	○ Gear driven ○ Belt driven ○ Air oil cooled • Internal/external regulators • Belts • Cooling fins • Pullys • ECM • Mounting hardware
4. Service starting and charging circuits	• Sensory inspection • Output voltage/amperage test • Current draw test • Voltage drop test • Belt condition and tension • Component removal and replacement • Cleaning components and connections • Fault codes

Achievement Criteria

Performance	The learner will be able to service charging and starting systems.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with functional starting and charging circuit
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): D SERVICE, DIAGNOSE, AND REPAIR ELECTRICAL AND ELECTRONIC SYSTEMS

Competency: D5 Service electrical circuits

Objectives

To be competent in this area, the individual must be able to:

- Describe electrical circuits and faults
- Service consumable electrical components

LEARNING TASKS	CONTENT

1. Describe electrical circuits	• Wiring harness
	• Trailer wiring circuits
	  ○ Connectors
	  ○ Junction box
	  ○ Wiring harness
	• Circuit identification
	• Wire gauge
	• Terminals/connectors
	  ○ Crimped
	  ○ Soldered

2. Describe sources of circuit faults	• Blown fuses • Fusable link • Circuit Breaker • Connection • Wiring
3. Service consumable electrical components	• Lamps • Switches • Motors • Fuses • Adjustment • Calibration • Anti-corrosion compound

Achievement Criteria

Performance	The learner will be able to service electrical circuits.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with electrical components
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): E SERVICE, DIAGNOSE, AND REPAIR FRAMES, STEERING, AND SUSPENSION

Competency: E1 Service, diagnose, and repair tires, wheels, and hubs

Objectives

To be competent in this area, the individual must be able to:

- Describe tires, rims, wheels, and hubs
- Describe steering geometry
- Describe traction devices
- Service tires, rims, wheels and hubs
- Diagnose tires, rims, wheels and hubs
- Repair tires, wheels, and hubs

LEARNING TASKS	CONTENT

1. Describe tires and rims	• Types of tires
	  ○ Radial
	  ○ Bias
	• Rating
	  ○ Load range
	  ○ Size
	  ○ Ply
	• Types of rims
	  ○ Dayton
	  ○ Hub pilot
	  ○ Stud pilot
	  ○ Multi-piece
	• Inflation and monitoring systems

2. Diagnose tires and rims	• Sensory inspection • Tire wear and damage • Wheel run out • Air pressure • Tread depth
3. Service tires and rims	• Safety precautions • Inspection • Rim cleanout • Pressure • Wheel nut torque • Matching • Scheduled maintenance

LEARNING TASKS	CONTENT

4. Repair tires and rims	• Repair/replacement
	• Balancing
	  ○ Static
	  ○ Dynamic
	• Mounting
	  ○ Runout
	• Plug and patch
	• Tube

5. Describe wheel hubs	• Types
	  ○ Conventional
	  ○ Planetary
	  ○ Unitized
	• Components
	  ○ Bearings
	  ○ Seals
	  ○ Studs
	  ○ Separator rings
	• Lubrication

6. Diagnose wheel hubs	• Sensory inspection
	• Testing
	  ○ End play
	  ○ Rolling resistance
	  ○ Leaks

7. Service wheel hubs	• Sensory inspection • Lubrication • Level • Condition

8. Repair wheel hubs	• Repair/replacement
	  ○ Bearings
	  ○ Seals
	  ○ Hubs
	  ○ Studs
	• Adjustment
	  ○ Bearing end play
	  ○ Rolling torque

Achievement Criteria

Performance	The learner will be able to service, diagnose, and repair tires, wheels, and hubs.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with tires and wheel assemblies
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): E SERVICE, DIAGNOSE, AND REPAIR FRAMES, STEERING, AND SUSPENSION

Competency: E2 Service steering systems

Objectives

To be competent in this area, the individual must be able to:

- Describe steering systems.
- Service steering systems.

LEARNING TASKS	CONTENT

1. Describe basic steering systems fundamentals	• Types
	  ○ Truck power assist
	  ○ Track steering
	  ○ Wheeled equipment steering
	• System Components
	  ○ Kingpins
	  ○ Tie-rod ends
	  ○ Drag link
	  ○ Tie rod
	  ○ Spindle
	  ○ Steering arms
	  ○ Steering gear
	  ○ Orbital valves/hand metering unit
	  ○ Cylinder
	  ○ Drive motor
	  ○ Steering pumps/motor
	  ○ Steering column
	  ○ Control valves
	  ○ Clutches

2. Service steering systems	• Sensory inspection
	• Removal or replacement
	• Installation
	• Lubrication
	  ○ Level
	  ○ Condition
	  ○ Filters
	  ○ Grease
	• Scheduled maintenance
	• Adjustment
	  ○ Drag link
	  ○ Tie rod ends

LEARNING TASKS

CONTENT

- Axle stops
- Steering gear
- Toe
- Track tension

- Calibration

Achievement Criteria

Performance	The learner will be able to service steering systems.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with various steering systems
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): E SERVICE, DIAGNOSE, AND REPAIR FRAMES, STEERING, AND SUSPENSION

Competency: E3 Service, diagnose, and repair suspension systems

Objectives

To be competent in this area, the individual must be able to:

- Describe suspension systems
- Service suspension systems
- Diagnose suspension systems
- Repair suspension systems

