SKILLEDTRADESBC

PROGRAM OUTLINE

Heavy Mechanical Foundation

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HEAVY MECHANICAL FOUNDATION

PROGRAM OUTLINE

APPROVED BY INDUSTRY

SEPTEMBER 2013

Developed by
SkilledTradesBC
Province of British Columbia

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Section 1

INTRODUCTION

Heavy Mechanical Foundation

Foreword

A Heavy Mechanical Foundation student upon successful completion of the Foundation Program will possess the full range of basic knowledge of the Heavy Duty, Truck and Transport, Diesel Engine, and Transport Trailer 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.

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:

- Reliabilty
- 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.

SAFETY ADVISORY

Be advised that references to the WorkSafeBC 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 him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.

Acknowledgements

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Transportation Career Development Association. Members include:

- K. Poisson, Coast Mountain Bus Company (Apprenticeship Coordinator)
- D. Vallely, Coast Mountain Bus Company (Manager of Mechanics)
- J. Saunders (Finning - Retired)
- J. Yardley, Canadian Forces (Mechanic)
- L. Babcock, Thompson Rivers University (Instructor)
- R. Lynds, TECK Cominco (Supervisor)
- L. Richardson, Resource Training Organization (Manager, Program Standards)
- R. Scales, SkilledTradesBC (Manager, Program Standards)

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- B. Holcik- Finning (Instructor)
- L. Babcock- Thompson Rivers University (Chair)
- B. Haugen- Vancouver Community College (Co-chair)
- P. Mottershead- Vancouver Island Univeristy (Instructor)
- T. Lockhart - Okanagan Community College (Instructor)
- R. Tremblay- Northern Lights College (Instructor)
- C. Hull- College of New Caledonia (Instructor)
- G. Warne-BCIT (Instructor)

Facilitators:

- G. Shorland (Facilitator and Director, Program Standards)
- R. Robertson (CEO transCDA)

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.

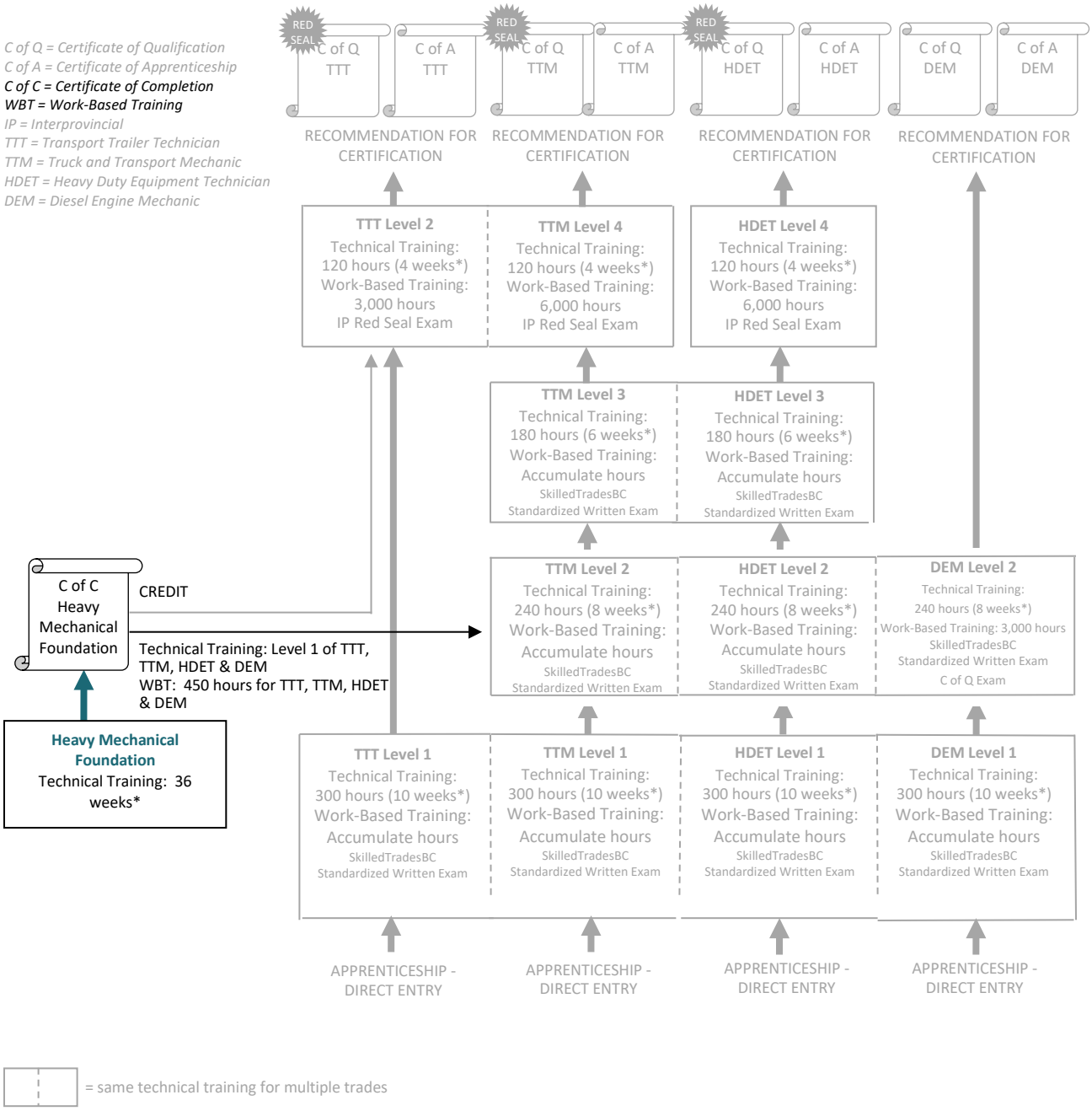
Section	Training Providers	Learners
Program Credentialing Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program, and pathway to completion
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	View the competencies they will achieve as a result of program completion
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	Understand 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
Program Content	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	Provides detailed information on program content and performance expectations for demonstrating competency
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	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

Section 2

PROGRAM OVERVIEW

Heavy Mechanical Foundation

Program Credentialing Model



**Suggested duration based on 30-hour week*

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, tractors, trucks, forklifts, wheeled and tracked vehicles of all types used in construction, logging, sawmill, manufacturing, mining and other similar industry.
- **Truck & Transport Mechanic:** "Truck & Transport Mechanic" means a person who maintains, rebuilds, overhauls, reconditions does diagnostic troubleshooting of motorized commercial truck, bus, and road transport equipment.
- **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.
- **Transport Trailer Technician:** "Transport Trailer Technician" means a person who maintains, rebuilds, overhauls, reconditions, and does diagnostic trouble shooting and repairs of commercial truck and trailers.

Occupational Skills A	Use Safe Work Practices A1	Apply Occupational Health and Safety A2	Use Environmental Practices A3	Use Hand Tools, Power Tools, and Shop Equipment A4	Use Fasteners and Fittings A5	Lift and Support Loads A6
	1 F	1 F	1 F	1 F	1 F	1 F
	Operate Equipment A7	Use Shop Resources and Record Keeping Practices A8	Service Winch Wire Rope A9	Identify Lubricants A10	Service Bearings and Seals A11	Apply Math and Science A12
	1 F	1 F	1 F	1 F	1 F	F
	Use Electronic Media A13	Use Cutting and Welding Equipment A14	Prepare Job Action A15	Describe Diagnostic Procedures A16	Prepare for Employment A17	
	1 F	1 F	F	1 F	F	

SKILLED TRADES BC

Program Overview

Brakes B	Service and Repair Hydraulic Brakes B1	1				F	Service and Repair Hydraulic Power Brakes B2	1				F	Service and Repair Air Brakes B3	1				F	
Hydraulics C	Describe Hydraulic Systems C1	1				F	Service Hydraulic Components C2	1				F							
Electrical D	Describe Electricity D1	1				F	Use Electrical Testing Instruments D2	1				F	Service and Diagnose Batteries D3	1				F	Service Charging Systems D4	1				F	Service Starting Systems D6	1				F	Service Electrical Circuits D8	1				F
Frames, Steering and Suspension E	Service and Diagnose Tires, Wheels, and Hubs E1	1				F	Service Steering Systems E2	1				F	Service, Diagnose and Repair Suspension Systems E4	1				F	Remove and Install Undercarriage E5					F	Diagnose and Repair Frames E6	1				F						
Trailer F	Service Landing Gear and Trailer Accessories F1	1				F	Service and Repair Coupling Systems F2	1				F	Service, Diagnose and Repair Trailer Body Components F3	1				F	Service, Diagnose and Repair Heating and Refrigeration Systems F4	1				F												
Heating, Ventilation & Air Conditioning G	Describe Heating and Air Conditioning Fundamentals G1	1				F	Diagnose and Repair Heating and Air Conditioning Systems G2	1				F																						

