

## PROGRAM OUTLINE

Heavy Duty Equipment  
Technician



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# **HEAVY DUTY EQUIPMENT TECHNICIAN PROGRAM OUTLINE**

**APPROVED BY INDUSTRY  
SEPTEMBER 2013**

**BASED ON  
NOA 2009**

**Developed by  
Industry Training Authority  
Province of British Columbia**



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# **Section 1**

## **INTRODUCTION**

### **Heavy Duty Equipment Technician**



## Foreword

A Heavy Duty Equipment Technician is a tradesperson who possesses the full range of knowledge, abilities and skills required to diagnose, repair, adjust, overhaul, maintain, operate and test the mobile, heavy duty machinery used in the construction, forestry, mining, petrochemical, material handling, landscaping, land clearing, transportation, road building and farming sectors.

Heavy Duty Equipment Technicians inspect bulldozers, heavy trucks, cranes, graders, drills and other heavy equipment for proper performance. They also inspect equipment to detect and diagnose faults and malfunctions to determine the extent of the repair required. These technicians service engines and engine support systems, hydraulic systems, pneumatics, drive trains and perform Commercial Vehicle Inspection. Other duties include adjusting equipment, welding and cutting, repairing or replacing defective parts, components or systems, using hand and power tools and diagnostic test equipment.

Heavy Duty Equipment Technicians 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 Duty Equipment Technician student are:

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

They also demonstrate the ability to:

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

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

### **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

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- K. Poisson, Coast Mountain Bus Company (Apprenticeship coordinator)
- D. Vallely, Coast Mountain Bus Company ( Director)
- 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)
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- B. Holcik- Finning (Instructor)
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- G. Warne-BCIT (Instructor)

Facilitators:

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

The Industry Training Authority would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Heavy Duty Equipment Technician occupation.



## 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	Apprentices
<b>Program Credentialing Model</b>	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program, and pathway to completion
<b>OAC</b>	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
<b>Training Topics and Suggested Time Allocation</b>	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
<b>Program Content</b>	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component	Provides detailed information on program content and performance expectations for demonstrating competency
<b>Training Provider Standards</b>	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 Duty Equipment Technician**

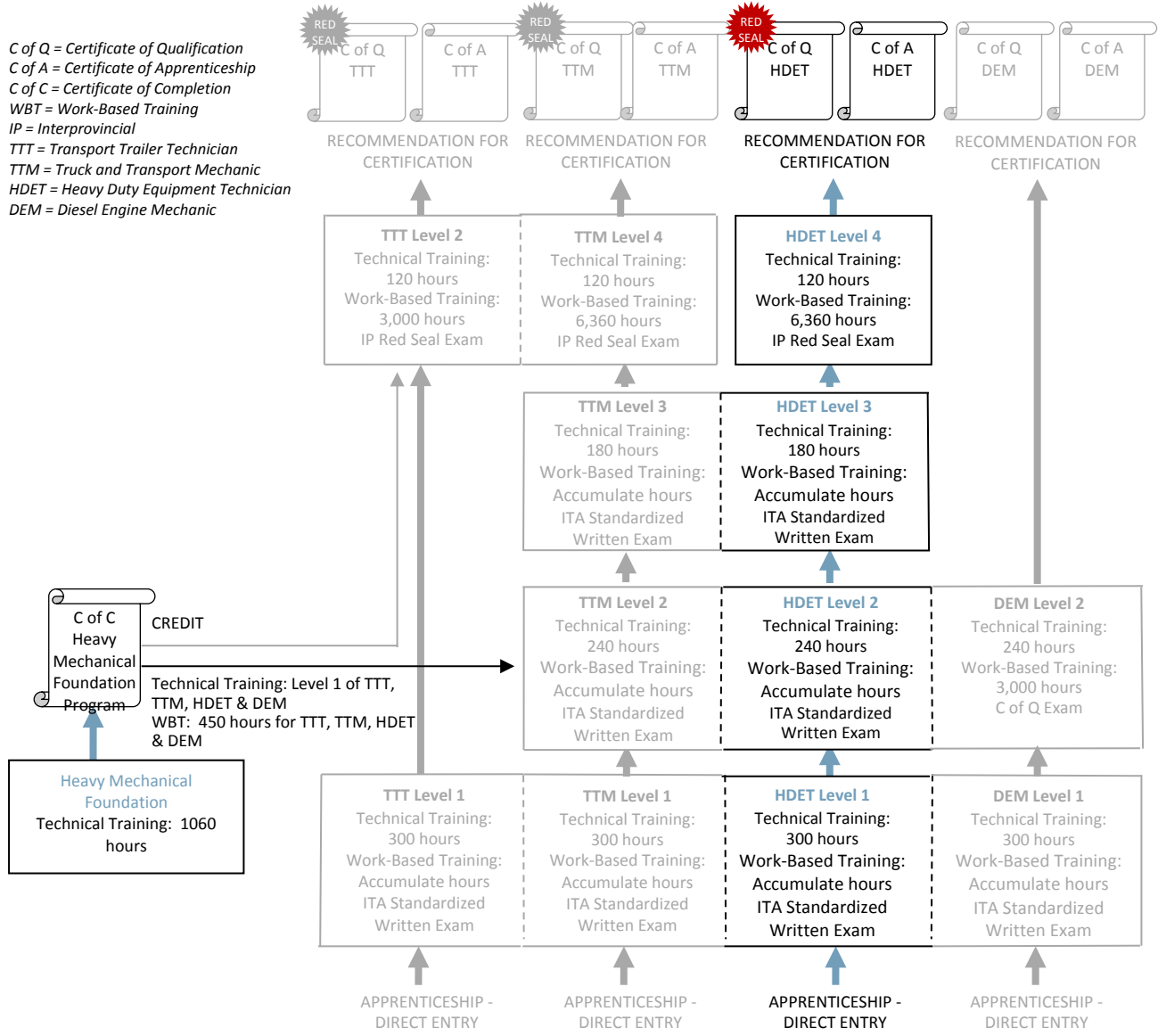


# Program Credentialing Model

## Apprenticeship Pathway

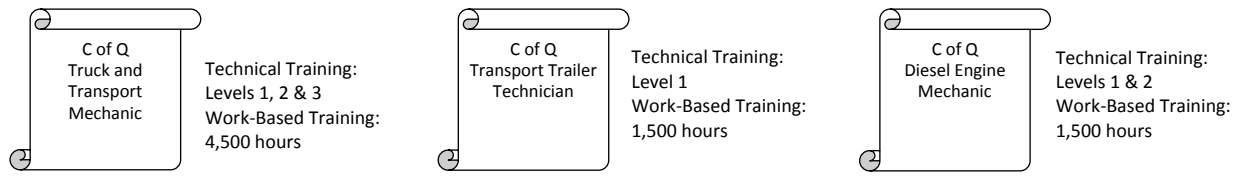
This graphic provides an overview of the Heavy Duty Equipment Technician apprenticeship pathway.

C of Q = Certificate of Qualification  
 C of A = Certificate of Apprenticeship  
 C of C = Certificate of Completion  
 WBT = Work-Based Training  
 IP = Interprovincial  
 TTT = Transport Trailer Technician  
 TTM = Truck and Transport Mechanic  
 HDET = Heavy Duty Equipment Technician  
 DEM = Diesel Engine Mechanic



= same technical training for multiple trades

**CROSS-PROGRAM CREDITS**  
 Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program

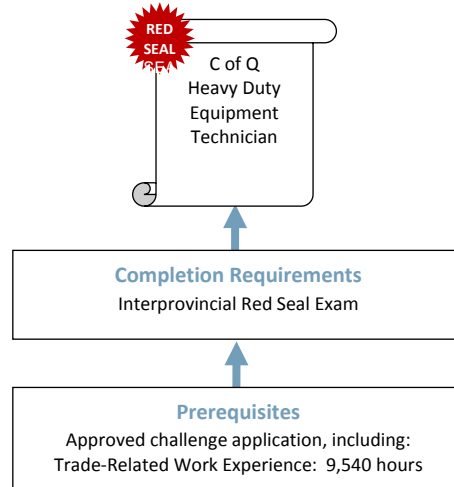




## Challenge Pathway

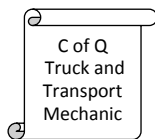
This graphic provides an overview of the Heavy Duty Equipment Technician challenge pathway.