LEARNING TASKS	CONTENT

1. Describe wheeled equipment suspension systems	• Types
	  ○ Hydro pneumatic
	  ○ Rigid
	  ○ Rubber block
	  ○ Oscillating axle
	• Components
	• Operation

2. Service wheeled equipment suspension systems	• Sensory inspection
	• Adjustments
	  ○ Pressure
	  ○ Height
	• Calibration
	• Lubrication
	• Scheduled maintenance

3. Diagnose wheeled equipment suspension systems	• Sensory inspection
	• Measuring
	  ○ Pressure
	  ○ Height
	  ○ Wear

4. Repair wheeled equipment suspension systems	• Repair/replacement/rebuild • Adjustment

5. Describe truck and trailer suspension systems	• Types
	  ○ Walking beams
	  ○ Leaf springs
	  ○ Air bag

LEARNING TASKS	CONTENT
	○ Rubber block ○ Lift axle • Components ○ Air bag ○ Shock aborbers ○ Spring construction ○ Hangers and attachments ○ Air suspension lockout ○ Valves • Operation
6. Service truck and trailer suspension systems	• Sensory inspection • Adjustments ○ Pressure ○ Height • Calibration • Lubrication • Scheduled maintenance
7. Diagnose truck and trailer suspension systems	• Sensory inspection • Measuring ○ Pressure ○ Height ○ Wear
8. Repair truck and trailer suspension systems	• Sensory inspection • Repair/replacement/rebuild • Adjustments • Lubrication

Achievement Criteria

Performance	The learner will be able to service, diagnose, and repair suspension systems.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with various suspension systems
Criteria	The learner will be evaluated on • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): E SERVICE, DIAGNOSE, AND REPAIR FRAMES, STEERING, AND SUSPENSION

Competency: E5 Service, diagnose, and repair frames

Objectives

To be competent in this area, the individual must be able to:

- Describe types of frames
- Diagnose frames
- Repair frames

LEARNING TASKS	CONTENT

1. Describe rail and frame types	• Types of rails
	  ○ Materials
	  ▪ Mild steel
	  ▪ High tensile steel
	  ▪ Aluminum
	  ○ Strength
	  ▪ Resisting bending moment (RBM)
	  ▪ Section modulus
	  ▪ Yield strength
	• Types of frames
	  ○ Channel
	  ○ Rigid
	  ○ Articulated
	  ○ I beam
	• Components
	  ○ Cross members
	  ○ Brackets
	  ○ Mounts
	  ○ Hardware
	  ○ Swing Bearing
	  ○ Fasteners
	  ▪ Grade
	  ▪ Type

2. Service frames	• Swing bearing • Measurement • Lubrication
3. Diagnose frames	• Sensory inspection • Measuring

LEARNING TASKS	CONTENT

	• Projection
	  ○ Laser
	  ○ String
	  ○ Ultrasonic

4. Repair Frames	• Sensory inspection
	• Rail replacement
	• Rail sectional replacement
	  ○ Welding procedure
	  ○ Brace support
	• Repair
	  ○ Crack
	  ○ Bent
	  ○ Twisted
	• Adjustments
	  ○ Alignment

Achievement Criteria

Performance	The learner will be able to service, diagnose, and repair frames.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with various frame configurations
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): E SERVICE, DIAGNOSE, AND REPAIR FRAMES, STEERING, AND SUSPENSION

Competency: E-F11 Remove and install undercarriage

Objectives

To be competent in this area, the individual must be able to:

- Describe track machine undercarriages
- Remove and reinstall track machine undercarriages

LEARNING TASKS	CONTENT

1. Describe undercarriages	• Types
	  ○ Steel
	  ○ Rubber
	• Components
	  ○ Rollers
	  ○ Sprockets
	  ○ Tracks
	  ○ Idler
	  ○ Boggies
	  ○ Pivot shaft
	  ○ Equalizer bar
	• Operation

2. Service undercarriages	• Adjustment
	• Lubrication
	• Inspection
	  ○ Measuring
	  ○ Sensory

3. Remove and install undercarriages	• Components
	  ○ Rollers
	  ○ Sprockets
	  ○ Tracks
	  ○ Idler

Line (GAC): F SERVICE, DIAGNOSE, AND REPAIR TRAILERS

Competency: F1 Service, diagnose, and repair landing gear and trailer accessories

Objectives

To be competent in this area, the individual must be able to:

- Describe landing gear and trailer accessories
- Service trailer accessories
- Diagnose trailer accessories
- Repair trailer accessories
- Service landing gear
- Diagnose landing gear
- Repair landing gear

LEARNING TASKS	CONTENT

1. Describe landing gear and trailer accessories	• Lift gates
	  ○ Hydraulic
	  ○ Mechanical
	• Landing gear
	  ○ Hydraulic
	  ○ Electric
	  ○ Mehanical
	• Landing gear components
	  ○ Gears
	  ○ Cross rods
	  ○ Support
	• Trailer accessories
	  ○ Tarping systems
	  ○ Ladders
	  ○ Ratchet winch
	  ○ Aerodynamic systems
	• Operation

2. Service landing gear and trailer accessories	• Operational checks • Lubrication • Adjustments • Scheduled maintenance

3. Diagnose landing gear and trailer accessories	• Inspection
	  ○ Sensory
	  ○ Measurement
	  ○ Operational

LEARNING TASKS	CONTENT
	○ Pressure/flow ○ Voltage • Lubrication
4. Repair landing gear and trailer accessories	• Repair/replacement/rebuild • Adjustments

Achievement Criteria

Performance — The learner will be able to service, diagnose, and repair landing gear and trailer accessories.