Engines and Supporting Systems **H**	Service Engine Support Systems H2				F	Service Diesel Fuel Supply Systems H4				F	Service Gasoline Fuel Systems H6				F	Remove and Install Diesel Engine H9				F	Service, Diagnose and Repair Electronic Ignition Systems H16				F
Powertrain **I**	Service Clutches I2				F	Service Manual Transmissions I4				F	Service Torque Converters and Dividers I7				F	Service Powershift and Automatic Transmissions I8				F	Service Drivelines I11				F	Service Drive Axles I13				F
	Service Final Drives I15				F	Remove and Install Transmissions I20				F	Remove and Install Drivelines and Differentials I21				F	Remove and Install Final Drives I22				F										
Structural Components & Accessories **J**	Identify Protective Structures J1				F	Service Cab Structures J2				F																				
	1					1																									

Training Topics and Suggested Time Allocation

Heavy Mechanical Foundation

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**OCCUPATIONAL SKILLS**	**30%**	**70%**	**30%**	**100%**
A1	Use Safe Work Practices		✓	✓	
A2	Apply Occupational Health and Safety		✓	✓	
A3	Use Environmental Practices		✓	✓	
A4	Use Hand Tools, Power Tools, and Shop Equipment		✓	✓	
A5	Use Fasteners and Fittings		✓	✓	
A6	Lift and Support Loads		✓	✓	
A7	Operate Equipment		✓	✓	
A8	Use Shop Resources and Record Keeping Practices		✓	✓	
A9	Service Winch Wire Rope		✓	✓	
A10	Identify Lubricants		✓	✓	
A11	Service Bearings and Seals		✓	✓	
A12	Apply Math and Science		✓		
A13	Use Electronic Media		✓	✓	
A14	Use Cutting and Welding Equipment		✓	✓	
A15	Prepare Job Action		✓		
A16	Describe Diagnostic Procedures		✓		
A17	Prepare for Employment		✓		
Line B	**BRAKES**	**12%**	**47%**	**53%**	**100%**
B1	Service and Repair Hydraulic Brakes		✓	✓	
B2	Service and Repair Hydraulic Power Brakes		✓	✓	
B3	Service and Repair Air Brakes		✓	✓	
Line C	**HYDRAULICS**	**6%**	**71%**	**29%**	**100%**
C1	Describe Hydraulic Systems		✓		
C2	Service Hydraulic Components		✓	✓	
Line D	**ELECTRICAL**	**10%**	**45%**	**55%**	**100%**
D1	Describe Electricity		✓		
D2	Use Electrical Testing Instruments		✓	✓	
D3	Service and Diagnose Batteries		✓	✓	
D4	Service Charging Systems		✓	✓	
D6	Service Starting Systems		✓	✓	
D8	Service Electrical Circuits		✓	✓	
Line E	**FRAMES, STEERINGAND SUSPENSION**	**15%**	**43%**	**57%**	**100%**
E1	Service and Diagnose Tires, Wheels, and Hubs		✓	✓	
E2	Service Steering Systems		✓	✓	
E4	Service, Diagnose and Repair Suspension Systems		✓	✓	
E5	Remove and Install Undercarriage		✓	✓	
E6	Diagnose and Repair Frames		✓	✓	
Line F	**TRAILER**	**6%**	**69%**	**31%**	**100%**

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
F1	Service Landing Gear and Trailer Accessories		✓	✓	
F2	Service and Repair Coupling Systems		✓	✓	
F3	Service, Diagnose and Repair Trailer Body Components		✓	✓	
F4	Service, Diagnose and Repair Heating and Refrigeration Systems		✓	✓	
Line G	**HEATING, VENTILATION AND AIR CONDITIONING**	**3%**	**50%**	**50%**	**100%**
G1	Describe, Heating and Air Conditioning Fundamentals		✓		
G2	Diagnose and Repair Heating and Air Conditioning Systems		✓	✓	
Line H	**ENGINES AND SUPPORTING SYSTEMS**	**9%**	**32%**	**68%**	**100%**
H2	Service Engine Support Systems		✓		
H4	Service Diesel Fuel Supply Systems		✓	✓	
H6	Service Gasoline Fuel Systems		✓	✓	
H9	Remove and Install Diesel Engine		✓	✓	
H16	Service, Diagnose and Repair Electronic Ignition Systems		✓	✓	
Line I	**POWERTRAINS**	**8%**	**36%**	**64%**	**100%**
I2	Service Clutches		✓	✓	
I4	Service Manual Transmissions		✓	✓	
I7	Service Torque Converters and Dividers		✓	✓	
I8	Service Powershift and Automatic Transmissions		✓	✓	
I11	Service Drivelines		✓	✓	
I13	Service Drive Axles		✓	✓	
I15	Service Final Drives		✓	✓	
I20	Remove and Install Transmissions		✓	✓	
I21	Remove and Install Drivelines and Differentials		✓	✓	
I22	Remove and Install Final Drives		✓	✓	
Line J	**STRUCTURAL COMPONENTS AND ACCESSORIES**	**1%**	**76%**	**24%**	**100%**
J1	Identify Protective Structures		✓		
J2	Service Cab Structures		✓	✓	
	Total Percentage for Heavy Mechanical Foundation	**100%**			

Section 3

PROGRAM CONTENT

Heavy Mechanical Foundation

Line (GAC): A 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.
- 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
	  ○ Head
	  ○ Hands
	  ○ Lungs
	  ○ Eyes
	  ○ Ears
	  ○ Feet
	• Safety meetings
	• Housekeeping
	• Maintaining PPE
	• Equipment and machine lock-out
	• Ventilation systems
	• Clear head
	• Professionalism
	• Respect for others' safety
	• Constant awareness of surroundings
	• Lifting

2. Lock out heavy duty equipment prior to service	• WorkSafeBC requirements • Electrical isolation (Night Switch) • Tag • Key storage

LEARNING TASKS	CONTENT
3. Locate shop emergency equipment and procedures	• Emergency shutoffs • Fire control systems • Eye wash facilities • Emergency exits • First aid facilities • Emergency contact/phone numbers • Outside meeting place • Disaster meeting place
4. Describe the conditions necessary to support a fire	• Air • Fuel • Heat
5. Describe the classes of fires according to the materials being burned	• Class A • Class B • Class C • Class D • Symbols and colours
6. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus	• Fuels • Diesel • Gasoline • Propane • Natural Gas • Ventilation • Purging • Lubricants • Oily rags • Combustible metals • Aerosols
7. Describe the considerations and steps to be taken prior to fighting a fire	• Warning others and the Fire Department • Evacuation of others • Fire contained and not spreading • Personal method of egress • Training

8. Describe the procedure for using a fire extinguisher	• P.A.S.S.
	  ○ Pull
	  ○ Aim
	  ○ Squeeze
	  ○ Sweep

LEARNING TASKS	CONTENT
9. Describe fire suppression systems	• Types • Construction • Operation • Disarming

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A2 Apply Occupational Health and Safety

Objectives

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

- Identify WorkSafeBC policies and procedures.

LEARNING TASKS	CONTENT

1. State the "Core Requirements" of the Occupational Health and Safety Regulations	• Definitions
	• Application
	• Right 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	• Chemical and biological substances • Substance specific requirements • Noise, vibration, radiation and temperature • Personal protective clothing and equipment • 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 OCCUPATIONAL SKILLS

Competency: A3 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.
- Explain the contents of the Material Safety Data Sheets (MSDS).
- Explain the content of a WHMIS label.
- Apply WHMIS regulations.