C of Q = Certificate of Qualification

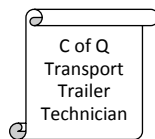


### CREDIT FOR PRIOR LEARNING

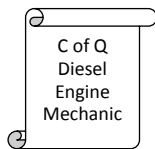
Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program



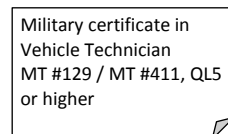
Work Experience:  
4,500 hours



Work Experience:  
1,500 hours



Work Experience:  
1,500 hours



Work Experience:  
9,000 hours



# Occupational Analysis Chart

## HEAVY DUTY EQUIPMENT TECHNICIAN

**Occupation Description:** The Heavy Duty Equipment Technician 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.

<b>Occupational Skills</b>  <b>A</b>	Use Safe Work Practices  A1 1	Use Hand Tools, Power Tools, and Shop Equipment  A4 1	Use Fasteners and Fittings  A5 1	Lift and Support Loads  A6 1	Operate Equipment  A7 1	Use Shop Resources and Record Keeping Practices  A8 1
	Service Winch Wire Rope  A9 1	Identify Lubricants  A10 1	Service Bearings and Seals  A11 1	Use Electronic Media  A13 1	Use Cutting and Welding Equipment  A14 1	Describe Diagnostic Procedures  A16 1
<b>Brakes</b>  <b>B</b>	Service and Repair Hydraulic Brakes  B1 1	Service and Repair Hydraulic Power Brakes  B2 1	Service and Repair Air Brakes  B3 1			
	<b>Hydraulics</b>  <b>C</b>	Describe Hydraulic Systems  C1 1	Service Hydraulic Components  C2 1	Diagnose and Repair Advanced Hydraulic Systems  C3 4		



<b>Electrical</b>  <b>D</b>	Describe Electricity  D1 1	Use Electrical Testing Instruments  D2 1	Service and Diagnose Batteries  D3 1	Service Charging Systems  D4 1	Diagnose and Repair Charging Systems  D5   2	Service Starting Systems  D6 1
	Diagnose and Repair Starting Systems  D7   2	Service Electrical Circuits  D8 1	Diagnose and Repair Electrical Components and Systems  D9   2	Diagnose and Repair Electronic Components and Systems  D10   2	Diagnose and Repair Vehicle Management Systems  D11   2	Service, Diagnose and Repair Electric Drive Systems  D13       4
<b>Frames, Steering and Suspension</b>  <b>E</b>	Service and Diagnose Tires, Wheels, and Hubs  E1 1	Service Steering Systems  E2 1	Service, Diagnose and Repair Suspension Systems  E4 1	Diagnose and Repair Frames  E6 1	Diagnose and Repair Wheeled Equipment Steering  E8       4	Diagnose and Repair Track Machine Steering  E9       4
	Diagnose and Repair Undercarriage  E10       4					
<b>Trailer</b>  <b>F</b>	Service Landing Gear and Trailer Accessories  F1 1	Service and Repair Coupling Systems  F2 1	Service, Diagnose and Repair Trailer Body Components  F3 1	Service, Diagnose and Repair Heating and Refrigeration Systems  F4 1		
	Heating, Ventilation and Air Conditioning  G 1	Describe Heating and Air Conditioning Fundamentals  G1 1	Diagnose and Repair Heating and Air Conditioning Systems  G2 1			



<b>Engines and Supporting Systems</b> <span style="float: right;">H</span>	Describe Engine Fundamentals <span style="float: right;">H1</span>	Diagnose and Repair Engine Support Systems <span style="float: right;">H3</span>	Diagnose and Repair Diesel Supply Systems <span style="float: right;">H5</span>	Describe Alternative Fuel Systems <span style="float: right;">H7</span>	Diagnose Engines and Components <span style="float: right;">H8</span>	Remove Engines and Components <span style="float: right;">H10</span>
	2	2	2	2	2	2
	Describe Diesel Fuel Injection Fundamentals <span style="float: right;">H11</span>	Diagnose and Repair Mechanical Fuel Injection Systems <span style="float: right;">H12</span>	Diagnose and Repair Electronic Diesel Fuel Systems <span style="float: right;">H13</span>	Diagnose and Repair Diesel Emissions Systems <span style="float: right;">H14</span>	Diagnose and Repair Engine Brakes <span style="float: right;">H15</span>	
	2	2	2	2	2	
<b>Powertrains</b> <span style="float: right;">I</span>	Describe Power Transfer Systems <span style="float: right;">I1</span>	Diagnose and Repair Clutches <span style="float: right;">I3</span>	Diagnose and Repair Manual Transmissions <span style="float: right;">I5</span>	Diagnose and Repair Automated Systems <span style="float: right;">I6</span>	Diagnose and Repair Automatic Transmissions and Torque Converters <span style="float: right;">I9</span>	Diagnose and Repair Power Shift Transmissions <span style="float: right;">I10</span>
	3	3	3	3	3	3
	Diagnose and Repair Drivelines <span style="float: right;">I12</span>	Diagnose and Repair Drive Axles <span style="float: right;">I14</span>	Diagnose and Repair Final Drives <span style="float: right;">I16</span>	Diagnose and Repair Driveline Retarders <span style="float: right;">I17</span>	Diagnose and Repair Winches <span style="float: right;">I18</span>	Diagnose and Repair Power Take-offs and Transfer Cases <span style="float: right;">I19</span>
	3	3	3	3	3	3
<b>Structural Components and Accessories</b> <span style="float: right;">J</span>	Identify Protective Structures <span style="float: right;">J1</span>	Service Cab Structures <span style="float: right;">J2</span>	Diagnose and Repair Working Attachments <span style="float: right;">J4</span>	Diagnose and Repair Pneumatic Systems <span style="float: right;">J5</span>		
	1	1	4	4		



## Training Topics and Suggested Time Allocation

### Heavy Duty Equipment Technician – Level 1

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line A</b>	<b>OCCUPATIONAL SKILLS</b>	<b>18%</b>	<b>55%</b>	<b>45%</b>	<b>100%</b>
A1	Use Safe Work 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		✓	✓	
A13	Use Electronic Media		✓	✓	
A14	Use Cutting and Welding Equipment		✓	✓	
A16	Describe Diagnostic Procedures		✓		
<b>Line B</b>	<b>BRAKES</b>	<b>17%</b>	<b>30%</b>	<b>70%</b>	<b>100%</b>
B1	Service and Repair Hydraulic Brakes		✓	✓	
B2	Service and Repair Hydraulic Power Brakes		✓	✓	
B3	Service and Repair Air Brakes		✓	✓	
<b>Line C</b>	<b>HYDRAULICS</b>	<b>13%</b>	<b>40%</b>	<b>60%</b>	<b>100%</b>
C1	Describe Hydraulic Systems		✓		
C2	Service Hydraulic Components		✓	✓	
<b>Line D</b>	<b>ELECTRICAL</b>	<b>17%</b>	<b>55%</b>	<b>45%</b>	<b>100%</b>
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		✓	✓	
<b>Line E</b>	<b>FRAMES, STEERING AND SUSPENSION</b>	<b>14%</b>	<b>30%</b>	<b>70%</b>	<b>100%</b>
E1	Service and Diagnose Tires, Wheels, and Hubs		✓	✓	
E2	Service Steering Systems		✓	✓	
E4	Service, Diagnose and Repair Suspension Systems		✓	✓	
E6	Diagnose and Repair Frames		✓	✓	



% of Time Allocated to:

		% of Time	Theory	Practical	Total
<b>Line F</b>	<b>TRAILER</b>	<b>10%</b>	<b>35%</b>	<b>65%</b>	<b>100%</b>
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		✓	✓	
<b>Line G</b>	<b>HEATING, VENTILATION AND AIR CONDITIONING</b>	<b>8%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
G1	Describe Heating and Air Conditioning Fundamentals		✓		
G2	Diagnose and Repair Heating and Air Conditioning Systems		✓	✓	
<b>Line J</b>	<b>STRUCTURAL COMPONENTS AND ACCESSORIES</b>	<b>3%</b>	<b>90%</b>	<b>10%</b>	<b>100%</b>
J1	Identify Protective Structures		✓		
J2	Service Cab Structures		✓	✓	
<b>Total Percentage for Heavy Duty Equipment Technician Level 1</b>		<b>100%</b>			





## Training Topics and Suggested Time Allocation

### Heavy Duty Equipment Technician – Level 2

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line D</b>	<b>ELECTRICAL</b>	<b>25%</b>	<b>40%</b>	<b>60%</b>	<b>100%</b>
D5	Diagnose and Repair Charging Systems		✓	✓	
D7	Diagnose and Repair Starting Systems		✓	✓	
D9	Diagnose and Repair Electrical Components and Systems		✓	✓	
D10	Diagnose and Repair Electronic Components and Systems		✓	✓	
D11	Diagnose and Repair Vehicle Management Systems		✓	✓	
<b>Line H</b>	<b>ENGINES AND SUPPORTING SYSTEMS</b>	<b>75%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
H1	Describe Engine Fundamentals		✓		
H3	Diagnose and Repair Engine Support Systems		✓	✓	
H5	Diagnose and Repair Diesel Supply Systems		✓	✓	
H7	Describe Alternative Fuel Systems		✓		
H8	Diagnose Engines and Components		✓	✓	
H10	Remove Engines and Components		✓	✓	
H11	Describe Diesel Fuel Injection Fundamentals		✓		
H12	Diagnose and Repair Mechanical Fuel Injection Systems		✓	✓	
H13	Diagnose and Repair Electronic Diesel Fuel Systems		✓	✓	
H14	Diagnose and Repair Diesel Emissions Systems		✓	✓	
H15	Diagnose and Repair Engine Brakes		✓	✓	
<b>Total Percentage for Heavy Duty Equipment Technician Level 2</b>		<b>100%</b>			



## Training Topics and Suggested Time Allocation

### Heavy Duty Equipment Technician – Level 3

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line I</b>	<b>POWERTRAINS</b>	<b>100%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
I1	Describe Power Transfer Systems		✓		
I3	Diagnose and Repair Clutches		✓	✓	
I5	Diagnose and Repair Manual Transmissions		✓	✓	
I6	Diagnose and Repair Automated Systems		✓	✓	
I9	Diagnose and Repair Automatic Transmissions and Torque Converters		✓	✓	
I10	Diagnose and Repair Power Shift Transmissions		✓	✓	
I12	Diagnose and Repair Drivelines		✓	✓	
I14	Diagnose and Repair Drive Axles		✓	✓	
I16	Diagnose and Repair Final Drives		✓	✓	
I17	Diagnose and Repair Driveline Retarders		✓	✓	
I18	Diagnose and Repair Winches		✓	✓	
I19	Diagnose and Repair Power Take-offs and Transfer Cases		✓	✓	
<b>Total Percentage for Heavy Duty Equipment Technician Level 3</b>		<b>100%</b>			