Conditions — The learner will be given

- Tools
- Test Equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with various landing gear and trailer accessories

Criteria — The learner will be evaluated on

- Following safe work practices throughout entire task including lock out procedures
- Conducting task in a logical manner
- Conducting task according to manufacturer's specifications
- Conducting task according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts

Line (GAC): F SERVICE, DIAGNOSE, AND REPAIR TRAILERS

Competency: F2 Service, diagnose, and repair coupling systems

Objectives

To be competent in this area, the individual must be able to:

- Describe coupling systems
- Service coupling systems
- Diagnose coupling systems
- Repair coupling systems

LEARNING TASKS	CONTENT

1. Describe coupling systems	• Trailer Combination Types
	  ○ A train
	  ○ B train
	  ○ C train
	• Coupling types
	  ○ Fifth wheel
	• Purpose and design

2. Describe couplers	• Ratings
	• Fifth wheel
	  ○ Top plate
	  ○ Base plate
	  ○ Mounting brackets
	  ○ Jaw and lock mechanisms
	  ○ Jaw release mechanisms
	  ○ Slide lock mechanisms
	  ○ Safety devices
	• Fifth wheel mounting types
	  ○ Fixed
	  ○ Sliding
	  ○ Osillating
	• Upper coupler
	  ○ Bolster plates
	  ○ King pins
	  ▪ Size
	  ▪ Mounting
	• Pintle
	  ○ Draw bar
	  ○ Pintle eye/hook
	  ○ Bushing
	  ○ Compensator

LEARNING TASKS	CONTENT
	○ Buffers ▪ Pneumatic ▪ Hydraulic ○ Safety chains • Ball ○ Safety chains
3. Service couplers	• Sensory inspection • Measurement • Adjustment • Lubrication
4. Diagnose couplers	• Sensory inspection • Testing ○ Operational • Measurement
5. Repair couplers	• Repair/replacement/rebuild • Adjustments • Verification of operation

Achievement Criteria

Performance	The learner will be able to service, diagnose, and repair coupling systems.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with various couplers
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): F SERVICE, DIAGNOSE, AND REPAIR TRAILERS

Competency: F3 Service, diagnose, and repair trailer body components

Objectives

To be competent in this area, the individual must be able to:

- Describe trailer bodies and components
- Service trailer body components
- Diagnose trailer body components
- Repair trailer body components

LEARNING TASKS	CONTENT

1. Describe trailer bodies and components	• Types
	  ○ Dump
	  ○ Logging
	  ○ Van
	  ○ Flat deck
	  ○ Car carrier
	  ○ Tanker
	  ○ Dolly
	  ○ Low bed
	• Components
	  ○ Frames
	  ○ Doors
	  ▪ Hinged
	  ▪ Roll up
	  ○ Bunks
	  ○ Bumpers
	  ○ Sliding bogies
	  ○ Tanks
	  ○ Valves
	  ○ Manifold piping
	  ○ Gauges
	  ○ Transfer pump
	  ○ Reflective tape
	  ○ Box
	  ▪ Transfer
	  ▪ Dump

2. Service trailer body components	• Sensory inspection • Measurement • Operation • Adjustments

LEARNING TASKS	CONTENT
	• Lubrication

3. Diagnose trailer body components	• Sensory inspection
	• Measurement
	• Operation
	• Testing
	  ○ Pressure
	  ○ Valves

4. Repair trailer body components	• Repair/replacement/rebuild • Operation • Adjustment • Lubrication • Verification of repair

Achievement Criteria

Performance: The learner will be able to service, diagnose, and repair trailer body components.

Conditions: The learner will be given

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with a variety of trailer bodies

Criteria: The learner will be evaluated on

- Following safe work practices throughout entire task including lock out procedures
- Conducting task in a logical manner
- Conducting task according to manufacturer's specifications
- Conducting task according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts

Line (GAC): F SERVICE, DIAGNOSE, AND REPAIR TRAILERS

Competency: F4 Service heating and refrigeration systems

Objectives

To be competent in this area, the individual must be able to:

- Describe heating and refrigeration systems.
- Service heating and refrigeration systems.

LEARNING TASKS	CONTENT

1. Describe heating and refrigeration systems	• Trailer mounted
	  ○ Cooling unit
	  ○ Heating unit
	  ○ Combination unit
	• Drive types
	  ○ Fuel
	  ○ Electric
	  ○ Hybrid
	• Components
	  ○ Valves
	  ○ Heat exchangers
	  ○ Compressor
	  ○ Generator
	  ○ Battery
	  ○ Electronic control module (ECM)
	  ○ Control panel
	  ○ Sensors
	  ○ Switches
	  ○ Motors
	• Operational modes
	  ○ Heating
	  ○ Cooling
	  ○ Defrost

2. Service heating and refrigeration systems	• Inspection
	  ○ Sensory
	  ○ Operational
	  ○ Temperature
	• Filters
	• Lubricants
	• Belts

Achievement Criteria

Performance	The learner will be able to service heating and refrigeration systems.
Conditions	The learner will be given • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with heating and refrigeration units
Criteria	The learner will be evaluated on • Following safe work practices throughout entire task including lock out procedures • Conducting task in a logical manner • Conducting task according to manufacturer's specifications • Conducting task according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): G SERVICE, DIAGNOSE, AND REPAIR HEATING, VENTILATION, AND AIR CONDITIONING