LEARNING TASKS	CONTENT
1. State the legislation that requires suppliers of hazardous materials to provide MSDSs and label products as a condition of sale and importation	• Hazardous Product Act • Controlled Products Regulations • Ingredients Disclosure List • Hazardous Materials Information Review Act • Hazardous Materials Information Review Regulations

2. State the purpose of the Workplace Hazardous Materials Information System (WHMIS)	• Protection of Canadian 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	• Material safety data sheets (MSDSs) • Labeling of containers of hazardous materials • Worker education programs

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

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

LEARNING TASKS	CONTENT
6. Describe information to be disclosed on a MSDS	• Hazardous ingredients • Preparation information • Product information • Physical data • Fire or explosion • Reactivity data • Toxicological properties • Preventive measures • First-aid measures

7. Identify 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 as they apply to hazardous materials used 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	• Environmental Protection Agency (EPA) • Hazardous Materials (HAZMAT) • Industry Standards

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A4 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	• Personal Protective Equipment
	  ○ Head
	  ○ Hands
	  ○ Lungs
	  ○ Eyes
	  ○ Ears
	  ○ Feet
	  ○ Clothing
	• 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
	  ○ Work with a safe attitude
	  ○ Tool selection
	  ○ Organize work area
	  ○ Correct usage of hand tools
	  ○ Maintain hand tools
	  ○ Safe tool handling
	  ○ Safe tool storage
	• Hazards
	• Wrenches
	• Screwdrivers
	• Cutting tools
	• Hammers
	• Chisels/punches
	• Pry bars
	• Pliers

LEARNING TASKS	CONTENT
	• Clamping tools • Abrasives • Pullers • Torque wrenches and multipliers
4. Select, use and maintain measuring instruments	• Layout tools • Precision measuring • Imperial • Metric • Micrometer • Veriner • Dial indicator • Feeler/thickness gauges • Bore gauges
5. Select, use and maintain power tools	• Pneumatic • Electric • Hydraulic
6. Select, use and maintain drill bits	• Types • Sharpening • Cutting speeds

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

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A5 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

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 OCCUPATIONAL SKILLS

Competency: A6 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.
- 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

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 wire ropes, chains and lifting straps	• Types • Capacities • Inspection • Rating tags • Rigging and lifting attachments
6. Use fibre rope knots, bends and hitches	• Types • Uses • Care and maintenance

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

8. Select, use and maintain hoisting equipment	• Types • Capacities • Operation
9. Lift, hoist and move loads	• Determine safe working load • Lifting and rigging procedures • Regulations and specifications

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A7 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.
- Obtain forklift operation training.

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
6. Lock-out heavy duty equipment prior to service	• WorkSafeBC requirements • Electrical isolation (Night switch) • Tag • Key in pocket

7. Operate a forklift	• Safe operation
	• Forklift training (certification optional)
	  ○ Occupational Health and Safety Regulations
	  ○ Maintenance and records

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A8 Use Shop Resources and Record Keeping Practices

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 record keeping 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

2. Describe the requirements for report writing	• Types of reports
	  ○ Service
	  ○ Structure
	  ○ Inclusions or 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 OCCUPATIONAL SKILLS

Competency: A9 Service Winch Wire Rope

Objectives

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

- Describe wire rope and its applictions.
- Inspect and service wire rope used on winches.

LEARNING TASKS	CONTENT

1. Describe wire rope	• Types
	  ○ Regular lay
	  ○ Lang lay
	• Construction
	• Application
	• Safe working load

2. Inspect wire rope	• Frequency • Wear • Damage
3. Service wire rope	• Inspection • Remove • Repair or replace • Lubrication • Scheduled maintenance

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A10 Identify Lubricants

Objectives

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

- Identify and select lubricants.

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
	  ○ Brake fluids
	  ○ Environmentally Friendly Liquids (EFL)
	• Ratings
	  ○ American Petroleum Institute (API)
	  ○ Society of Automotive Engineers (SAE)
	  ○ International Standardization Organization (ISO)
	  ○ Military Standards
	  ○ International Lubricant Standardization Approval Committee (ILSAC)

3. Describe the use of lubricants	• Applications
	• Oils
	• Greases
	• Dry lubricants
	• Synthetics
	• Brake fluids
	  ○ Dot 3
	  ○ Dot 4
	  ○ Dot 5
	• Manufacturer's specifications
	• Minimum requirements
	• Warranty issues

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

5. Perform fluid analysis	• Procedures
	• Safety
	• Reports
	  ○ Contamination
	  ○ Condition
	  ○ Recommendations

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A11 Service Bearings and Seals

Objectives

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

- Select and 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 • Lubrication • Storage • Installation • Adjustments

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

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

LINE (GAC): A OCCUPATIONAL SKILLS

Competency: A12 Apply Math and Science

Objectives

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

- Use mathematics to solve problems involving whole numbers.
- Describe key terms and concepts for working with fractions.
- Solve problems involving common fractions.
- Describe key terms and concepts for working with decimals.
- Convert between common decimal fractions.
- Solve problems involving decimal fractions.
- Describe and convert between metric and imperial measurements.
- Describe key terms and concepts for working with ratio and proportion.
- Use ratio and proportion to solve problems.
- Describe and use key terms and concepts for equations and formulas.
- Solve problems using perimeters, areas and volume.
- Describe and use angles and geometric construction.

LEARNING TASKS	CONTENT

1. Identify words indicating mathematical operations	• Operations
	  ○ Addition
	  ○ Subtraction
	  ○ Multiplication
	  ○ Divisions

2. Solve word problems involving whole numbers	• Process
3. Describe key terms and concepts for working with fractions	• Numerator • Denominator • Terms • Proper fraction • Improper fraction • Mixed number • Common fraction • Reciprocal • Lowest common denominator
4. Add and subtract fractions	• Unlike fractions • Like fractions • Mixed numbers
5. Multiply and divide fractions	• Proper fractions • Improper fractions • Mixed numbers

LEARNING TASKS	CONTENT
6. Solve word problems involving fractions	• Process
7. Describe key terms and concepts for working with decimals	• Place value • Significant digits • Rounding • Repeating decimal fractions

8. Convert between decimals and fractions	• Conversion
	  ○ Decimal to fraction
	  ○ Fraction to decimal
	• Fraction with lowest terms

9. Add, subtract, multiply and divide decimals	• Place value • Word problems
10. Describe metric measurement	• Units • Prefixes • Converting within the metric system
11. Convert between the metric and imperial system of measurement	• Length • Mass • Volume • Temperature • Pressure • Torque

12. Describe key terms and concepts for working with ratio and proportion	• Ratio
	  ○ Formulas
	• Proportion
	  ○ Cross multiplication

13. Solve word problems involving ratio and proportion	• Process
14. Describe key terms and concepts for equations and formulas	• Equation • Formula • Constant • Solution
15. Solve problems involving formulas	• Operational symbols • Order of operations • Word problems
16. Solve problems involving perimeters	• Calculations • Formulas
17. Solve problems involving area	• Calculations • Formulas

LEARNING TASKS	CONTENT
18. Solve problems involving volume	• Calculations • Formulas

19. Describe key terms and concepts associated with using angles	• Angle
	• Degree
	• Vertex
	• Angle types
	  ○ Acute
	  ○ Right
	  ○ Obtuse
	  ○ Straight
	  ○ Reflex
	  ○ Complementary
	  ○ Supplementary
	  ○ Opposite
	• Triangle
	• Triangle types
	  ○ Right
	  ○ Equilateral
	  ○ Isosceles
	  ○ Similar

20. Use angles	• Protractors • Inclinometer • Angles and parallel lines • Units of angle measurement • 3:4:5 triangles ○ Pythagorean theorem

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A13 Use Electronic Media

Objectives

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

- Use computers to create documents and conduct research.
- Use electronic imaging equipment.

LEARNING TASKS	CONTENT

1. Use computers	• Hardware
	• Keyboarding
	• Software
	• Operating system
	  ○ Windows
	  ○ Managing files
	  ○ Printing
	• Applications
	  ○ Word processing
	  ○ Internet access
	  ○ E-mail
	  ○ On-line resources
	  ○ Data bases

2. Use electronic media	• Digital camera • Digital video

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A14 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
2. Identify metals	• Metals and alloys • Teminology • Shapes • Storage and handling
3. Identify oxy-acetylene components	• Gases • Valves and regulators • Cylinders • Hoses and fittings • Cutting torches and tips • Safety precautions • Blow back • Check valves
4. Use oxy-acetylene equipment	• Assembly procedures • Operation procedures • Lighting • Pressures • Adjusting • Shut down procedures • Leak testing • Storage
5. Cut mild steel with oxy-acetylene equipment	• Set-up • Freehand cuts • Guided cuts • Hole piercing

LEARNING TASKS	CONTENT
6. Weld mild steel with oxy-acetylene equipment	• Principles of fusion welding • Filler metal • Flux • Welding tips • Flame • Technique • Basic joints
7. Braze lap joints with oxy-acetylene equipment	• Brazing set-up • Brazing techniques

8. Solder tubing and sheet metal	• Process and procedures
	• Solder types
	  ○ 60/40
	  ○ 40/60
	  ○ Rosin core
	  ○ Acid core

9. Describe the shielded metal arc welding (SMAW) process	• Process • Applications • Safety requirements
10. Identify shielded metal arc welding equipment	• AC/DC machines • Components • Electrode holder • Ground clamps • Cables • Connectors
11. Identify mild steel electrodes for shielded metal arc welding	• Types • Operations • Classifications • Selection • Storage and handling
12. Weld mild steel with shielded metal arc	• Procedures • Weld ground placement • Settings • Positions • Joints • Types of welds

LEARNING TASKS	CONTENT
13. Weld mild steel using wire feed processes	• Procedures • Settings • Safety • Weld types and positions • Wire type
14. Describe air-arc gouging	• Purpose • Procedure • Safety

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A15 Prepare Job Action

Objectives

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

- Describe the importance of following a diagnostic procedure.
- Describe the procedures to prepare a job action.