## Training Topics and Suggested Time Allocation

### Heavy Duty Equipment Technician – Level 4

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line C</b>	<b>HYDRAULICS</b>	<b>68%</b>	<b>45%</b>	<b>55%</b>	<b>100%</b>
C3	Diagnose and Repair Advanced Hydraulic Systems		✓	✓	
<b>Line D</b>	<b>ELECTRICAL</b>	<b>5%</b>	<b>70%</b>	<b>30%</b>	<b>100%</b>
D13	Service, Diagnose and Repair Electric Drive Systems		✓	✓	
<b>Line E</b>	<b>FRAMES, STEERING, AND SUSPENSION</b>	<b>18%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
E8	Diagnose and Repair Wheeled Equipment Steering		✓	✓	
E9	Diagnose and Repair Track Machine Steering		✓	✓	
E10	Diagnose and Repair Undercarriage		✓	✓	
<b>Line J</b>	<b>STRUCTURAL COMPONENTS AND ACCESSORIES</b>	<b>9%</b>	<b>55%</b>	<b>45%</b>	<b>100%</b>
J4	Diagnose and Repair Working Attachments		✓	✓	
J5	Diagnose and Repair Pneumatic Systems		✓	✓	
<b>Total Percentage for Heavy Duty Equipment Technician Level 4</b>		<b>100%</b>			



# **Section 3**

## **PROGRAM CONTENT**

### **Heavy Duty Equipment Technician**



# Level 1

# Heavy Duty Equipment Technician



**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

1. Apply personal safety precautions and procedures
  
  
  
  
  
  
  
  
  
  
2. Lock out heavy duty equipment prior to service
  
  
  
  
  
  
  
  
  
  
3. Locate shop emergency equipment and procedures

### CONTENT

- Personal apparel
- Clothing
- Hair and beards
- Jewellery
- Personal protective equipment (PPE)
  - 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
  
- WorkSafeBC requirements
- Electrical isolation (Night switch)
- Tag
- Key storage
  
- Emergency shutoffs
- Fire control systems
- Eye wash facilities
- Emergency exits
- First aid facilities
- Emergency contact/phone numbers



**LEARNING TASKS**

4. Describe the conditions necessary to support a fire
5. Describe the classes of fires according to the materials being burned
6. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus
7. Describe the considerations and steps to be taken prior to fighting a fire
8. Describe the procedure for using a fire extinguisher
9. Describe fire suppression systems

**CONTENT**

- Outside meeting place
- Disaster meeting place
- Air
- Fuel
- Heat
- Class A
- Class B
- Class C
- Class D
- Symbols and colours
- Fuels
- Diesel
- Gasoline
- Propane
- Natural Gas
- Ventilation
- Purging
- Lubricants
- Oily rags
- Combustible metals
- Aerosols
- Warning others and the Fire Department
- Evacuation of others
- Fire contained and not spreading
- Personal method of egress
- Training
- P.A.S.S.
  - Pull
  - Aim
  - Squeeze
  - Sweep
- Types
- Construction
- Operation
- Disarming



**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**

1. Use protective equipment associated with the use of tools and shop equipment
  
2. Apply lock-out procedures to shop equipment
  
3. Select, use and maintain hand tools

**CONTENT**

- Personal Protective Equipment
  - Head
  - Hands
  - Lungs
  - Eyes
  - Ears
  - Feet
  - Clothing
- Screening
- Guarding
- Ventilation
- Clean up
- WorkSafeBC lock-out procedures
- Electrical isolation
- Tags
- Locks
- 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





**LEARNING TASKS**

- 4. Select, use and maintain measuring instruments
- 5. Select, use and maintain power tools
- 6. Select, use and maintain drill bits
- 7. Select, use and maintain shop equipment

**CONTENT**

- Pry bars
- Pliers
- Clamping tools
- Abrasives
- Pullers
- Torque wrenches and multipliers
- Layout tools
- Precision measuring
- Imperial
- Metric
- Micrometer
- Veriner
- Dial indicator
- Feeler/thickness gauges
- Bore gauges
- Pneumatic
- Electric
- Hydraulic
- Types
- Sharpening
- Cutting speeds
- 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**

1. Select and use imperial and metric fasteners
  
2. Cut and repair internal and external threads
  
3. Select use and repair tubing, pipe and fittings

**CONTENT**

- Thread systems
- Fastener types
  - Installation
- Washers
  - Types
  - Applications
- Locking devices
  - Types
  - Applications
- Taps
- Dies
- Thread repair
- Tubing
  - Types
  - Sizing
  - Applications
- Pipe
  - Types
  - Sizing
- Threads
  - Applications
- Fitting
  - Types
  - Sizing
  - Applications
- Assembly procedures
- Sealants
- Cutting, bending and flaring



**LEARNING TASKS**

4. Select and use hose and hose fittings

**CONTENT**

- 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**

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Apply the Occupational Health and Safety Regulations</li> <li>2. Determine load weight</li> <li>3. Select, use and maintain jacks</li> <li>4. Select, use and maintain stands and blocking</li> <li>5. Select, use and maintain wire ropes, chains and lifting straps</li> <li>6. Use fibre rope knots, bends and hitches</li> <li>7. Use visual and sound signals</li> <li>8. Select, use and maintain hoisting equipment</li> </ol> | <ul style="list-style-type: none"> <li>• Refer to regulations               <ul style="list-style-type: none"> <li>○ PPE</li> <li>○ Clothing</li> <li>○ Housekeeping</li> <li>○ Safe lifting and carrying</li> <li>○ Safe handling with cranes</li> </ul> </li> <li>• Manufacturer’s specification</li> <li>• Estimation</li> <li>• Types</li> <li>• Capacities</li> <li>• Manufacturer’s procedures</li> <li>• Types</li> <li>• Capacities</li> <li>• Bridging</li> <li>• Types</li> <li>• Capacities</li> <li>• Inspection</li> <li>• Rating tags</li> <li>• Rigging and lifting attachments</li> <li>• Types</li> <li>• Uses</li> <li>• Care and maintenance</li> <li>• WorkSafeBC Safety Regulations               <ul style="list-style-type: none"> <li>○ Hand</li> <li>○ Sound</li> </ul> </li> <li>• Types</li> <li>• Capacities</li> <li>• Operation</li> </ul> |
|---|--|



**LEARNING TASKS**

9. Lift, hoist and move loads

**CONTENT**

- 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**

1. Describe pre-start and walk around inspections
2. Describe starting aids
3. Describe start up procedures
4. Describe emergency shut down procedures
5. Start, operate and shut down selected equipment
6. Lock-out heavy duty equipment prior to service
7. Operate a forklift

**CONTENT**

- Checklist
- Operator’s manuals
- Glow plug systems
- Intake preheater systems
- Starting fluids
- Block/circulating heaters
- Battery warmers
- Controls
- Cranking
- Monitoring
- Jump starting
- Cut-off
  - Fuel
  - Air
- Pre-start and walk around
- Use of starting aids
- Moving
- Securing and shutting down
- WorkSafeBC requirements
- Electrical isolation (Night switch)
- Tag
- Key in pocket
- Safe operation
- Forklift training (certification optional)
  - Occupational Health and Safety regulations
  - Maintenance and records



**Program Content  
Level 1**



**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**

1. Use record keeping forms
2. Describe the requirements for report writing
3. Use manuals

**CONTENT**

- 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
- Types of reports
  - Service
  - Structure
  - Inclusions or attachments
  - Shift end
  - Maintenance log
  - Accident
  - Safety
  - Digital media
- Technical
  - Service
  - Repair
- Parts
- Systems
- Operators
- Service bulletins/updates
- Digital media







**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

1. Describe the theory of lubrication
2. Describe the properties of lubricants
  
3. Describe the use of lubricants

### CONTENT

- Friction
- Purpose
- 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)
- Applications
- Oils
- Greases
- Dry lubricants
- Synthetics
- Brake fluids
  - Dot 3
  - Dot 4
  - Dot 5
- Manufacturer's specifications
- Minimum requirements
- Warranty issues



**LEARNING TASKS**

4. Handle lubricants
  
  
  
  
  
  
  
  
  
  
5. Perform fluid analysis

**CONTENT**

- Storage
- Disposal
- Personal protection
  
- 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**

1. Describe bearings

2. Select and service bearings

3. Describe seals

4. Select and service seals

### **CONTENT**

- Purpose
- Types
  - Friction
  - Antifriction
- Terminology
- Applications
- Loads
  - Axial
  - Radial
- Removal
- Clean
- Inspection
- Lubrication
- Storage
- Installation
- Adjustments
- Types
  - Static
  - Dynamic
- Applications
- Removal
- Inspection
- Installation



**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

1. Use computers

2. Use electronic media

### CONTENT

- Hardware
- Keyboarding
- Software
- Operating system
  - Windows
  - Managing files
  - Printing
- Applications
  - Word processing
  - Internet access
  - E-mail
  - On-line resources
  - Data bases
- 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**

1. Identify regulations with respect to welding
2. Identify metals
  
3. Identify oxy-acetylene components
  
4. Use oxy-acetylene equipment
  
5. Cut mild steel with oxy-acetylene equipment
  
6. Weld mild steel with oxy-acetylene equipment

**CONTENT**

- WorkSafeBC Safety Regulations
- Metals and alloys
- Terminology
- Shapes
- Storage and handling
- Gases
- Valves and regulators
- Cylinders
- Hoses and fittings
- Cutting torches and tips
- Safety precautions
- Blow back
- Check valves
- Assembly procedures
- Operation procedures
- Lighting
- Pressures
- Adjusting
- Shut down procedures
- Leak testing
- Storage
- Set-up
- Freehand cuts
- Guided cuts
- Hole piercing
- Principles of fusion welding