Competency: G1 Describe heating and air conditioning fundamentals

Objectives

To be competent in this area, the individual must be able to:

- Identify heating and air conditioning components
- Describe the construction and operation of heating and air conditioning systems
- Describe the impact of refrigerants on the environment
- Apply legislated procedures when dealing with systems containing refrigerants

LEARNING TASKS	CONTENT
1. Describe principles of heating and air conditioning systems	• Describe the laws of thermodynamics

2. Identify components of heating and air conditioning systems	• Heater core
	• Valves
	• Controls
	• Ducts
	• Filters
	• Resistor pack
	• Door actuator
	• Compressor
	• Drive systems
	• Evaporator
	• Fans
	• Condenser
	• Receiver-drier/accumulator
	• Orifice tubes/expansion valves
	• Refrigerant
	  ○ Ozone depleting potential
	  ○ Global warming potential
	  ○ Types
	• Lubricants
	  ○ Mineral
	  ○ Synthetic
	• Controls
	• Sensors
	• Hoses, piping and connectors
	• Seats and gaskets

LEARNING TASKS	CONTENT
3. Describe the design and operation of heating and air conditioning systems	• Heating system • Refrigeration cycle • Compressor • Evaporator • Condenser • Receiver-drier/accumulator • Orifice tubes/expansion valves • Refrigerant • Lubricants • Controls • Sensors
4. Describe the impact of refrigerants on the environment	• Ozone depletion • Global warming
5. Identify legislation dealing with the use and handling of refrigerants	• Training requirements • Certification • Jurisdictional regulations

Line (GAC): H SERVICE, DIAGNOSE, AND REPAIR ENGINES AND SUPPORTING SYSTEMS

Competency: H2 Service engine support systems

Objectives

To be competent in this area, the individual must be able to:

- Describe engine support systems
- Service engine support systems

LEARNING TASKS	CONTENT

1. Describe cooling systems	• Types
	  ○ Air
	  ○ Liquid
	• Coolants
	  ○ Types
	• Components
	  ○ Radiator/pressure cap
	  ○ Thermostat
	  ○ Expansion/surge tank
	  ○ Fan system
	  ○ Pump
	• Shutter system
	• Operation

2. Service cooling systems	• Sensory inspection • Adjustment • Testing • Scheduled maintenance

3. Describe lubrication systems	• Types
	• Components
	  ○ Filters/bypass
	  ○ Pumps
	  ○ Pressure regulators
	  ○ Coolers
	• Operation

4. Service lubrication systems	• Sensory inspection • Testing • Scheduled maintenance ○ Oil/filter analysis

LEARNING TASKS	CONTENT
	○ Filter service ○ Oil change
5. Describe air induction systems	• Types ○ Naturally aspirated ○ Boosted • Components ○ Turbo charger ○ Filteration ○ Ducting ○ Positive air shut offs ○ Coolers ○ Warning devices • Operation
6. Service air induction systems	• Sensory inspection • Scheduled maintenance ○ Filter service
7. Describe exhaust systems	• Components ○ Turbo chargers ○ Mufflers ○ Manifold ○ Emission systems • Operation
8. Service exhaust systems	• Sensory inspection • Scheduled maintenance

Line (GAC): H SERVICE, DIAGNOSE, AND REPAIR ENGINES AND SUPPORTING SYSTEMS

Competency: H4 Service diesel fuel supply systems

Objectives

To be competent in this area, the individual must be able to:

- Describe characterstics of diesel fuel
- Describe diesel fuel supply systems
- Service diesel supply systems

LEARNING TASKS	CONTENT
1. Describe characteristics of diesel fuel	• Grades • Viscosity • Flash point • Cetane • Sulfur content • Cloud point • Storage • Disposal

2. Describe diesel fuel supply systems	• Components
	  ○ Tank
	  ○ Lines
	  ○ Filters
	  ○ Low pressure pumps
	  ○ Water separator
	  ○ Sensors
	  ○ Regulator
	• Operation

3. Service diesel fuel supply systems	• Sensory inspection • Priming • Additives • Scheduled maintenance

Line (GAC): H SERVICE, DIAGNOSE, AND REPAIR ENGINES AND SUPPORTING SYSTEMS

Competency: H-F12 Remove and install diesel engines

Objectives

To be competent in this area, the individual must be able to:

- Describe the procedures to prepare a diesel engine for removal
- Remove diesel engines in trucks and heavy equipment applications
- Install diesel engines in trucks and heavy equipment applications

LEARNING TASKS	CONTENT

1. Describe the procedures to prepare a diesel engine for removal	• Cleanliness and organization
	• Lock out
	  ○ Electrical
	  ○ Mechanical
	• Disconnecting batteries
	• Precautions
	  ○ Electronic devices
	  ○ Environmental
	  ○ Fuel/oil lines
	  ○ Air conditioning
	  ○ Estimate weight of engine
	• Tagging before removal
	  ○ Oil lines
	  ○ Air lines
	  ○ Coolant hoses
	  ○ Wiring
	• Noting location of all accessories and attachments

2. Remove engines	• Support and chocking of vehicle/equipment • Draining systems • Removal of hoses/lines and wiring • Support or removal of attachments • Selection and use of rigging/lifting devices • Supporting engine after removal
3. Install engines	• Selection and use of rigging/lifting devices • Installation of attachments