LEARNING TASKS	CONTENT
1. Describe the importance of preparing a job action	• Cost of improper diagnosis • Unhappy customers • Lost business • Time management • Efficiency • Damage to components

2. Describe the procedures to prepare a job action	• Understand system
	• Understand complaint
	  ○ Communicate with operator
	  ○ Operational test
	  ○ Visual inspection
	• Access documentation
	• Personal Protective Equipment
	• Environmental considerations
	• Tools and equipment
	• Parts

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A16 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 • Time management • Efficiency • Damage to components
2. Describe general diagnostic procedures	• Understand system • Understand complaint • Communicate with operator • Operational test • Visual inspection • Form all possible conclusions • Test conclusions • System component isolation
3. Describe the importance of following manufacturer's diagnostic procedures where available	• Time saving • Warranty requirement • Diagnostic efficiency
4. Describe the importance of failure analysis	• Repeat failure • Extend life • Cost • Customer satisfaction

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A17 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 • Dealerships • Fleets
5. Describe labour groups	• Union • Non-union

LEARNING TASKS	CONTENT
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 positive employee attributes	• Communication • Critical thinking • Desire to continue learning • Positive attitude • Responsibility • Adaptability • Team skills • Care for quality • Personal care • Following safety regulations
8. Describe employer responsibility	• Respect • Trust • Fairness • Safe work site • Timely payment • Follow applicable legislations

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

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

LEARNING TASKS	CONTENT
11. Identify job search sources	○ Closing Paragraph • Newspapers • Internet • Networking • Industry publications • Direct approach
12. 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
13. Follow up on an interview	• Written ○ Letter of appreciation • Verbal

Line (GAC): B BRAKES

Competency: B1 Service and Repair Hydraulic 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	• Friction • Definition • Coefficient • Heat • Absorbing • Dissipating • Effects of speed and weight • Brake fade

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

3. Review hydraulic principles	• Pressure, force and area

LEARNING TASKS	CONTENT

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

5. Select brake fluids	• Requirements
	• Types
	  ○ DOT 3
	  ○ DOT 4
	  ○ DOT 5
	  ○ Others
	• Characteristics
	  ○ Hygroscopic
	  ○ Boiling point
	  ○ Viscosity
	• Identification

6. Describe parking brake systems	• Types
	  ○ Integral
	  ○ Driveline
	  ○ Hydraulic
	  ○ Mechanical
	• Components
	• Operation

7. Diagnose hydraulic brake systems	• Diagnostic procedures
	  ○ Operational checks
	  ○ Fluid condition/level
	• Inspection

8. Repair hydraulic brake systems	• Components
	  ○ Hydraulic
	  ○ Mechanical
	• Inspection
	• Remove
	• Repair or replace
	• Install
	• Flush/bleed

LEARNING TASKS	CONTENT
9. Service parking brake systems	• Inspection • Remove • Repair or replace • Install
10. Perform preventive maintenance	• Inspection • Operational tests • Fluid level checks • Adjustment • Lubrication

Achievement Criteria

Performance	B1 Service and Repair Hydraulic Brakes
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment Equipment with hydraulic disk and drum brakes
Criteria	The learner will be competent once the performance criteria is met: • 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 BRAKES

Competency: B2 Service and Repair Hydraulic Power Brakes

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 and repair hydraulic anti-lock braking (ABS) systems.

LEARNING TASKS	CONTENT

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

2. Diagnose power brake systems	• Diagnostic procedures • Operational test • Components • Inspection • Testing
3. Repair power brake systems	• Inspection • Remove • Repair or replace • Install • Adjustments • Verify system operation

4. Describe hydraulic anti-lock braking systems	• Types
	  ○ Single channel
	  ○ Two channel
	  ○ Four 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 • Remove • Repair or replace • Install • Adjustments • Verify system operation • Diagnostic codes

Achievement Criteria

Performance	B2 Service and Repair Hydraulic Power Brakes
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment Equipment with hydraulic disk and drum brakes
Criteria	The learner will be competent once the performance criteria is met: • 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 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.
- Describe and perform a pre-trip inspection.

LEARNING TASKS	CONTENT
1. Describe the principles of braking	• Friction • Definition • Coefficient • Heat • Absorbing • Dissipating • Effects of speed and weight • Brake fade • Water cooling
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 the basics of air brake schedules	• 121

LEARNING TASKS	CONTENT
5. Repair foundation brake assembly	• S • SX • Operation and routine maintenance • Inspection • Disassembly • Replacement • Measurement • Assembly • Adjustment

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

7. Describe tractor trailer pre-trip brake inspection	• As per motor vehicle standards
8. Perform a tractor trailer pre-trip brake inspection	• As per motor vehicle standards

Achievement Criteria

Performance: B3 Service and Repair Air Brakes

Conditions: The learner will require:

- Tools
- Test equipment
- Manufacturer's specifications
- A work place or training environment

Equipment with hydraulic disk and drum brakes

Criteria: The learner will be competent once the performance criteria is met:

- 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): C HYDRAULICS

Competency: C1 Describe Hydraulic Systems

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.

LEARNING TASKS	CONTENT
1. Describe the principles of hydraulics	• Terminology • Advantages/Disadvantages • Fluid characteristics • Pascal's Law • Calculations • Bernoulli's Principle

2. Describe the basic operation of a hydraulic system	• Components
	• Reservoir
	  ○ Vented
	  ○ Pressurized
	• Pump
	  ○ Positive displacement
	  – Gear
	  – Vane
	  – Piston
	  ○ Ratings
	• Control valves
	  ○ Pressure
	  ○ Directional
	  ○ Volume
	• Actuators
	  ○ Cylinder
	  ○ Motor
	• Connecting lines
	• Hydraulic fluids

3. Describe types of hydraulic systems	• Open-centre • Closed-centre • Vented • Pressurized

LEARNING TASKS	CONTENT

4. Interpret basic hydraulic diagrams	• Types
	  ○ Pictorial
	  ○ Schematic
	• Basic symbols

Line (GAC): C HYDRAULICS

Competency: C2 Service Hydraulic Components

Objectives

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

- Describe selected 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 hydraulic components	• Seals • Hoses/lines • Fittings • Filters
2. Select hydraulic fluids	• Requirements • SAE viscosity ratings • ISO viscosity ratings • API service ratings • Manufacturer's specifications • Synthetic/Non-synthetic (mineral) • Component/System compatibility

3. Select hydraulic hoses and fittings	• Hose construction
	• Working pressure
	• 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

4. Assemble hydraulic hoses and fittings	• Permanent • Reusable

LEARNING TASKS	CONTENT
5. Demonstrate safe work procedures	• Safety blocking equipment and attachments • Relieve pressure • Reservoir venting • Actuator neutralization • Temperature hazards
6. Perform scheduled maintenance	• Visual inspection • Leaks • Hose rubs • External damage • Fluid level check • Filter change, fluid change, fluid analysis • Strainers • Flushing system

Achievement Criteria

Performance	C2 Service Hydraulic Components
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment • Equipment with mobile hydraulic systems
Criteria	The learner will be competent once the performance criteria is met: • 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): D ELECTRICAL

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 perform calculations	• Sources of electricity • Atomic Theory • Current flow • Electrons • Protons • Neutron • Conductors • Insulators • Semiconductors • Basic circuit • Source

LEARNING TASKS	CONTENT
	• Load • Complete path • Electrical relationships • Ohm's Law • Watt's Law • Series circuits • Parallel circuits • Series parallel circuits

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

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

5. Describe the basic function of common electronic components	• Diodes • Transistors
6. Interpret basic electrical wiring diagrams	• Types • Wiring schematic and diagrams • Symbols • Conventions • Abbreviations

Line (GAC): D ELECTRICAL

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 • VAT's (Volt amp testers) • Continuity testers • Test lights • Safety precautions
2. Diagnose electrical circuits	• Voltage drops • Shorts • Grounds • Opens • Resistance • Amperage draw

Line (GAC): D ELECTRICAL

Competency: D3 Service and Diagnose Batteries

Objectives

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

- Describe battery design and operation.
- Select, test and maintain batteries.
- Diagnose causes of battery failure.
- Remove and replace batteries.
- Use booster batteries.