**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <p>7. Braze lap joints with oxy-acetylene equipment</p> <p>8. Solder tubing and sheet metal</p> <p>9. Describe the shielded metal arc welding (SMAW) process</p> <p>10. Identify shielded metal arc welding equipment</p> <p>11. Identify mild steel electrodes for shielded metal arc welding</p> <p>12. Weld mild steel with shielded metal arc</p> <p>13. Weld mild steel using wire feed processes</p> | <ul style="list-style-type: none"> <li>• Filler metal</li> <li>• Flux</li> <li>• Welding tips</li> <li>• Flame</li> <li>• Technique</li> <li>• Basic joints</li> <li>• Brazing set-up</li> <li>• Brazing techniques</li> <li>• Process and procedures</li> <li>• Solder types             <ul style="list-style-type: none"> <li>○ 60/40</li> <li>○ 40/60</li> <li>○ Rosin core</li> <li>○ Acid core</li> </ul> </li> <li>• Process</li> <li>• Applications</li> <li>• Safety requirements</li> <li>• AC/DC machines</li> <li>• Components</li> <li>• Electrode holder</li> <li>• Ground clamps</li> <li>• Cables</li> <li>• Connectors</li> <li>• Types</li> <li>• Operations</li> <li>• Classifications</li> <li>• Selection</li> <li>• Storage and handling</li> <li>• Procedures</li> <li>• Weld ground placement</li> <li>• Settings</li> <li>• Positions</li> <li>• Joints</li> <li>• Types of welds</li> <li>• Procedures</li> <li>• Settings</li> <li>• Safety</li> <li>• Weld types and positions</li> <li>• Wire type</li> </ul> |
|--|--|



**LEARNING TASKS**

14. Describe air-arc gouging

**CONTENT**

- Purpose
- Procedure
- Safety



**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**

1. Describe the importance of following a diagnostic process
  
2. Describe general diagnostic procedures
  
3. Describe the importance of following manufacturer’s diagnostic procedures where available
  
4. Describe the importance of failure analysis

**CONTENT**

- Cost of improper diagnosis
- Unhappy customers
- Lost business
- Time management
- Efficiency
- Damage to components
- Understand system
- Understand complaint
- Communicate with operator
- Operational test
- Visual inspection
- Form all possible conclusions
- Test conclusions
- System component isolation
- Time saving
- Warranty requirement
- Diagnostic efficiency
- Repeat failure
- Extend life
- Cost
- Customer satisfaction





**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

1. Describe the principles of braking
2. Describe the foundation brake
3. Review hydraulic principles
4. Describe the hydraulics of a brake system

### CONTENT

- Friction
- Definition
- Coefficient
- Heat
- Absorbing
- Dissipating
- Effects of speed and weight
- Brake fade
- Types
  - Disk
  - Drum
  - Multidisc
  - Others
- Components
  - Calipers
  - Wheel cylinder
  - Lines
  - Shoes/pads
- Operation
  - Self energizing and non-self energizing
  - Servo/non-servo
- Pressure, force and area
- Types
  - Disk
  - Drum
  - Multidisc
  - Others
- Components
  - Master cylinder
  - Metering valve
  - Proportioning valve



**LEARNING TASKS**

- 5. Select brake fluids
  
- 6. Describe parking brake systems
  
- 7. Diagnose hydraulic brake systems
  
- 8. Repair hydraulic brake systems
  
- 9. Service parking brake systems
  
- 10. Perform preventive maintenance

**CONTENT**

- Switches
- Operation
- Requirements
- Types
  - DOT 3
  - DOT 4
  - DOT 5
  - Others
- Characteristics
  - Hygroscopic
  - Boiling point
  - Viscosity
- Identification
- Types
  - Integral
  - Driveline
  - Hydraulic
  - Mechanical
- Components
- Operation
- Diagnostic procedures
  - Operational checks
  - Fluid condition/level
- Inspection
- Components
  - Hydraulic
  - Mechanical
- Inspection
- Remove
- Repair/replace
- Install
- Flush/bleed
- Inspection
- Remove
- Repair/replace
- Install
- Inspection
- Operational tests
- Fluid level checks
- Adjustment

**LEARNING TASKS****CONTENT**

- 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**

1. Describe the power brake systems
  
2. Diagnose power brake systems
  
3. Repair power brake systems
  
4. Describe hydraulic anti-lock braking systems

**CONTENT**

- Types
  - Vacuum boosters
  - Hydro-boost
  - Hydro-max
  - Hydraulic
- Components
- Operation
- Diagnostic procedures
- Operational test
- Components
- Inspection
- Testing
- Inspection
- Remove
- Repair/replace
- Install
- Adjustments
- Verify system operation
- Types
  - Single channel
  - Two channel
  - Four channel
- Components
- Operation
- Precautions



**LEARNING TASKS**

5. Diagnose hydraulic anti-lock braking systems
  
6. Repair hydraulic anti-lock braking systems

**CONTENT**

- Manufacturer's diagnostic procedures
- Road test
- Diagnostic codes
- Components
- Inspection
- Testing
  
- Inspection
- Remove
- Repair/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**

1. Describe the principles of braking
2. Describe the principles of pneumatics
3. Describe a basic air brake system

### **CONTENT**

- Friction
- Definition
- Coefficient
- Heat
- Absorbing
- Dissipating
- Effects of speed and weight
- Brake fade
- Water cooling
- Characteristics of air
- Relationship between force, pressure and area
- Effects of heat on air
- Time lag
- Pneumatic balance
- Sub systems
- Supply
- Delivery
- Foundation brakes
  - Drum
  - Disc
- Components
  - Compressor
  - Governor
  - Treadle
  - Relay
  - Brake chamber
- Operation



**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 4. Describe the basics of air brake schedules          | <ul style="list-style-type: none"> <li>• 121</li> <li>• X</li> <li>• SX</li> <li>• Operation and routine maintenance</li> </ul>   |
| 5. Repair foundation brake assembly                    | <ul style="list-style-type: none"> <li>• Inspection</li> <li>• Disassembly</li> <li>• Replacement</li> <li>• Measurement</li> <li>• Assembly</li> <li>• Adjustment</li> </ul>   |
| 6. Service and inspect air brakes                      | <ul style="list-style-type: none"> <li>• Tractor and trailer</li> <li>• Components               <ul style="list-style-type: none"> <li>○ Foundation brakes</li> <li>○ Reservoirs</li> <li>○ Lines</li> <li>○ Disc/Drum</li> </ul> </li> <li>• Adjustment</li> <li>• Scheduled maintenance</li> </ul> |
| 7. Describe tractor trailer pre-trip brake inspection  | <ul style="list-style-type: none"> <li>• As per motor vehicle standards</li> </ul>  |
| 8. Perform a tractor trailer pre-trip brake inspection | <ul style="list-style-type: none"> <li>• As per motor vehicle standards</li> </ul>  |

**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

1. Describe the principles of hydraulics
2. Describe the basic operation of a hydraulic system
3. Describe types of hydraulic systems

### CONTENT

- Terminology
- Advantages/disadvantages
- Fluid characteristics
- Pascal's Law
- Calculations
- Bernoulli's Principle
- Components
- Reservoir
  - Vented
  - Pressurized
- Pump
  - Positive displacement
    - Gear
    - Vane
    - Piston
  - Ratings
- Control valves
  - Pressure
  - Directional
  - Volume
- Actuators
  - Cylinder
  - Motor
- Connecting lines
- Hydraulic fluids
- Open-centre
- Closed-centre
- Vented
- Pressurized





**LEARNING TASKS**

4. Interpret basic hydraulic diagrams

**CONTENT**

- 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**

1. Describe hydraulic components
  
2. Select hydraulic fluids
  
3. Select hydraulic hoses and fittings
  
4. Assemble hydraulic hoses and fittings

**CONTENT**

- Seals
- Hoses/lines
- Fittings
- Filters
  
- Requirements
- SAE viscosity ratings
- ISO viscosity ratings
- API service ratings
- Manufacturer's specifications
- Synthetic/Non-synthetic (mineral)
- Component/System compatibility
  
- 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
  
- Permanent
- Reusable



### LEARNING TASKS

5. Demonstrate safe work procedures
  
6. Perform scheduled maintenance

### CONTENT

- Safety blocking equipment and attachments
- Relieve pressure
- Reservoir venting
- Actuator neutralization
- Temperature hazards
  
- 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***





## LEARNING TASKS

3. Describe magnetic theory
  
4. Identify common electrical components
  
5. Describe the basic function of common electronic components
  
6. Interpret basic electrical wiring diagrams

## CONTENT

- Load
- Complete path
- Electrical relationships
- Ohm's Law
- Watt's Law
- Series circuits
- Parallel circuits
- Series parallel circuits
- Properties of magnetic lines of force
- Terminology
- Relationship to electric current
- Electromagnetic induction
  - Types
  - Requirements
  - Factors affecting magnitude
- Lamps
- Switches
- Relays
- Solenoids
- Resistors
  - Fixed
  - Variable
- Capacitors
- Motors
- Alternators
- Fuses
- Diodes
- Transistors
- 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

1. Describe how to use electrical measuring devices.
  
  
  
  
  
  
  
  
  
  
2. Diagnose electrical circuits

### CONTENT

- Analog vs. digital
- Voltmeters
- Ammeters
- Ohmmeters
- Multimeters (VOM)
- Amp clamp
- VAT's (Volt amp testers)
- Continuity testers
- Test lights
- Safety precautions
  
- 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

1. Describe safety considerations when working with batteries
2. Describe the design and construction of the various types of batteries
3. Describe the chemical action that takes place in a battery during charging and discharging