LEARNING TASKS	CONTENT
	• Installation of hoses/lines and wiring • Refilling systems • Verification of crankshaft rotation and endplay • Engine pre-start checks • Verification of operation and checking for leaks

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F13 Service clutches

Objectives

To be competent in this area, the individual must be able to:

- Describe the principles and operation of clutches and related components
- Service clutches and related components

LEARNING TASKS	CONTENT

1. Describe clutches and related components	• Clutch Types
	  ○ Diaphragm
	  ○ Pull/Push
	  ○ Self-adjusting
	  ○ Over centre
	  ○ Jaw
	  ○ Wet/dry
	  ○ Single/multi-plate
	  ○ Magnetic
	  ○ Band
	• Clutch actuation systems
	• Operation

2. Service clutches and related components	• Sensory inspection
	• Adjustment
	  ○ Linkage
	  ○ Internal/external
	• Operational check
	• Lubrication

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F14 Service manual transmissions

Objectives

To be competent in this area, the individual must be able to:

- Describe manual transmissions
- Service manual transmissions

LEARNING TASKS	CONTENT

1. Describe manual transmissions	• Types
	  ○ Single countershaft
	  ○ Multiple countershaft
	• Components
	• Shifting operation
	  ○ Mechanical
	  ○ Pneumatic
	• Lubrication
	  ○ Operation

2. Service manual transmissions	• Sensory inspection
	• Operational checks
	• Scheduled maintenance
	  ○ Lubrication
	  ○ Filters

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F15 Service powershift and automatic transmissions

Objectives

To be competent in this area, the individual must be able to:

- Describe torque converters
- Describe powershift and automatic transmissions
- Service torque converters
- Service powershift and automatic transmissions

LEARNING TASKS	CONTENT

1. Describe torque converters	• Types
	  ○ Conventional
	  ○ Dividers
	  ○ Fluid coupler
	• Components
	• Fluids
	• Operation
	  ○ Stages
	  ○ Phases

2. Describe powershift and automatic transmissions	• Types
	  ○ Countershaft
	  ○ Planetary
	  ○ Shift operation
	• Operation

3. Service powershift and automatic transmissions	• Sensory Inspection • Fluid level • Filter • Fluid/filter analysis • Operational check • Calibration
4. Service torque converters	• Sensory inspection • Fluid level • Filter • Fluid/filter analysis • Operational check

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F16 Service drivelines

Objectives

To be competent in this area, the individual must be able to:

- Describe drivelines and their components
- Service drivelines and their components

LEARNING TASKS	CONTENT

1. Describe drivelines and components	• Types
	  ○ Main drive shaft
	  ○ Power takeoff shaft (PTO)
	• Arrangements
	  ○ Parrallel
	  ○ Non-parallel
	• Components
	  ○ U-joint
	  ○ Slipshaft
	  ○ Steady bearing
	  ○ Yoke
	  ○ Tube
	  ○ Shear pins
	• Operation
	• Working angles
	• Phasing
	• Balance
	• Total Indicated Runout (TIR)

2. Service drivelines and components	• Sensory Inspection • Lubrication • Scheduled maintenance

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F17 Service drive axles

Objectives

To be competent in this area, the individual must be able to:

- Describe drive axles
- Service drive axles

LEARNING TASKS	CONTENT

1. Describe drive axles	• Drive axle types
	  ○ Single axle
	  ○ Tandem axle
	  ○ Tridem axle
	• Drive types
	  ○ Conventional
	  ○ Electric
	• Components
	  ○ Differentials
	  ▪ Lockers
	  ▪ Limited slip
	  ○ Axle shafts
	  ▪ Semi-floating
	  ▪ Full-floating
	  ○ Gears
	  ○ Thrust pin
	• Controls and circuits
	• Mounting
	• Lubrication
	• Cooling
	• Operation

2. Service drive axles	• Sensory inspections • Operational check • Lubrication • Filter/breathers

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F18 Service final drives

Objectives

To be competent in this area, the individual must be able to:

- Describe machine final drives
- Service machine final drives

LEARNING TASKS	CONTENT

1. Describe final drives	• Types
	  ○ Inboard
	  ○ Outboard
	  ○ Chain
	  ○ Gear
	  ▪ Planetary
	  ▪ Bull and pinion
	• Components
	• Operation

2. Service final drives	• Sensory inspection • Lubrication • Filters • Operational test

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F19 Remove and install transmissions

Objectives

To be competent in this area, the individual must be able to:

- Identify transmissions
- Remove transmissions
- Install transmissions

LEARNING TASKS	CONTENT

1. Identify transmissions	• Types
	  ○ Manual shift
	  ○ Automatic
	  ○ Automated
	  ○ Powershift
	• Components
	• Related components
	  ○ Clutch
	  ○ Torque converter
	• Shifting operation
	  ○ Mechanical
	  ○ Pneumatic
	  ○ Electronic
	• Lubrication

2. Remove transmissions	• Supporting and chocking vehicle/equipment/attachments • Draining system • Fluid • Air • Removal of hoses/lines and wiring • Support or removal attachments • Selection and use of rigging/lifting devices • Support of transmission after removal
3. Install transmissions	• Selection and use of rigging/lifting devices • Installation of attachments • Installation of hoses/lines and wiring • Refill of systems