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

2. Describe the design and construction of the various types of batteries	• Types
	  ○ Conventional
	  ○ Low maintenance
	  ○ Maintenance free
	  ○ Deep-cycle
	  ○ Gel
	  ○ AGM
	• Plates
	  ○ Grid material
	  ○ Active material
	• Plate straps
	• Separators
	• Electrolyte/Gel
	• Case
	• Terminals

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

LEARNING TASKS	CONTENT

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 • Three minute fast charge test • Battery impedance test
7. Use booster batteries	• Safety • Voltage ○ 6/12/24 • Polarity

Achievement Criteria

Performance — D3 Service and Diagnose Batteries

Conditions — The learner will require:

- Tools
- Test equipment
- Manufacturer's specifications
- A work place or training environment
- Equipment with maintenance and maintenance free batteries

Criteria — The learner will be competent once the performance criteria is met:

- 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): D ELECTRICAL

Competency: D4 Service Charging Systems

Objectives

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

- Describe the purpose of charging circuits.
- Perform routine maintenance on charging circuits.

LEARNING TASKS	CONTENT
1. Describe charging circuits	• Purpose • Operation • Connections
2. Maintain charging circuits	• Inspection • Visual • Audible • Output voltage/amperage test • Belt condition and tension • Alternator removal and replacement

Achievement Criteria

Performance D4 Service Charging Systems

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's specifications
- A work place or training environment
- Equipment with functional charging circuit

Criteria The learner will be competent once the performance criteria is met:

- 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): D ELECTRICAL

Competency: D6 Service Starting Systems

Objectives

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

- Identify starting circuit components.
- Describe the design and operation of starting circuits.
- Perform maintenance on starting circuits.

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

2. Describe the design and operation of starting circuits	• System voltage
	  ○ 12 volt
	  ○ 24 volt
	• Battery configuration
	  ○ Series
	  ○ Parallel
	  ○ Series parallel
	• Isolation switches
	• Starter motor assembly
	• Solenoids and relays
	• Magnetic switch
	• Thermal switch
	• Ignition switch
	• Neutral safety switch/clutch pedal switch
	• Cables and terminals

3. Inspect starting circuits	• Inspection
	  ○ Visual
	  ○ Audible
	• Routine maintenance
	• Component removal and replacement

Achievement Criteria

Performance	D6 Service Starting Systems
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment • Equipment with functional starter circuit
Criteria	The learner will be competent once the performance criteria is met: • 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 context***

Line (GAC): D ELECTRICAL

Competency: D8 Service Electrical Circuits

Objectives

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

- Service electrical circuits.
- Describe trailer wiring.

LEARNING TASKS	CONTENT
1. Replace electrical components	• Lamps • Starters • Alternators • Batteries • Switches • Motors • Fuses

2. Select and install conductors and terminals/connectors	• Wire gauge
	• Terminals/connectors
	  ○ Crimped
	  ○ Soldered

3. Describe sources of circuit faults	• Blown fuses • Fusable link • Circuit breaker • Connection • Wiring
4. Describe trailer wiring circuits	• Connectors • Junction box • Wiring harness • Circuit identification

Achievement Criteria

Performance	D8 Service Electrical Circuits
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment • Equipment with electrical and electronic
Criteria	The learner will be competent once the performance criteria is met: • 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 FRAMES, STEERINGAND SUSPENSION

Competency: E1 Service and Diagnose Tires, Wheels, and Hubs

Objectives

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

- Describe and service tires and rims.
- Describe and service wheels and hubs.
- Describe traction devices.

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

2. Diagnose tires and rims	• Inspection • Tire wear • Wheel run out • Air pressure • Tread depth

3. Service tires and rims	• Safety precautions
	• Inspection
	• Repair or replace
	• Matching
	• Mounting
	  ○ Runout
	• Balancing
	  ○ Static
	  ○ Dynamic
	• Scheduled maintenance

LEARNING TASKS	CONTENT

4. Describe wheel hubs	• Types
	  ○ Conventional
	  ○ Planetary
	  ○ Unitized
	• Components
	  ○ Bearings
	  ○ Seals
	• Lubrication

5. Diagnose wheel hubs	• Inspection • Testing

6. Service wheel hubs	• Inspection
	• Replacement
	• Repair
	• Adjustment
	  ○ Bearing end play
	  ○ Rolling torque
	• Lubrication
	• Scheduled maintenance

7. Describe traction devices	• Types
	  ○ Chains
	  ○ Sanders
	  ○ Calcium

Achievement Criteria

Performance — E1 Service and Diagnose Tires, Wheels, and Hubs

Conditions — The learner will require:

- Tools
- Test equipment
- Manufacturer's specifications
- A work place or training environment
- Equipment with tires and wheel assemblies

Criteria — The learner will be competent once the performance criteria is met:

- 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 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
	• Truck system components
	  ○ Kingpins
	  ○ Tie-rod ends
	  ○ Drag link
	  ○ Tie rod
	  ○ Spindle
	  ○ Steering arms
	• Track system components
	• Wheeled system components

2. Service steering systems	• Inspection
	• Remove or replace
	• Install
	• Lubrication
	• Scheduled maintenance
	• Adjustment
	  ○ Drag link
	  ○ Tie rod ends
	  ○ Axle stops
	  ○ Steering gear
	  ○ Toe

Achievement Criteria

Performance	E2 Service Steering Systems
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment • Equipment with various steering systems
Criteria	The learner will be competent once the performance criteria is met: • 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 FRAMES, STEERING AND SUSPENSION

Competency: E4 Service, Diagnose and Repair Suspension Systems

Objectives

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

- Describe suspension systems.
- Diagnose and repair suspension systems.

LEARNING TASKS	CONTENT

1. Describe wheeled equipment suspension systems	• Types
	  ○ Hydro pneumatic
	  ○ Rigid
	• Components
	• Operation

2. Diagnose wheeled equipment suspension systems	• Inspection • Measuring
3. Repair wheeled equipment suspension systems	• Inspection • Remove • Repair or replace • Install • Adjustments • Lubrication • Scheduled maintenance
4. Diagnose and repair auto-lube systems	• Inspection • Remove • Repair or replace • Install • Adjustments • Scheduled maintenance

5. Describe truck and trailer steering axle suspension systems	• Types
	  ○ Single
	  ○ Tandem
	• Components
	  ○ Air bag
	  ○ Shock aborbers
	  ○ Spring construction
	  ○ Hangers and attachments
	• Operation

LEARNING TASKS	CONTENT
6. Repair truck and trailer steering axle suspension systems	• Inspection • Replacement • Repair • Adjustments • Lubrication

7. Describe truck and trailer rear axle suspension systems	• Arrangements
	  ○ Single axle
	  ○ Tandem axle
	  ○ Tri axle
	  ○ Lift axle
	  ○ Tag axle
	• Types
	  ○ Walking beams
	  ○ Leaf springs
	  ○ Air bag
	  ○ Rubber block
	• Components
	  ○ Torque rods
	  ○ Transverse rods
	  ○ Frame attachments
	  ○ Springs
	  ○ Pins and bushings
	• Operation

8. Repair truck and trailer rear axle suspension systems	• Inspection • Replacement • Repair • Lubrication • Adjustments

Achievement Criteria

Performance: E4 Service, Diagnose and Repair Suspension Systems

Conditions: The learner will require:

- Tools
- Test equipment
- Manufacturer's specifications
- A work place or training environment
- Equipment with various suspension systems

Criteria: The learner will be competent once the performance criteria is met:

- 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 FRAMES, STEERING AND SUSPENSION

Competency: E5 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
	  ○ Excavator
	  ○ Crawler, Dozer/Loader
	  ○ Crane
	  ○ Tank
	  ○ Rock drill
	  ○ Crawler crane
	  ○ Shovel
	• Components
	• Operation

2. Remove and reinstall undercarriages	• Components
	  ○ Rollers
	  ○ Sprockets
	  ○ Tracks
	  ○ Idler
	• Adjustment
	• Inspection
	  ○ Measuring
	  ○ Visual

Line (GAC): E FRAMES, STEERING AND SUSPENSION

Competency: E6 Diagnose and Repair Frames

Objectives

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

- Describe types of frames.
- Diagnose and 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
	  ○ Fasteners
	  – Grade
	  – Type

2. Diagnose frames	• Components
	• Inspection
	• Alignment
	  ○ Measuring
	  – Projection
	  – Laser
	  – String

LEARNING TASKS

3. Repair frames

CONTENT

- Visual inspection
- Rail replacement
- Rail sectional replacement
  - Welding procedure
  - Brace support
- Repair
  - Crack
  - Bent
  - Twisted
- Adjustments
  - Alignment

Achievement Criteria

Performance	E6 Diagnose and Repair Frames
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment • Equipment with various frame configurations
Criteria	The learner will be competent once the performance criteria is met: • 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): F TRAILER

Competency: F1 Service Landing Gear and Trailer Accessories

Objectives

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

- Describe the construction and operation of accessories.
- Service limited accessories.