### CONTENT

- Personal protection
  - Face shield
  - Apron
- Hydrogen gassing
- Acid
- Frozen batteries
- Short circuit (arcing)
- Environmental considerations
- Types
  - Conventional
  - Low maintenance
  - Maintenance free
  - Deep-cycle
  - Gel
  - Absorbed Glass Matt (AGM)
- Plates
  - Grid material
  - Active material
- Plate straps
- Separators
- Electrolyte/Gel
- Case
- Terminals
- Charging cycle
- Discharging cycle



### LEARNING TASKS

4. Select batteries
  
5. Service batteries
  
6. Diagnose batteries
  
7. Use booster batteries

### CONTENT

- Battery rating methods
  - Cold cranking amperes (CCA)
  - Cranking amperes (CA)
  - Reserve capacity
  - Amp hour
- Physical dimensions
- Safety precautions
- Inspection
- Cleaning
- Terminal servicing
- Charging
- Replacement
- Scheduled maintenance
- Storage and handling
- Specific gravity
- Open circuit voltage test
- Load test
- 3 minute fast charge test
- Battery Impedance test
- 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**

1. Describe charging circuits
  
2. Maintain charging circuits

**CONTENT**

- Purpose
- Operation
- Connections
  
- 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***



**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**

1. Replace electrical components
  
2. Select and install conductors and terminals/connectors
  
3. Describe sources of circuit faults
  
4. Describe trailer wiring circuits

**CONTENT**

- Lamps
- Starters
- Alternators
- Batteries
- Switches
- Motors
- Fuses
  
- Wire gauge
- Terminals/connectors
  - Crimped
  - Soldered
- Blown fuses
- Fusible link
- Circuit Breaker
- Connection
- Wiring
- 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 components

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: 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

1. Describe tires and rims
2. Diagnose tires and rims
3. Service tires and rims

### CONTENT

- Types of tires
  - Radial
  - Bias
- Rating
  - Load range
  - Size
  - Ply
- Types of rims
  - Dayton
  - Hub pilot
  - Stud pilot
- Inspection
- Tire wear
- Wheel run out
- Air pressure
- Tread depth
- Safety precautions
- Inspection
- Repair/replace
- Matching
- Mounting
  - Runout
- Balancing
  - Static
  - Dynamic
- Scheduled maintenance



### LEARNING TASKS

4. Describe wheel hubs
  
5. Diagnose wheel hubs
  
6. Service wheel hubs
  
  
  
  
  
7. Describe traction devices

### CONTENT

- Types
  - Conventional
  - Planetary
  - Unitized
- Components
  - Bearings
  - Seals
- Lubrication
- Inspection
- Testing
  
- Inspection
- Replacement
- Repair
- Adjustment
  - Bearing end play
  - Rolling torque
- Lubrication
- Scheduled maintenance
  
- 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

1. Describe basic steering systems fundamentals

2. Service steering systems

### CONTENT

- 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
- 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**

1. Describe wheeled equipment suspension systems
  
2. Diagnose wheeled equipment suspension systems
  
3. Repair wheeled equipment suspension systems
  
  
4. Diagnose and repair auto-lube systems
  
  
5. Describe truck and trailer steering axle suspension systems

**CONTENT**

- Types
  - Hydro pneumatic
  - Rigid
- Components
- Operation
  
- Inspection
- Measuring
  
- Inspection
- Remove
- Repair/replace
- Install
- Adjustments
- Lubrication
- Scheduled maintenance
  
- Inspection
- Remove
- Repair/replace
- Install
- Adjustments
- Scheduled maintenance
  
- Types
  - Single
  - Tandem
- Components
  - Air bag
  - Shock absorbers
  - Spring construction
  - Hangers and attachments
- Operation



**LEARNING TASKS**

- 6. Repair truck and trailer steering axle suspension systems
  
- 7. Describe truck and trailer rear axle suspension systems
  
- 8. Repair truck and trailer rear axle suspension systems

**CONTENT**

- Inspection
- Replacement
- Repair
- Adjustments
- Lubrication
  
- 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
  
- 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: 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

1. Describe rail and frame types

2. Diagnose frames

### CONTENT

- 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
- 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

1. Describe the construction and operation of accessories

### CONTENT

- 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**

2. Service and repair lift gates, landing gears and winches

**CONTENT**

- Inspect
  - Operation
  - Hydraulics
  - Pivots
  - Lubrication
- Remove
- Repair/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***







**LEARNING TASKS**

4. Describe bolster plates and king pins
  
5. Describe pintle hooks and eyes
  
6. Service and repair pintle hooks and eyes

**CONTENT**

- Bolster plates
- King pins
  - Size
  - Mounting
- Types
- Ratings
- Buffers
- Pneumatic
- Hydraulic
- Safety chains
- Compensators
- 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

1. Describe the purpose and operation of trailer body components
  
2. Remove and install trailer body components
  
3. Diagnose trailer body components
  
4. Repair trailer body components

### CONTENT

- Components
  - Frames
  - Doors
    - Hinged
    - Roll up
  - Bumpers
  - Tanks
  - Valves
  - Manifold piping
  - Gauges
  - Transfer pump
  - Reflective tape
  
- Safety
- Operation
- Procedures
- Support systems
  
- Operation
- Manufacturer's specifications
- Inspection and testing procedures
- Diagnosis
- Damage and wear identification
  
- 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**

1. Describe types of heating and refrigeration
  
2. Service and repair heating and refrigeration systems
  
3. Describe hazards associated with refrigeration units

**CONTENT**

- Trailer mounted
  - Cooling unit
  - Heating unit
- Maintenance
- Inspections
  - Operational checks
  - Pressure checks
  - Temperature checks
- Lubricants
- Service intervals
- Belts
- Fall protection
- Refrigerant
- Environmental 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**

1. Describe principles of heating and air conditioning systems
2. Identify components of heating and air conditioning systems

**CONTENT**

- Describe the laws of thermodynamics
- 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



**LEARNING TASKS**

3. Describe the design and operation of heating and air conditioning systems
  
4. Describe the impact of CFCs on the environment
  
5. Identify legislation/agreements dealing with the use and handling of CFCs

**CONTENT**

- Heater
- Refrigeration cycle
- Compressor
- Evaporator
- Condenser
- Receiver-drier/accumulator
- Orifice tubes/expansion valves
- Refrigerant
- Lubricants
- Controls
- Sensors
  
- Ozone depletion
- Global warming
  
- 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**

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Diagnose heating and air conditioning systems</li> </ol>  | <ul style="list-style-type: none"> <li>• Diagnostic procedures</li> <li>• Manufacturer’s procedures</li> <li>• Performance test</li> <li>• Diagnostic codes</li> <li>• Components</li> <li>• Inspection</li> <li>• Sensory inspection</li> <li>• Visual</li> <li>• Audible</li> <li>• Smell</li> <li>• Touch</li> <li>• Testing</li> <li>• Vacuum</li> <li>• Electrical</li> <li>• Mechanical</li> <li>• Pressure</li> <li>• Leak detection methods</li> </ul> |
| <ol style="list-style-type: none"> <li>2. Repair heating and air conditioning systems</li> </ol>    | <ul style="list-style-type: none"> <li>• Recovering, evacuation and recharging</li> <li>• Pressure/leak testing</li> <li>• Environmental considerations</li> <li>• Removing and replacing components</li> <li>• Verify system operations</li> </ul>  |
| <ol style="list-style-type: none"> <li>3. Describe the impact of CFCs on the environment</li> </ol> | <ul style="list-style-type: none"> <li>• Ozone depletion</li> <li>• Global warming</li> </ul>  |



**LEARNING TASKS**

4. Identify legislation/agreements dealing with the use and handling of CFCs

**CONTENT**

- 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
- 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): 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**

1. Describe structural components
  
2. Describe inspection procedures
  
3. Identify operational regulations

**CONTENT**

- Roll Over Protective Structure (ROPS)
- Falling Objects Protective Structure (FOPS)
- Operator Protective Structure (OPS)
  
- Cracks
- Dents
- Fatigue
  
- Components
- Safety glass
- Screens
- Service/diagnose/repair



**Line (GAC): J STRUCTURAL COMPONENTS & 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**

1. Identify cabs, bodies and components

2. Service cabs, bodies and components

**CONTENT**

- Types
- Components
  - Cab
    - Fixed
    - Air ride
  - Doors
  - Windows
  - Seats
  - Supplemental restraint system (air bag)
  - Sleepers
  - Ventilation systems
  - Mounting
- Operation
- 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***



## Level 2

# Heavy Duty Equipment Technician



**Line (GAC):**        **D    ELECTRICAL**  
**Competency:**     **D5   Diagnose and Repair Charging Systems**

**Objectives**

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

- Describe charging system components.
- Describe the design and operation of charging systems.
- Perform inspection, diagnosis and repair of charging systems.