LEARNING TASKS	CONTENT
	• Verification of crankshaft rotation and endplay • Adjustments • Verification of operation and checking for leaks

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F20 Remove and install drivelines and differentials

Objectives

To be competent in this area, the individual must be able to:

- Remove drivelines and drive axle carriers
- Install drivelines and drive axle carriers

LEARNING TASKS	CONTENT

1. Remove drivelines	• Components
	  ○ U-joint
	  ○ Yoke
	• Supporting and chocking vehicle/equipment
	• Selection and use of rigging/lifting devices
	• Supporting driveline after removal

2. Install drivelines	• Components
	  ○ U-joint
	  ○ Yoke
	• Selection and use of rigging/lifting devices
	• Lubrication
	• Verification of system operation and checking for leaks

3. Remove drive axle carriers	• Supporting and chocking vehicle/equipment • Draining system • Removal of hoses/lines and wiring • Support or removal of attachments • Selection and use of rigging/lifting devices • Supporting carrier after removal
4. Install drive axle carriers	• Selection and use of rigging/lifting devices • Installation of attachments • Installation of hoses/lines and wiring • Lubrication • Verification of system operation and checking for leaks

Line (GAC): I SERVICE, DIAGNOSE, AND REPAIR POWERTRAINS

Competency: I-F21 Remove and install final drives

Objectives

To be competent in this area, the individual must be able to:

- Remove final drives
- Install final drives

LEARNING TASKS	CONTENT
1. Remove final drives	• Supporting and chocking vehicle/equipment • Draining system • Removal of hoses/lines and wiring • Support or removal attachments • Selection and use of rigging/lifting devices • Supporting final drive after removal
2. Install final drives	• Selection and use of rigging/lifting devices • Installation of attachments • Installation of hoses/lines and wiring • Lubrication • Adjustments • Verification of system operation and checking for leaks

Line (GAC): J SERVICE, DIAGNOSE, AND REPAIR STRUCTURAL COMPONENTS AND ACCESSORIES

Competency: J1 Describe protective structures

Objectives

To be competent in this area, the individual must be able to:

- Describe regulations related to protective structures.
- Describe inspection procedures of protective structures.

LEARNING TASKS	CONTENT
1. Describe structural components	• Roll Over Protective Structure (ROPS) • Falling Objects Protective Structure (FOPS) • Operator Protective Structure (OPS)

2. Describe inspection procedures	• Damage
	  ○ Cracks
	  ○ Dents
	  ○ Fatigue
	  ○ Alterations
	• Certification labeling
	• Secondary escape
	• Safety equipment

3. Describe operational regulations	• Components
	  ○ Safety glass
	  ○ Screens

Line (GAC): J SERVICE, DIAGNOSE, AND REPAIR STRUCTURAL COMPONENTS AND ACCESSORIES

Competency: J2 Service, diagnose, and repair cab structures

Objectives

To be competent in this area, the individual must be able to:

- Describe cab, bodies, and components
- Service cab, bodies, and components
- Diagnose cab, bodies, and components
- Repair cab, bodies, and components

LEARNING TASKS	CONTENT

1. Describe cabs, bodies, and components	• Body types
	  ○ Articulating
	  ○ Coach
	  ○ Transit
	  ○ School
	  ○ Monocoque
	• Cab types
	  ○ Conventional
	  ○ Cab over
	  ○ Tilting cab
	• Cab mounting
	  ○ Fixed
	  ○ Air ride
	  ○ Cushion
	• Components
	  ○ Doors
	  ○ Windows
	  ○ Hood
	  ○ Seats
	  ○ Seat belts
	  ○ Supplemental Restraint System (SRS)
	  ○ Accessibility devices
	  ○ Sleepers
	  ○ Emergency system
	  ○ Aerodynamic devices
	• Operation

2. Service cabs, bodies, and components	• Sensory inspection ○ Components • Operational testing

LEARNING TASKS	CONTENT
	○ Restraint certification • Adjustment • Lubrication
3. Diagnose cabs, bodies, and components	• Sensory inspection • Testing ○ Operational ○ Pressure ○ Leaks • Adjustment • Lubrication • Supplemental Restraint System (SRS) • Fault codes
4. Repair cabs, bodies, and components	• Sensory inspection • Repair/replacement/rebuild • Lubrication • Adjustment ○ Hood ○ Cab ○ Doors ○ Windows ○ Cab suspension • Verification of system operation

Achievement Criteria

Performance: The learner will be able to service, diagnose, and repair cab structures.

Conditions: The learner will be given

- Tools
- Test equipment
- Manufacturer's specifications
- A work place or training environment
- Equipment with cab structures

Criteria: The learner will be evaluated on

- Following safe work practices throughout entire task including lock out procedures
- Conducting task in a logical manner
- Conducting task according to manufacturer's specifications
- Conducting task according to work place requirements

Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts

Line (GAC): L USE COMMUNICATION AND MENTORING TECHNIQUES

Competency: L1 Use communication techniques

Objectives

To be competent in this area, the individual must be able to:

- Use communication techniques
- Use digital communication technologies and platforms

LEARNING TASKS	CONTENT

1. Use effective communication skills	• Safety and information meetings
	• Verbal and written instructions
	• Professionalism
	  ○ Participation
	  ○ Responsibilites
	  ○ Respect
	• Harrassment and discrimination
	• Constructive feedback