LEARNING TASKS	CONTENT

1. Describe the construction and operation of accessories	• Types
	• Lift gates
	  ○ Hydraulic
	• Landing gear
	  ○ Speeds
	  ○ Gears
	  ○ Cross rods
	  ○ Support
	• Ladders
	• Dump box
	  ○ Transfer box
	  ○ High lift gate
	  ○ Pony
	  ○ End dump
	  ○ Side dump
	  ○ Clam dump
	• Log bunks
	  ○ Stakes
	  ○ Extensions
	  ○ Bunk
	  ○ Bolster
	  ○ Live
	  ○ Fixed
	• Draw bar
	  ○ Pintle eye
	  ○ Bushing
	  ○ Compensator
	• Load winch
	  ○ Ratchet
	  ○ Locks
	• Components
	• Operation

LEARNING TASKS	CONTENT

2. Service and repair lift gates, landing gears and winches	• Inspect
	  ○ Operation
	  ○ Hydraulics
	  ○ Pivots
	  ○ Lubrication
	• Remove
	• Repair or replace
	• Install
	• Lubrication
	• Adjust
	• Scheduled maintenance

Achievement Criteria

Performance	F1 Service Landing Gear and Trailer Accessories
Conditions	The learner will require: • Tools • Test Equipment • Manufacturer's specifications • A work place or training environment • Equipment – trailer accessories, landing gear, logging bunk, lift gate
Criteria	The learner will be competent once the performance criteria is met: • 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): F TRAILER

Competency: F2 Service and Repair Coupling Systems

Objectives

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

- Describe hitches and couplers.
- Service hitches and couplers.

LEARNING TASKS	CONTENT
1. Describe the tractor-trailer combinations	• Types • A train • B train • C train • Purpose and design

2. Describe fifth wheels	• Types
	  ○ Fixed
	  ○ Sliding
	  ○ Oscillating
	• Components
	  ○ Top plate
	  ○ Base plate
	  ○ Mounting brackets
	  ○ Jaws and lock mechanisms
	  ○ Jaw release mechanisms
	  ○ Slide lock mechanisms
	  ○ Safety devices

3. Service and repair fifth wheel assemblies	• Inspection
	  ○ Jaws
	  ○ Top plate
	  ○ Slides
	  ○ Locks
	  ○ Pins
	  ○ Bushings
	• Replacement
	• Adjustment
	  ○ Jaws
	• Lubrication
	  ○ Slide
	  ○ Jaws
	  ○ Linkages
	  ○ Top plate
	• Scheduled maintenance

LEARNING TASKS	CONTENT

4. Describe bolster plates and king pins	• Bolster plates
	• King pins
	  ○ Size
	  ○ Mounting

5. Describe pintle hooks and eyes	• Types • Ratings • Buffers • Pneumatic • Hydraulic • Safety chains • Compensators

6. Service and repair pintle hooks and eyes	• Inspection
	  ○ Cracks
	  ○ Wear
	  ○ Evidence of welding
	  ○ Bushings
	• Replacement
	• Lubrication
	• Scheduled maintenance

Achievement Criteria

Performance: F2 Service and Repair Coupling Systems

Conditions: The learner will require:

- Tools
- Test equipment
- Manufacturer's specifications
- A work place or training environment
- Equipment - fifth wheel and pintle hitch assembly

Criteria: The learner will be competent once the performance criteria is met:

- 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): F TRAILER

Competency: F3 Service, Diagnose and Repair Trailer Body Components

Objectives

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

- Describe the purpose and operation of trailer body components.
- Install and remove trailer body components.
- Diagnose and repair or replace trailer body components.

LEARNING TASKS	CONTENT

1. Describe the purpose and operation of trailer body components	• Components
	  ○ Frames
	  ○ Doors
	  – Hinged
	  – Roll up
	  ○ Bumpers
	  ○ Tanks
	  ○ Valves
	  ○ Manifold piping
	  ○ Gauges
	  ○ Transfer pump
	  ○ Reflective tape

2. Remove and install trailer body components	• Safety • Operation • Procedures • Support systems
3. Diagnose trailer body components	• Operation • Manufacturer's specifications • Inspection and testing procedures • Diagnosis • Damage and wear identification

4. Repair trailer body components	• Procedures
	• Manufacturer's specifications
	• Testing
	• Replacement
	• Doors
	  ○ Sidewall panels
	  ○ Cross members

Achievement Criteria

Performance	F3 Service, Diagnose and Repair Trailer Body Components
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment • Equipment with a variety of trailer bodies
Criteria	The learner will be competent once the performance criteria is met: • 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): F TRAILER

Competency: F4 Service, Diagnose and Repair Heating and Refrigeration Systems

Objectives

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

- Identify heating and refrigeration components.
- Diagnose refrigeration units.
- Repair heating and refrigeration systems.

LEARNING TASKS	CONTENT

1. Describe types of heating and refrigeration	• Trailer mounted
	  ○ Cooling unit
	  ○ Heating unit

2. Service and repair heating and refrigeration systems	• Maintenance
	• Inspections
	  ○ Operational checks
	  ○ Pressure checks
	  ○ Temperature checks
	• Lubricants
	• Service intervals
	• Belts

3. Describe hazards associated with refrigeration units	• Fall protection
	• Refrigerant
	• Enviromental considerations
	  ○ Ozone depletion
	  ○ Global warming
	  ○ Release of refrigerant

Achievement Criteria

Performance	F4 Service, Diagnose and Repair Heating and Refrigeration Systems
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's specifications • A work place or training environment • Equipment with refrigeration units
Criteria	The learner will be competent once the performance criteria is met: • 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): G 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 CFCs on the environment.
- Apply legislated procedures when dealing with systems containing CFCs.

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
	• Valves
	• Controls
	• Ducts
	• Compressor
	• Drive systems
	• Evaporator
	• Condenser
	• Receiver-drier/accumulator
	• Orifice tubes/expansion valves
	• Refrigerant
	  ○ Ozone depleting potential
	• Lubricants
	  ○ Mineral
	  ○ Synthetic
	• Controls
	• Sensors
	• Hoses, piping and connectors
	• Seats and gaskets

3. Describe the design and operation of heating and air conditioning systems	• Heater • Refrigeration cycle • Compressor • Evaporator • Condenser • Receiver-drier/accumulator • Orifice tubes/expansion valves • Refrigerant

LEARNING TASKS	CONTENT
	• Lubricants • Controls • Sensors
4. Describe the impact of CFCs on the environment	• Ozone depletion • Global warming
5. Identify legislation/agreements dealing with the use and handling of CFCs	• International • Montreal Protocol on Substances that Deplete the Ozone Layer • Kyoto Protocol to the United Nations Framework Convention on Climate Change • Canadian Environmental Protection Act • Provincial regulations • Ozone Depleting Substances and Other Halocarbons Regulation • Waste Management Act • Training requirements • Environmental awareness training course on ozone depleting substance control • Certification • CFC Handling • Conservation objectives

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

Competency: G2 Diagnose and Repair Heating and Air Conditioning Systems

Objectives

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

- Diagnose heating and air conditioning systems.
- Repair heating and air conditioning systems.
- Describe the impact of CFCs on the environment.
- Apply legislated procedures when dealing with systems containing CFCs.