**LEARNING TASKS**

1. Review the charging systems
  
2. Describe the design and operation of alternator assemblies
  
3. Diagnose charging systems

**CONTENT**

- Components
- Operation
- Alternator
  - Rotor
  - Stator
  - Rectifier
  - Brushes
- Regulators
- Field circuits
- Drive
- Cooling
- Inspection
- Operation
- Testing
  - System tests
  - Component tests
  - Voltage drop
  - Shorts
  - Opens
  - Grounds
  - High resistance
- Adjustments
- Diagnostic codes



**LEARNING TASKS**

4. Repair charging system components

**CONTENT**

- Inspection
- Remove
- Bench tests
- Repair/replace
- Rebuild
- Install
- Adjustments
- Lubrication
- Verify operation
- Scheduled maintenance
- Diagnostic codes

**Achievement Criteria**

Performance D5 Diagnose and Repair Charging Systems

Conditions The learner will require:

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

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:**    **D7**        **Diagnose and Repair Starting Systems**

**Objectives**

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

- Identify starting system components.
- Describe the design and operation of starting systems.
- Diagnose and repair starting systems and their components.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| 1. Review the starting systems                                    | <ul style="list-style-type: none"> <li>• Components</li> <li>• Operation</li> </ul>   |
| 2. Describe the design and operation of starting motor assemblies | <ul style="list-style-type: none"> <li>• Motor             <ul style="list-style-type: none"> <li>○ Series</li> <li>○ Parallel</li> </ul> </li> <li>• Drives</li> <li>• Solenoids</li> <li>• Control circuits             <ul style="list-style-type: none"> <li>○ Relays</li> <li>○ Switches</li> <li>○ Electronic Control Unit (ECU)</li> </ul> </li> <li>• Armature</li> <li>• Winding</li> <li>• Brushes</li> <li>• Counter-EMF (CEMF)</li> </ul> |
| 3. Diagnose starting systems                                      | <ul style="list-style-type: none"> <li>• Inspection</li> <li>• Operation</li> <li>• Testing             <ul style="list-style-type: none"> <li>○ System test</li> <li>○ Component test</li> <li>○ Voltage drop</li> <li>○ Shorts</li> <li>○ Opens</li> <li>○ Grounds</li> <li>○ High resistance</li> </ul> </li> </ul>  |



**LEARNING TASKS**

4. Repair starting system components

**CONTENT**

- Inspection
- Remove
- Bench tests
- Install
- Adjustments
- Lubrication
- Verify operation
- Scheduled maintenance
- Rebuild
- Replace

**Achievement Criteria**

Performance D7 Diagnose and Repair 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:**       **D9**   **Diagnose and Repair Electrical Components & Systems**

**Objectives**

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

- Identify electrical components.
- Identify electrical systems.
- Diagnose and repair electrical systems and components.

**LEARNING TASKS**

1. Review the electrical systems
  
2. Diagnose components and systems
  
3. Repair components and systems

**CONTENT**

- Components
- Operation
- Sensory inspection
- Diagnostic tools
- Test procedure
- Wiring schematics
- Repair connections
- Replace components
- Splice, solder, crimp
- Apply connection sealant

**Achievement Criteria**

Performance   D9 Diagnose and Repair Electrical Components and Systems

Conditions     The learner will require:

- Tools
- Test equipment
- Manufacturer’s Specifications
- A work place or training environment
- Equipment with electric components and 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***



**Achievement Criteria**

Performance D10 Diagnose and Repair Electronic Components and Systems

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with electric components and 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:** D11 Diagnose and Repair Vehicle Management Systems

### Objectives

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

- Describe a vehicle management system.
- Diagnose and repair vehicle management systems.

### LEARNING TASKS

1. Describe vehicle management systems
  
2. Diagnose vehicle management systems
  
3. Repair vehicle management systems

### CONTENT

- Dash displays
- Electronic Control Module (ECM)
- Satellite tracking
- Multiplexing
  - CAN data bus
    - J1587
    - J1708
    - J1939
- Communication protocols
- Diagnostic procedures
- Interpret test results
- Test equipment
- Codes
- Replace components
- Re-program Electronic Control Module (ECM)
- Component replacement
- Repair wiring and connections
- Update software

**Achievement Criteria**

Performance D11 Diagnose and Repair Vehicle Management Systems

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with electric components and 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): H ENGINES AND SUPPORTING SYSTEMS****Competency: H1 Describe Engine Fundamentals****Objectives**

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

- Describe the combustion process.
- Describe terminology and perform calculations related to engines.
- Describe the principles of operation of two and four stroke cycle internal combustion engines.

**LEARNING TASKS**

1. Describe the combustion process
  
  
  
  
  
  
  
  
  
  
  
2. Describe terminology and perform calculations related to engines

**CONTENT**

- Composition of air
- Composition of fossil fuels
- Requirements of combustion
- Combining air, fuel and heat
  - Heat value and energy of fuel
  - By-products of combustion
- Concepts of
- Work
- Energy
  - Heat
  - BTU's
  - Joules
- Inertia
- Friction
- Power
- Kilowatts
- Horsepower
- Bore and stroke
- Displacement
- Compression ratio
- Torque
- Volumetric efficiency
- Metric and Imperial formula



**LEARNING TASKS**

3. Describe internal combustion engine classifications
4. Describe the operation of four stroke internal combustion engines
5. Describe the operation of two stroke internal combustion engines

**CONTENT**

- Fuel
  - Gasoline
  - Diesel
  - Compressed natural gas (CNG)/Liquefied natural gas (LNG)
  - Liquefied petroleum gas (LPG)
- Cooling
  - Air
  - Liquid
- Ignition
- Number of cylinders
- Firing order
- Cycle type
- Cylinder configuration
- Aspiration
- Rotation
- Stroke Cycle
  - Intake
  - Compression
  - Power
  - Exhaust
- Scavenging
- Stroke Cycle
  - Intake
  - Compression
  - Power
  - Exhaust
- Scavenging





**LEARNING TASKS**

4. Describe lubrication systems
  
5. Diagnose lubrication systems
  
6. Repair lubrication systems and components
  
7. Describe air induction systems
  
8. Diagnose air induction systems
  
9. Repair air induction systems and components

**CONTENT**

- Types
- Components
  - Filters/bypass
  - Pumps
  - Pressure regulators
  - Coolers
- Operation
- Pressure tests
- Diagnostic codes
- Components
- Inspection
- Testing
- Remove
- Repair/replace
- Rebuild
- Install
- Adjustments
- Verify system operation
- Types
- Components
  - Filters
  - Ducting
  - Coolers
  - Warning devices
- Naturally aspirated type
- Boosted type
- Operation
- Diagnostic codes
- Components
- Inspection
- Testing
- Precautions
- Inspection
- Remove
- Repair/replace
- Install
- Verify system operation



**LEARNING TASKS**

- 10. Describe exhaust systems
  
- 11. Diagnose exhaust systems
  
- 12. Repair exhaust systems and their components

**CONTENT**

- Types
  - Marine
  - Conventional
- Components
  - Mufflers
  - Manifold
  - Emission systems
- Operation
- Components
- Inspection
- Testing
- Remove
- Repair/replace
- Install
- Adjustments
- Verify system operation

**Achievement Criteria**

Performance H3 Diagnose and Repair Engine Support Systems

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with functional diesel engines

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***



**Achievement Criteria**

Performance H5 Diagnose and Repair Diesel Supply Systems

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with functional diesel engines

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:         H7    Describe Alternative Fuel Systems**

**Objectives**

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

- Describe the characteristics of liquefied petroleum gas (LPG).
- Identify the components of an LPG system.

**LEARNING TASKS**

1. Describe the characteristics of liquefied petroleum gas (LPG)
  
2. Identify the components that make up an LPG fuel system
  
3. Describe the characteristics of compressed natural gas (CNG) and liquefied natural gas (LNG)
  
4. Identify the components that make up an CNG/LNG fuel system

**CONTENT**

- Physical properties
- Heat value
- Storage considerations
  
- Tank
- Lines
- Filters
- Valves
  
- Physical properties
- Heat value
- Storage considerations
  
- Tank
- Lines
- Filters
- Valves



**Line (GAC):** H **ENGINES AND SUPPORTING SYSTEMS**  
**Competency:** H8 **Diagnose Engines and Components**

### Objectives

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

- Diagnose and identify problems on a diesel engine.

### LEARNING TASKS

1. Perform diagnostic procedures

### CONTENT

- Types of problems
  - Lack of power
  - Hard starting
  - Rough running
  - Frequent stalling
  - Variations in exhaust smoke
  - Abnormal engine temperature
  - Abnormal oil consumption
  - Abnormal coolant consumption
  - Excessive vibration and noise
  - No start
- Types of tests
  - Blow-by
  - Compression
  - Boost pressure
  - Oil pressure/coolant system pressure
  - Cylinder balance
  - Valve adjustment
  - Diagnostic codes
  - Performance
  - Exhaust temperature
  - Dye testing
  - Engine oil analysis



**Achievement Criteria**

Performance H8 Diagnose Engine and Components

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with functional diesel engines

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: H10 Repair Engines and Components**

**Objectives**

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

- Describe the construction and operation of engine components.
- Overhaul a **diesel** engine.
- Perform initial start up procedures.

**LEARNING TASKS**

1. Describe the construction and operation of engine components
  
2. Prepare for overhaul
  
3. Disassemble engine
  
4. Repair or replace components

**CONTENT**

- Head
- Valve train
- Block
- Internal components
- Attachments
- Safety
- Types of overhaul
  - Inframe
  - Removal
- Cleaning
- Removal of attachments
- Environmental concerns
- Inspection
- Failure analysis
- Engine measurements
- Determine parts and component requirements
- Cleaning and care of components
- Crankshaft
- Camshaft
- Liners
- Pistons
- Bearings



### LEARNING TASKS

5. Reassemble an engine
  
  
  
  
  
  
  
  
  
  
  
6. Perform break-in of engine

### CONTENT

- Assembly measurements
  - Liner protrusion
  - Ring gap
  - Bearing clearance
  - End play
- Pre-lube of components
- Timing
- Mounting of attachments
- Prepare for installation or storage
- Pre-lube lubrication system
- Prime fuel systems
- Pre-start procedure
- Start up procedure
- Monitor engine operation
- Break-in procedure
- Operational checks

### Achievement Criteria

Performance H10 Repair Engines and Components

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with functional diesel engines

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: H11 Describe Diesel Fuel Injection Fundamentals**

### Objectives

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

- Describe the characteristics of diesel fuel.
- Describe the combustion process.
- Describe the requirements of a diesel fuel injection system.