2. Use active listening	• Attention • Clarification • Acknowledgement of understanding • Eye contact • Engagement • Open-ended questions

3. Use digital communication technologies and platforms	• Email
	• Text messages
	• Social media
	• Record keeping
	  ○ Apps and platforms
	  ○ Service/work orders
	  ○ Inspection reports

Section 4

TRAINING PROVIDER STANDARDS

Facility Requirements

Classroom Area

- Recommended 2.5 Sq. meters per student
- Projection screen, multimedia projector, whiteboard or similar
- Seating and tables suitable for lecturing
- Compliance with all safety codes

Shop Area

- Recommended 25 Sq. meters per student
- Meet all safety,fire, and environmental codes
- Good lighting
- Appropriate lifting cranes as required to move industry equipment
- Approved ventilation systems

Lab Requirements

- Recommended 10 Sq. meters per student
- Computer labs on-site

Student Facilities

- 1 locker per student
- Study areas
- Computer labs
- Food facility
- Hand wash facility
- Washroom facility

Instructor's Office Space

- Recommended 3.5 Sq. Meters

Other

- Storage space for classroom and shop props
- Parking space for heavy equipment and trucks
- Outside machine/truck wash bay

Tools and Equipment

Shop Equipment

Required Safety Equipment

- Aerial work platform
- Apron
- Arc-rated faceshield/helmet
- Arc-rated protective clothing
- Emergency backup lighting
- Eye wash station
- Face shield
- Fall arrest equipment
- Fall prevention equipment
- Fire extinguisher
- Fireproof blanket
- First aid station
- Gas mask
- Gloves
- Goggles
- Hearing protection
- High voltage gloves
- High voltage safety hook
- Ladder
- Leather gloves
- Respirator
- Safety boots
- Safety cage
- Safety glasses
- Safety hat
- Splash suit

Other Required Equipment

- Air compressor
- Axle stand
- Battery charger
- Battery load/starting system tester
- Bearing heater
- Bleeding equipment
- Booster cable
- Bottle/axle jack
- Cable hoist
- Chain hoist
- Component heating or cooling equipment
- Computer, portable diagnostic computer
- Crack detecting equipment
- Cutting and welding torch set
- Cylinder cart and tank
- Diagnostic equipment
- Dolly
- Drill: bench, hand drivers, twist, air

- Engine rotator
- Fast charger
- Floor hoist
- Forklift
- Fuel recovery and storage system
- Grinder: bench, hand, valve
- Honing equipment
- Hydraulic floor jack
- Hydraulic hand jack
- Hydraulic transmission jack
- Leak detection equipment
- Nitrogen charging equipment
- Parts wash station
- Press: arbor, spring, hydraulic, bushing, shop, mechanical
- Pressure washer
- Printer
- Puller: bearing, gear, heavy duty, reamer
- Refrigerant recycling cart
- Retrieval and storage equipment
- Safety equipment
- Scanning tool
- Shop crane
- Sling/cable/chain
- Spreader bar
- Support stand
- Tire guard
- Transmission jack
- Welding equipment

Recommended

- Alignment tool
- Analyzer: gas, infrared, vibration meter
- Black light
- Coolant recycling unit
- Oil recovery and storage tank
- Overhead crane

Student Equipment (supplied by school)

Required

- 1/4, 3/8, and 1/2 inch drive socket sets
- Adjustable wrench
- Bar (pry, aligning, heel)
- Battery post and clamp cleaner, battery
- Battery terminal puller
- Brass drift
- Center punch
- Chisel
- Digital multimeter

- Feeler gauge set
- File
- Hacksaw and blade
- Hammer: impact, rubber, sledge, air, slide, soft blow
- Hex key set, metric and imperial
- High voltage hand tools
- Jumper wire
- Magnetic pick-up tool (telescopic, flex)
- Metric and imperial steel rule
- Micrometer
- Pick (o-ring, seal)
- Pin punch
- Pipe wrench
- Pliers: insulated, snap ring, torque, punch
- Scraper
- Screwdriver
- Tape measure
- Test light
- Tool chest
- Universal joint
- Utility knife
- Wire brush
- Wire crimper and stripper
- Wire cutter, plier cutters, shears
- Wrench set, combination (metric & imperial)
- Wrench set, flare nut (metric & imperial)

Recommended

- Belt tension gauge
- Borescope
- Depth micrometer
- Dial gauge
- Digital multimeter
- Feeler gauge
- Flowmeter
- Hydrometer
- Inside micrometer
- Level
- Pressure gauge
- Pull-type scale
- Pyrometer
- Small hole gauge

- Steel ruler
- Stethoscope
- Straight edge
- Tachometer
- Telescoping gauge
- Temperature gauge
- Test light
- Thermometer
- Timing gauge
- Tire gauge
- Vacuum gauge

Student Equipment (supplied by student)

Required Safety Equipment

- Coveralls
- Safety boots (CSA approved)
- Safety glasses (CSA approved)

Recommended Safety Equipment

- High visabilty coveralls
- Mechanic gloves

Reference Materials

Recommended Resources

- SkilledTradesBC: www.skilledtradesbc.ca
- WorkSafeBC: www.worksafebc.com

Recommended Texts

Foundation:

- Fundamentals of Medium/Heavy Duty Commercial Vehicle Systems
  Wright, Gus and Owen C. Duffy
  Jones and Bartlett Learning
- Fundamentals of Mobile Heavy Equipment
  Duffy, Owen C., et al.
  Jones and Bartlett Learning

Instructor Requirements

Occupation Qualification

The instructor must possess:

- Heavy Duty Equipment Technician – Certificate of Qualification with Interprovincial Red Seal endorsement; or
- Truck & Transport Mechanic – Certificate of Qualification with Interprovincial Red Seal endorsement

Work Experience

A minimum of 10 years of experience working in the industry as a journeyperson.