LEARNING TASKS	CONTENT
1. Diagnose heating and air conditioning systems	• Diagnostic procedures • Manufacturer's procedures • Performance test • Diagnostic codes • Components • Inspection • Sensory inspection • Visual • Audible • Smell • Touch • Testing • Vacuum • Electrical • Mechanical • Pressure • Leak detection methods
2. Repair heating and air conditioning systems	• Recovering, evacuation and recharging • Pressure/leak testing • Environmental considerations • Removing and replacing components • Verify system operations
3. Describe the impact of CFCs on the environment	• Ozone depletion • Global warming
4. Identify legislation/agreements dealing with the use and handling of CFCs	• International • Montreal Protocol on Substances that Deplete the Ozone Layer • Kyoto Protocol to the United Nations Framework Convention on Climate Change

LEARNING TASKS

CONTENT

- Canadian Environmental Protection Act
- Provincial regulations
- Ozone Depleting Substances and Other Halocarbons Regulation
- Waste Management Act
- Training requirements
- Environmental awareness training course on ozone depleting substance control
- Certification
- Conservation objectives

Achievement Criteria

Performance: G2 Diagnose and Repair Heating and Air Conditioning Systems

Conditions: The learner will require:

- Tools
- Test equipment
- Manufacturer's specifications
- A work place or training environment
- Equipment with air conditioning units

Criteria: The learner will be competent once the performance criteria is met:

- 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): H 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.
- Describe combustion of two and four stroke.

LEARNING TASKS	CONTENT
1. Describe the operation of two and four stroke internal combustion engines	• Intake • Compression • Power • Exhaust • Scavenging

2. Identify cooling systems	• Types
	  ○ Air
	  ○ Liquid
	• Coolants
	  ○ Types
	• Components
	  ○ Coolant system
	  ○ Radiator/pressure cap
	  ○ Thermostat
	  ○ Expansion/surge tank
	  ○ Fan system
	• Shutter system

3. Service and maintain cooling systems and their components	• Inspection • Adjustment • Testing • Scheduled maintenance
4. Identify lubrication systems	• Types • Lubricants • Components • Filter and cooler circuits

5. Service lubrication systems and components	• Inspection
	• Lubrication
	• Testing
	• Scheduled maintenance
	  ○ Oil/filter analysis
	  ○ Filter service

LEARNING TASKS	CONTENT
6. Identify air induction systems	○ Oil change • Types • Components ○ Naturally aspirated type ○ Boosted type
7. Service air induction systems and components	• Precautions • Inspection • Lubrication • Scheduled maintenance ○ Filter service
8. Identify exhaust systems	• Types • Components ○ Mufflers ○ Emission systems
9. Service exhaust systems and their components	• Inspection • Scheduled maintenance

LINE (GAC): H ENGINES AND SUPPORTING SYSTEMS

Competency: H4 Service Diesel Fuel Supply Systems

Objectives

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

- Identify characterstics of diesel fuel.
- Identify diesel fuel supply circuits and their components.
- Perform limited service on diesel supply circuits.

LEARNING TASKS	CONTENT

1. Identify characteristics of diesel fuel	• Grades
	• Characteristics
	• Viscosity
	• Cetane
	  ○ Rating
	  ○ Number
	• Flash point
	• Sulfur content
	• Storage
	• Disposal
	• Safety precautions

2. Identify diesel fuel supply circuits	• Types
	• Components
	  ○ Tank
	  ○ Lines
	  ○ Primary/secondary filters
	  ○ Low/high pressure pumps
	• Operation

3. Service diesel fuel supply circuits	• Inspection • Removal • Replacement • Priming • Scheduled maintenance • Safety precautions

Line (GAC): H ENGINES AND SUPPORTING SYSTEMS

Competency: H6 Service Gasoline Fuel Systems

Objectives

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

- Describe the characteristics of gasoline.
- Describe gasoline fuel injection systems.
- Service gasoline fuel injection systems.

LEARNING TASKS	CONTENT
1. Review the characteristics of gasoline	• Physical properties • Heat value • Octane

2. Describe gasoline fuel injection systems	• Types
	  ○ Throttle body
	  ○ Port injection
	  ○ Direct
	• Components
	  ○ Tank
	  ○ Lines
	  ○ Filters
	• Operation

3. Service gasoline fuel injection systems	• Inspection • Scheduled maintenance

Line (GAC): H ENGINES AND SUPPORTING SYSTEMS

Competency: H9 Remove and Install Diesel Engine

Objectives

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

- Identify the preperation prior to diesel engine removal.
- Remove and install diesel engines in trucks and heavy equipment applications.

LEARNING TASKS	CONTENT

1. Describe the procedures to prepare a diesel engine for removal	• Cleaning
	• Lock out
	• Disconnect batteries
	• Precautions
	  ○ Electronic devices
	  ○ Environmental
	  ○ Fuel/oil lines
	  ○ Air conditioning
	  ○ Estimate weight of engine
	• Tag before removal
	  ○ Oil lines
	  ○ Air lines
	  ○ Coolant hoses
	  ○ Wiring
	• Note location of all accessories and attachments

2. Remove and install engines	• Remove
	  ○ Support and block vehicle/equipment
	  ○ Drain and/or discharge systems
	  ○ Remove hoses/lines and wiring
	  ○ Support or remove attachments
	  ○ Select and use of rigging/lifting devices
	  ○ Support engine after removal
	• Install
	  ○ Select and use of rigging/lifting devices
	  ○ Install attachments
	  ○ Install hoses/lines and wiring
	  ○ Refill systems
	  ○ Verify crankshaft rotation and endplay
	  ○ Verify operation and check for leaks

Line (GAC): H ENGINES AND SUPPORTING SYSTEMS

Competency: H16 Service, Diagnose and Repair Electronic Ignition Systems

Objectives

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

- Describe the design and operation of electronic ignition systems.
- Perform limited inspection and repair of electronic ignition systems.

LEARNING TASKS	CONTENT

1. Describe the design and operation of electronic ignition systems	• Components
	• Primary and secondary circuit
	• Timing
	• Ignition switch and wiring
	• Trigger device(s)
	  ○ Hall effect
	  ○ Magnetic pulse
	  ○ Photo sensitive transistor
	• Sensors
	• Computer
	• Signal amplifier
	• Distributor type
	  ○ Condenser
	  ○ Rotor
	  ○ Cap
	  ○ Advance/retard mechanisms
	  ○ Ballast resistor
	• Distributorless
	• Direct ignition
	• Ignition coil(s)
	• High tension wires
	• Spark plugs
	• Connectors

2. Service electronic ignition systems	• Inspection • Adjustments • Scheduled maintenance
3. Diagnose electronic ignition systems	• Diagnostic codes • Components • Inspection • Testing • Special testing equipment
4. Repair electronic ignition systems	• Inspection

LEARNING TASKS	CONTENT
	• Remove • Repairor replace • Install • Adjustments • Testing • Scheduled maintenance

Line (GAC): I POWERTRAINS

Competency: I2 Service Clutches

Objectives

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

- Identify clutches and related components.
- Service clutches and related components.

LEARNING TASKS	CONTENT

1. Identify clutches and related components	• Types
	  ○ Friction
	  – Wet/dry
	  – Single/multi-plate
	  ○ Mechanical
	  – Jaw
	  ○ Magnetic
	  ○ Band
	• Components
	• Operation

2. Service clutches and related components	• Inspection
	  ○ Visual
	  – Wear
	  – Heat damage
	• Adjustment
	  ○ Linkage
	  ○ Internal/external
	• Lubrication
	• Scheduled maintenance

Line (GAC): I POWERTRAINS

Competency: I4 Service Manual Transmissions

Objectives

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

- Identify the operation of manual transmissions.
- Service manual transmissions.

LEARNING TASKS	CONTENT

1. Identify the operation of manual transmissions	• Types
	  ○ Manual shift
	  ○ Auxillary
	• Components
	• Lubrication
	  ○ Types
	  ○ Grades

2. Service manual transmissions	• Inspection
	  ○ Mounting
	  ○ Leaks
	• Lubrication
	• Scheduled maintenance

Line (GAC): I POWERTRAINS

Competency: I7 Service Torque Converters and Dividers

Objectives

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

- Identify purpose of torque converters and dividers.
- Service torque converters and dividers.

LEARNING TASKS	CONTENT
1. Identify the purpose of torque converters and dividers	• Types • Components • Fluids

2. Service torque converters and dividers	• Check operation
	• Visual inspections
	  ○ Fluid levels
	  ○ Leaks
	  ○ Mounting of attachments
	• Filter/screens
	• Oil coolers
	• Scheduled maintenance

Line (GAC): I POWERTRAINS

Competency: I8 Service Powershift and Automatic Transmissions

Objectives

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

- Identify the operation of powershift and automatic transmissions.
- Service powershift and automatic transmissions.