### LEARNING TASKS

1. Describe characteristics of diesel fuel

2. Describe the combustion process

### CONTENT

- Types
  - Low sulfur
  - Ultra low sulfur
  - Bio-diesel
- Grades
- Characteristics
  - Viscosity
  - Cetane
  - Rating
  - Number
  - Flash point
  - Cloud point
  - Sulfur content
  - API gravity
- Distillation
- Summer/winter fuel
- Storage
- Disposal
- Safety precautions
- Compression ignition
- Stages of combustion
- Direct injection
- Indirect injection



**Line (GAC):**        **H    ENGINES AND SUPPORTING SYSTEMS**  
**Competency:**       **H12 Diagnose and Repair Mechanical Fuel Injection Systems**

**Objectives**

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

- Describe the design and operation of mechanical fuel injection systems.
- Diagnose and service mechanical fuel injection systems.

**LEARNING TASKS**

1. Describe the theory of diesel fuel injection
  
2. Describe fuel injection systems
  
3. Diagnose fuel injection systems
  
4. Repair fuel injection systems
  
5. Describe hydraulic and mechanical injectors
  
6. Diagnose hydraulic and mechanical injectors

**CONTENT**

- Requirements of injection systems
- Principles
- Governors
  
- Principles
  - Hydraulically actuated
  - Mechanically actuated
  - Low pressure
  - High pressure
- Procedures
- Inspection
- Testing
  
- Injector replacement
- Injector adjustment
- Pump timing
- Repair/replace
  
- Types
- Components
- Operations
  
- Procedures
- Inspection
- Testing

**Achievement Criteria**

Performance H12 Diagnose and Repair Mechanical Fuel Injection Systems

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with mechanical diesel fuel injection 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):**        **H   ENGINES AND SUPPORTING SYSTEMS**  
**Competency:**       **H13 Diagnose and Repair Electronic Diesel Fuel Systems**

**Objectives**

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

- Describe electronically controlled diesel fuel systems.
- Identify electronic diesel fuel systems.
- Describe the necessary conditions for the engine to start.
- Diagnose electronic fuel systems.
- Repair electronic fuel systems.

**LEARNING TASKS**

**CONTENT**

- |   |  |
|---|--|
| <p>1. Describe electronic control of diesel fuel systems</p>                  | <ul style="list-style-type: none"> <li>• Components</li> <li>• Operation</li> <li>• Inputs</li> <li>• Processing</li> <li>• Outputs</li> </ul>   |
| <p>2. Identify electronic diesel fuel systems</p>                             | <ul style="list-style-type: none"> <li>• Types</li> <li>• Partial authority <ul style="list-style-type: none"> <li>○ Port and helix</li> <li>○ Distributor</li> </ul> </li> <li>• Full authority</li> <li>• Electronic Unit Injectors (EUI)</li> <li>• Electronic Unit Pump (EUP)</li> <li>• Hydraulic Electronic Unit Injector (HEUI)</li> <li>• High Pressure Injector – Time Pressure (HPI-TP)</li> <li>• High Pressure Common Rail (HPCR)</li> </ul> |
| <p>3. Describe the necessary conditions for the engine to start</p>           | <ul style="list-style-type: none"> <li>• Power to ECM</li> <li>• Connections</li> <li>• Fuses</li> <li>• Grounds</li> <li>• Engine Position Signal</li> <li>• Sensor/adjustment</li> <li>• Fuel supply</li> </ul>  |
| <p>4. Diagnose full authority (EUI, EUP, HEUI, HPI-TP, HPCR) fuel systems</p> | <ul style="list-style-type: none"> <li>• Diagnostic procedures</li> <li>• Operational test</li> <li>• Diagnostic codes</li> <li>• Components</li> <li>• Inspection</li> <li>• Testing</li> </ul>   |



**LEARNING TASKS**

5. Repair full authority (EUI, EUP, HEUI, HPI-TP, HPCR) fuel systems

**CONTENT**

- Inspection
- Remove
- Repair/replace
- Install
- Adjustments/calibrate
- Lubrication
- Verify systems operation
- Diagnostic codes

**Achievement Criteria**

Performance H13 Diagnose and Repair Electronic Diesel Fuel Systems

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with electronic diesel fuel system

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:         H14   **Diagnose and Repair Diesel Emissions Systems****

**Objectives**

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

- Describe the causes and effects of harmful emissions.
- Describe emission systems.
- Diagnose and repair emission systems.

**LEARNING TASKS**

1. Describe the causes and effects of harmful emissions
  
2. Describe the emission systems on diesel engines
  
3. Diagnose emission systems on diesel engines

**CONTENT**

- Combustion process
- Byproducts
- Causes
- Effects
- Environmental
- Health
- Smog
- Solutions
- Legislation
  
- Systems
- Components and controls
  - Diesel particulate filters (DPF)
  - Selective catalytic reduction (SCR)
  - Oxygen catalyst (OC)
  - Exhaust gas recirculation (EGR)
  - Sensors
- Exhaust systems
- Operation
  
- Diagnostic codes
- Components
- Inspection
- Testing



### LEARNING TASKS

4. Repair emission systems on diesel engines

### CONTENT

- Inspection
- Remove
- DPF cleaning
- Repair/replace
- Regeneration
  - Passive
  - Active
  - Stationary
- Install
- Verify systems operation
- Diagnostic codes

### Achievement Criteria

Performance H14 Diagnose and Repair Diesel Emission Systems

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with functional exhaust emissions 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): H ENGINES AND SUPPORTING SYSTEMS**

**Competency: H15 Diagnose and Repair Engine Brakes**

**Objectives**

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

- Describe engine brakes.
- Diagnosis and repair engine brakes.

**LEARNING TASKS**

1. Describe engine brakes
  
2. Diagnose engine brakes
  
3. Repair engine brakes

**CONTENT**

- Types
  - Compression
  - Exhaust
  - Hydraulic
- Components
- Operation
- Diagnostic procedures
- Diagnostic codes
- Inspection
- Testing
- Remove
- Repair/replace
- Install
- Adjustments
- Verify system operation
- Diagnostic codes

**Achievement Criteria**

Performance H15 Diagnose and Repair Engine Brakes

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with engine 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***



## Level 3

# Heavy Duty Equipment Technician



**Line (GAC):**        **I**    **POWERTRAINS**  
**Competency:**     **I1**   **Describe Power Transfer Systems**

**Objectives**

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

- Describe methods of transferring power.
- Describe the principles of power transfer.
- Calculate gear ratios.

**LEARNING TASKS**

1. Describe methods of transferring power
  
  
  
  
  
  
  
  
  
  
2. Describe the principles of power transfer

**CONTENT**

- Fluids
- Shafts
- Belts
- Chains
- Gears
  
- Gear ratios
  - Simple
  - Compound
  - Planetary
- Torque
- Speed
- Power flow
  - Truck
  - Crawler
  - Excavator
  - Loader
- Gear types
- Gear nomenclature



**Line (GAC):** I **POWERTRAINS**  
**Competency:** I3 **Diagnose and Repair Clutches**

**Objectives**

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

- Describe the principles and operation of clutches and related components.
- Diagnose and repair clutches and related components.

**LEARNING TASKS**

1. Review principles and operation of clutches and related components
  
2. Diagnose clutches and related components
  
3. Repair clutches and related components

**CONTENT**

- Types
  - Friction
  - Wet/dry
  - Single/multi-disc
  - Mechanical
  - Jaw
  - Magnetic
  - Band
- Components
- Operation
- Diagnostic procedures
- Operational test
- Components
- Inspection
- Linkage wear
- Heat damage
- Measure
- Component wear
- Flywheel and housing runout
- Removal
- Replacement
- Adjustment
  - Free play
  - Clutch brake
- Lubrication
- Verify operation

**Achievement Criteria**

Performance I3 Diagnose and Repair Clutches

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with various clutch types

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):** I **POWERTRAINS**  
**Competency:** I5 **Diagnose and Repair Manual Transmissions**

**Objectives**

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

- Describe the operation of manual transmissions.
- Diagnose and repair manual transmissions.

**LEARNING TASKS**

1. Describe the principles and operation of manual transmissions
  
2. Diagnose manual transmissions
  
3. Repair manual transmissions

**CONTENT**

- Types
  - Single countershaft
  - Multiple countershaft
- Components
- Transmission operation
- Shifting operation
  - Mechanical
  - Pneumatic
- Lubrication
- Inspection
- Components and controls
- Testing
- Repair/replace
- Overhaul
- Adjustments
- Lubrication
- Verify operation



**Achievement Criteria**

Performance I5 Diagnose and Repair Manual Transmissions

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with manual transmission

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):** I **POWERTRAINS**  
**Competency:** I6 **Diagnose and Repair Automated Transmissions**

**Objectives**

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

- Describe the operation of automated transmissions.
- Diagnose and repair automated transmissions.

**LEARNING TASKS**

1. Describe the principles and operation of automated transmissions
  
2. Diagnose an automated transmission
  
3. Repair an automated transmission

**CONTENT**

- Types
- Components
- Transmission operation
- Lubrication
  
- Diagnostic procedures
- Diagnostic codes
- Inspection
- Components and controls
- Testing
  
- Repair/replace
- Lubrication
- Verify operation
- Diagnostic codes

**Achievement Criteria**

Performance I6 Diagnose and Repair Automated Transmissions

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with automated transmission

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):** I **POWERTRAINS**  
**Competency:** I9 **Diagnose and Repair Automatic Transmissions and Torque Converters**

**Objectives**

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

- Describe the principles of planetary gear sets.
- Describe the operation of torque converters and automatic transmissions.
- Diagnose and repair torque converters and automatic transmissions.