Instructional Experience and Education

It is preferred that the instructor also possesses one of the following:

- Grade 12 or equivalent
- Instructor Diploma

Appendices

Appendix A
Acronyms

ABS	Anti-lock braking system
ACR	Amplified Common Rail
AGM	Absorbed Glass Matt
API	American Petroleum Institute
CA	Cranking amperes
CCA	Cold cranking amperes
CEMF	Counter-Electromotive Force
CNG	Compressed natural gas
CVSE	Commercial Vehicle Safety Enforcement Regulations
CVT	Constant Variable Transmission
DEF	Diesel Exhaust Fluid
DO	Diesel Oxygen Catalyst
DPF	Diesel Particulate Filters
ECM	Electronic Control Module
EGR	Exhaust Gas Recirculation
ESDC	Employment and Social Development Canada
SDC	Electronic Service Tool
EST	Electronic Unit Injectors
EUI	Electronic Unit Pump
EUP	Electric Vehicle
FOPS	Falling Objects Protective Structure
GET	Ground Engaging Tools
GPS	Global Positioning System
HEUI	Hydraulic Electronic Unit Injector
HPCR	High Pressure Common Rail
HPI-TP	High Pressure Injector – Time Pressure
ICBC	Insurance Corporation of British Columbia
ISO	International Organization for Standardization
JIC	Joint Industry Conference
LNG	Liquified natural gas
LPG	Liquified petroleum gas
NPT	National Pipe Thread
OPS	Operator Protective Structure
ORS	O-ring Boss
ORFS	O-ring Face
P.A.S.S.	Pull, Aim, Squeeze, Sweep
PPE	Personal Protective Equipment
PTO	Power Takeoff Shaft
RPM	Revolutions per Minute
SAE	Society of Automotive Engineers

SCR	Selective Catalytic Reduction
SMAW	Shielded Metal Arc Welding
SRS	Supplemental Restraint System
TDG	Transportation of Dangerous Goods Act
TIR	Total Indicated Runout
VOM	Volt-Ohm Milliammeter
WHMIS	Workplace Hazardous Materials Information System

Appendix B
Summary of Achievement Criteria

Achievement Criteria are included for competencies that require a practical assessment. The intent of including Achievement Criteria in the Program Outline is to ensure consistency in training across the many training institutions in British Columbia. Their purpose is to reinforce the theory and to provide a mechanism for evaluation of the learner's ability to apply the theory to practice. It is important that these performances be observable and measurable and that they reflect the skills spelled out in the competency. The conditions under which these performances will be observed and measured must be clear to the learner as well as the criteria by which the learner will be evaluated. The learner must also be given the evaluation criteria.

The performance spelled out in the Achievement Criteria is a suggested performance and is not meant to stifle flexibility of delivery. Training providers are welcome to substitute other practical performances that measure similar skills and attainment of the competency. Multiple performances may also be used to replace individual performances where appropriate.

The following tables summarize the practical assessments for each level. **For details, please refer to the Achievement Criteria following the competency in the Program Content section.**

HEAVY MECHANICAL FOUNDATION SUMMARY OF ACHIEVEMENT CRITERIA		
SUBJECT COMPETENCY		ACHIEVEMENT CRITERIA TASK
A3	Use hand tools, power tools, and shop equipment	The learner will be able to use hand tools, power tools, and shop equipment.
A10	Use cutting and welding equipment	The learner will be able to use cutting and welding equipment.
B1	Service and repair hydraulic brakes and parking brakes	The learner will be able to service and repair hydraulic brakes and parking brakes.
B2	Service and repair hydraulic power brakes and ABS systems	The learner will be able to service hydraulic components.
B3	Service and repair air brakes	The learner will be able to service and repair air brakes.
C1	Service hydraulic components	The learner will be able to service hydraulic components.
D3	Service, diagnose, and repair battery systems	The learner will be able to service, diagnose, and repair battery systems.
D4	Service starting and charging systems	The learner will be able to service charging and starting systems.
D5	Service electrical circuits	The learner will be able to service electrical circuits.
E1	Service, diagnose, and repair tires, wheels, and hubs	The learner will be able to service, diagnose, and repair tires, wheels, and hubs.
E2	Service steering systems	The learner will be able to service steering systems.
E3	Service, diagnose, and repair suspension systems	The learner will be able to service, diagnose, and repair suspension systems.
E5	Service, diagnose, and repair frames	The learner will be able to service, diagnose, and repair frames.
F1	Service, diagnose, and repair landing gear and trailer accessories	The learner will be able to service, diagnose, and repair landing gear and trailer accessories.
F2	Service, diagnose, and repair coupling systems	The learner will be able to service, diagnose, and repair coupling systems.
F3	Service, diagnose, and repair trailer body components	The learner will be able to service, diagnose, and repair trailer body components.

F4	Service heating and refrigeration systems	The learner will be able to service heating and refrigeration systems.
J2	Service, diagnose, and repair cab structures	The learner will be able to service, diagnose, and repair cab structures