LEARNING TASKS	CONTENT

1. Identify the basic operation of powershift and automatic transmissions	• Types
	  ○ Multi-shaft
	  ○ Planetary
	• Operation

2. Service powershift and automatic transmissions	• Inspection
	  ○ Mounting
	  ○ Leaks
	• Adjustments
	• Fluid level
	• Operational testing
	• Scheduled maintenance

Line (GAC): I POWERTRAINS

Competency: I11 Service Drivelines

Objectives

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

- Identify drivelines and their components.
- Service drivelines and their components.

LEARNING TASKS	CONTENT

1. Identify drivelines and components	• Types
	• Components
	  ○ U-joint
	  ○ Yoke
	  ○ Slip joint
	  ○ Tube
	• Operation

2. Service drivelines and components	• Inspection
	  ○ Damage
	  ○ Bent
	  ○ Play
	• Lubrication
	• Scheduled maintenance

Line (GAC): I POWERTRAINS

Competency: I13 Service Drive Axles

Objectives

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

- Identify drive axles.
- Service drive axles.

LEARNING TASKS	CONTENT

1. Identify drive axles	• Types
	  ○ Single axle
	  ○ Tandem axle
	  ○ Tridem axle
	  ○ Multi speed
	• Components
	  ○ Differentials
	  ○ Axles shafts
	  ○ Traction devices
	  ○ Inter axle differentials
	  ○ Controls and circuits
	• Mounting
	• Basic operation
	• Lubrication

2. Service drive axles	• Visual inspections
	  ○ Fluid levels
	  ○ Leaks
	  ○ Mounting of attachments
	• Check operation
	• Lubrication
	• Scheduled maintenance

Line (GAC): I POWERTRAINS

Competency: I15 Service Final Drives

Objectives

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

- Identify machine final drives.
- Service machine final drives.

LEARNING TASKS	CONTENT

1. Identify machine final drives	• Types
	  ○ Inboard
	  ○ Outboard
	  ○ Planetary
	  ○ Chain
	  ○ Gear
	• Components
	• Basic operation

2. Service machine final drives	• Inspection • Lubrication • Operational test • Scheduled maintenance

Line (GAC): I POWERTRAINS

Competency: I20 Remove and Install Transmissions

Objectives

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

- Identify transmissions.
- Remove and install transmissions.

LEARNING TASKS	CONTENT

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

2. Remove transmissions	• Remove
	  ○ Support and block vehicle/equipment
	  ○ Drain system
	  ○ Remove hoses/lines and wiring
	  ○ Support or remove attachments
	  ○ Select and use of rigging/lifting devices
	  ○ Support transmission after removal

3. Install transmissions	• Install
	  ○ Select and use of rigging/lifting devices
	  ○ Install attachments
	  ○ Install hoses/lines and wiring
	  ○ Refill systems
	  ○ Verify crankshaft rotation and endplay
	  ○ Adjustments
	  ○ Verify operation and check for leaks

Line (GAC): I POWERTRAINS

Competency: I21 Remove and Install Drivelines and Differentials

Objectives

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

- Remove and install drivelines and differentials.

LEARNING TASKS	CONTENT

1. Remove drivelines and differentials	• Remove
	  ○ Support and block vehicle/equipment
	  ○ Drain system
	  ○ Remove hoses/lines and wiring
	  ○ Support or remove attachments
	  ○ Select and use of rigging/lifting devices
	  ○ Support differential after removal

2. Install drivelines and differentials	• Install
	  ○ Select and use of rigging/lifting devices
	  ○ Install attachments
	  ○ Install hoses/lines and wiring
	  ○ Refill systems
	  ○ Adjustments
	  ○ Verify operation and check for leaks

Line (GAC): I POWERTRAINS

Competency: I22 Remove and Install Final Drives

Objectives

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

- Identify final drives.
- Remove and install final drives.

LEARNING TASKS	CONTENT

1. Remove final drives	• Remove
	  ○ Support and block vehicle/equipment
	  ○ Drain system
	  ○ Remove hoses/lines and wiring
	  ○ Support or remove attachments
	  ○ Select and use of rigging/lifting devices
	  ○ Support final drive after removal

2. Install final drives	• Install
	  ○ Select and use of rigging/lifting devices
	  ○ Install attachments
	  ○ Install hoses/lines and wiring
	  ○ Refill systems
	  ○ Adjustments
	  ○ Verify operation and check for leaks

Line (GAC): J STRUCTURAL COMPONENTS AND ACCESSORIES

Competency: J1 Identify Protective Structures

Objectives

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

- Describe regulations related to protective structures.
- Perform service or inspection 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	• Cracks • Dents • Fatigue
3. Identify operational regulations	• Components • Safety glass • Screens • Service/diagnose/repair

Line (GAC): J STRUCTURAL COMPONENTS AND ACCESSORIES

Competency: J2 Service Cab Structures

Objectives

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

- Identify cab, bodies and components.
- Service cab, bodies and components.

LEARNING TASKS	CONTENT

1. Identify cabs, bodies and components	• Types
	• Components
	  ○ Cab
	  – Fixed
	  – Air ride
	  ○ Doors
	  ○ Windows
	  ○ Seats
	  ○ Supplemental restraint system (air bag)
	  ○ Sleepers
	  ○ Ventilation systems
	  ○ Mounting
	• Operation

2. Service cabs, bodies and components	• Inspection • Replacement ○ Components • Adjustment • Lubrication

Achievement Criteria

Performance: J2 Service Cab Structures

Conditions: The learner will require:

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

Criteria: The learner will be competent once the performance criteria is met:

- 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

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 and 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

- One 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

- Ear protection
- 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
- Ladder
- Leather gloves
- Leggings
- Manlift
- Respirator
- Safety boots
- Safety cage
- Safety glasses
- Safety hat
- Splash suit

Student Tools (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
- Terminal nut
- Battery terminal puller
- Brass drift
- Center punch
- Chisel
- Wire cutter, plier cutters, shears

- Digital multimeter
- Feeler gauge set
- File
- Hacksaw and blade
- Hammer: impact, rubber, sledge, air, slide, soft blow
- Hex key set, metric and imperial
- 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
- Wrench set, combination (metric & imperial)
- Wrench set, flare nut (metric & imperial)

Recommended

- Air pressure gauge
- Belt tension gauge
- Boost gauge
- Borescope
- Depth micrometer
- Dial gauge
- Digital multimeter
- Electric pressure gauge
- Flowmeter
- Fuel pressure gauge
- Holding gauge
- Hydraulic pressure testing gauge/fittings
- Hydrometer
- Inside micrometer

- Level
- Manifold gauge
- Mechanical pressure gauge
- Non-magnetic feeler gauge
- Oil temperature gauge
- Phototachometer
- Pressure gauge
- Pull-type scale
- Pyrometer
- Small hole gauge
- Spectroscope
- Spring scale
- Steel ruler
- Stethoscope
- Straight edge
- Tachometer
- Telescoping gauge
- Test light
- Thermometer
- Timing gauge
- Tire gauge
- Transmission gauge set
- Vacuum gauge

Student Equipment (supplied by school)

Required

- 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
- Engine rotator
- Floor hoist
- Forklift
- Drill: bench, hand drivers, twist, air
- Fast charger
- 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
- Retrieval and storage equipment
- Scanning tool
- Shop crane
- Sling/cable/chain
- Spreader bar
- Support stand
- Tire guard
- Transmission jack
- Welding equipment
- Refrigerant recycling cart
- Safety equipment

Recommended

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

Specialty Tools

Required Safety Equipment for Student (supplied by student)

Required

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

Recommended

- High visabilty coveralls
- Mechanics gloves

Reference Materials

Recommended Resources

- SkilledTradesBC www.skilledtradesbc.ca
- Transportation Career Development Association (TCDA) www.tcda.ca
- WorkSafeBC www.worksafebc.com

Foundation

- Heavy Mechanical Group Foundation Learning Resources, Queens Printer
- FOS Hydraulics (Deere) ISBN 0-86691-239-0

or

- Vickers Mobile Hydraulics, ISBN 0-9634162-5-1
- FOS Electronic and Electrical Systems (Deere), ISBN 0-86691-240-1
- Heavy Duty Truck Systems 5th Edition (Norman/Scharff/Cosinchock), ISBN 0-7668-1340-1
- Inside Air Brake Valves and Devices (Allan C. Wright)
- Alberta Trades Training Modules, Queens Printer
- FOS Air Conditioning (Deere) ISBN 086691-221-5
- Driving Commercial Vehicles Manual MV2677 – Insurance Corporation of BC (ICBC) www.icbc.com

NOTE:

This list of Reference Materials is for training providers. Apprentices should contact their preferred training provider for a list of recommended or required texts for this program.

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 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– not mandatory
- Instructors Diploma– not mandatory