**LEARNING TASKS**

1. Describe the principles and operation of torque converters
  
2. Describe the principles and operation of automatic transmissions
  
3. Diagnose torque converters and automatic transmissions

**CONTENT**

- Types
  - Radial
  - Axial
- Components
- Operation
  - Stages
  - Phases
- Lubrication
  
- Planetary gear sets
- Combinations
- Gear ratios
- Types
- Components
- Hydraulic circuit diagrams
- Electrical circuit diagrams
- Operation
- Power flow
- Mechanical/hydraulic
- Electronic/hydraulic
- Controls
- Lubrication
  
- Diagnostic codes
- Pressure tests
- Electrical/Electronic tests
- Inspection
- Components and controls
- Testing
  - Stall
  - Temperature
  - Pressure



### LEARNING TASKS

4. Repair torque converters and automatic transmissions

### CONTENT

- Components
- Filter/screens
- Oil Coolers
- Controls
- Transmission
- Torque converter
- Inspection
- Repair/replace
- Adjustments
- Lubrication
- Verify operation
- Diagnostic codes
- Reprogram

### Achievement Criteria

Performance I9 Diagnose and Repair Automatic Transmission and Torque Converters

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with automatic transmissions

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***



**Achievement Criteria**

Performance I10 Diagnose and Repair Powershift Transmissions

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with powershift transmission

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***



**Achievement Criteria**

Performance I12 Diagnose and Repair Drivelines

Conditions The learner will require:

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

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***





**Achievement Criteria**

Performance I14 Diagnose and Repair Drive Axles

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with drive axles

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):** I **POWERTRAINS**  
**Competency:** I16 **Diagnose and Repair Final Drives**

**Objectives**

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

- Describe the operation of final drives.
- Diagnose and repair final drives.

**LEARNING TASKS**

1. Describe operation of final drives
  
2. Diagnose final drives
  
3. Repair final drives

**CONTENT**

- Types
  - Inboard
  - Outboard
  - Planetary
  - Chain
  - Gear
- Components
- Operation
- Diagnostic procedures
- Operational test
- Components
- Inspection
- Overhaul
- Adjustments
- Lubrication
- Verify operation

**Achievement Criteria**

Performance I16 Diagnose and Repair Final Drives

- Conditions The learner will require:
- Tools
  - Test equipment
  - Manufacturer's Specifications
  - A work place or training environment
  - Equipment with final drives

- 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):** I **POWERTRAINS**  
**Competency:** I17 **Diagnose and Repair Driveline Retarders**

**Objectives**

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

- Describe driveline retarders.
- Diagnose and repair driveline retarders.

**LEARNING TASKS**

1. Describe driveline retarders
  
2. Diagnose driveline retarders
  
3. Repair driveline retarders

**CONTENT**

- Types
  - Hydraulic
  - Electric
- Components
- Operation
- Diagnostic procedures
- Operational test
- Components
- Inspection
- Repair/replace
- Adjustments
- Verify operation

**Achievement Criteria**

Performance I17 Diagnose and Repair Driveline Retarders

- Conditions The learner will require:
- Tools
  - Test equipment
  - Manufacturer's Specifications
  - A work place or training environment
  - Equipment with driveline retarders

- 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):** I **POWERTRAINS**  
**Competency:** I18 **Diagnose and Repair Winches**

**Objectives**

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

- Describe winches.
- Diagnose and repair winches.

**LEARNING TASKS**

1. Describe winches
  
2. Diagnose winches
  
3. Repair winches

**CONTENT**

- Types
  - Mechanical
  - Electrical
  - Hydraulic
- Components
  - Wire Rope
  - Drums
  - Clutch/brake
- Operation
- Operational test
- Components
- Inspection
- Repair/replace
- Adjustments
- Lubrication
- Verify operation

**Achievement Criteria**

Performance I18 Diagnose and Repair Winches

Conditions The learner will require:

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

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***





**LEARNING TASKS**

- 5. Diagnose transfer cases
  
- 6. Repair transfer cases

**CONTENT**

- Diagnostic codes
- Operational test
- Inspection
- Components and controls
- Drivelines
- Repair/replace
- Adjustments
- Lubrication
- Verify operation
- Diagnostic codes

**Achievement Criteria**

Performance I19 Diagnose and Repair Power Take-offs and Transfer Cases

Conditions The learner will require:

- Tools
- Test equipment
- Manufacturer's Specifications
- A work place or training environment
- Equipment with power take-offs and transfer cases

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***



## Level 4

# Heavy Duty Equipment Technician







## LEARNING TASKS

4. Repair electronic hydraulic systems

## CONTENT

- Accumulators
- Coolers
- Connecting lines
- Fluids
- Inspection
- Remove/install
- Repair/replace
- System flushing
- Safety precautions
- Sensors
- Actuators
- Wiring and connectors
- Electronic Control Module (ECM)
- Communication protocols
- Remove/install
- Repair/replace
- Verify systems operation

## Achievement Criteria

Performance C3 Diagnose and Repair Advanced Hydraulic Systems

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:           D13 Service, Diagnose and Repair Electric Drive Systems**

**Objectives**

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

- Describe an electrical drive system

**LEARNING TASKS**

1. Describe an electrical drive system
  
2. Service electric drive systems
  
3. Diagnose electric drive systems
  
4. Repair electric drive systems

**CONTENT**

- Operation
- Components
- Safety
  - High voltage
- Coolant
- Cooling fans
- Codes
- Test procedures
- Components
  - Cables
  - Inverters
  - Converters

**Achievement Criteria**

**Performance**   D13 Service, Diagnose and Repair Electric Drive Systems

**Conditions**    The learner will require:

- Tools
- Test equipment
- manufacturers Specifications
- A work place or training environment
- Equipment with electric drive



**Achievement Criteria**

Performance E8 Diagnose and Repair Wheeled Equipment Steering

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):** E **FRAMES, STEERING AND SUSPENSION**  
**Competency:** E9 **Diagnose and Repair Track Machine Steering**

**Objectives**

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

- Describe track machine steering systems.
- Diagnose and service selected track machine steering systems.

**LEARNING TASKS**

1. Describe steering systems
  
2. Diagnose steering systems
  
3. Repair steering systems

**CONTENT**

- Types
  - Steering clutch
  - Hydrostatic
  - Differential
- Components
- Operation
- Operation
- Components
- Inspection
- Testing
- Inspection
- Remove
- Repair/replace
- Install
- Adjustments
- Lubrication
- Verify system operation

**Achievement Criteria**

Performance E9 Diagnose and Repair Track Machine Steering

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): E FRAMES, STEERING AND SUSPENSION**

**Competency: E10 Diagnose and Repair Undercarriage**

**Objectives**

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

- Describe track machine undercarriages.
- Troubleshoot and service track machine undercarriages.

**LEARNING TASKS**

1. Describe undercarriages

2. Diagnose and repair undercarriages

**CONTENT**

- Types
  - Excavator
  - Crawler, Dozer/Loader
  - Crane/Shovel
  - Tank
  - Rock drill
- Components
- Operation
- Operation
- Components
- Inspection
- Measuring
- Adjustments
- Lubrication
- Scheduled maintenance

**Achievement Criteria**

Performance E10 Diagnose and Repair Undercarriage

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***





**Achievement Criteria**

Performance J4 Diagnose and Repair Working Attachments

Conditions The learner will require:

- Tools
- Test equipment
- manufacturers Specifications
- A work place or training environment
- Equipment with working attachments

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 manufacturers 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):** J **STRUCTURAL COMPONENTS AND ACCESSORIES**  
**Competency:** J5 **Diagnose and Repair Pneumatic Systems**

**Objectives**

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

- Describe the construction and operation of industrial air compressors.
- Service diagnose and repair industrial air compressors.

**LEARNING TASKS**

1. Describe industrial air compressors
  
2. Service industrial air compressors
  
3. Diagnose and repair industrial air compressors

**CONTENT**

- Types
  - Reciprocating
  - Rotary vane
  - Rotary screw
- Components
- Operation
- Adjustments
- Lubrication
- Scheduled maintenance
- Inspection
- Operational test
- Repair/replace
- Adjustments
- Diagnostic codes

**Achievement Criteria**

Performance J5 Diagnose and Repair Pneumatic Systems

Conditions The learner will require:

- Tools
- Test equipment
- manufacturers Specifications
- A work place or training environment
- Equipment with various pneumatic devices

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 manufacturers 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, fire, and environmental codes
- Good lighting
- Appropriate lifting cranes as required to move industry equipment
- Approved ventilation systems

### Lab Requirements

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

### Student Facilities

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

### Instructor's Office Space

- Recommended 3.5 Sq. Meters

### Other

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



## Tools and Equipment

### Shop Equipment

#### *Required Safety Equipment*

- 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***

#### **Safety Equipment for Student (supplied by student)**

##### ***Required***

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

##### ***Recommended***

- High visibility coveralls
- Mechanics gloves



## Reference Materials

### Recommended Resources

- Industry Training Authority (ITA) [www.itabc.ca](http://www.itabc.ca)
- WorkSafeBC [www.worksafebc.com](http://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](http://www.icbc.com)

### Level One

- Heavy Mechanical Group level 1 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](http://www.icbc.com)

### Level Two

- Heavy Duty Truck Systems 5th Edition (Norman/Scharff/Cosinchock), ISBN 0-7668-1340-1
  - Alberta Trades Training Modules, Queens Printer
  - Diesel Technology (Norman/Scharff/Cosinchock), ISBN 1-56637-014-0
- or
- Medium HD/Truck Engines, Fuel and Management Systems(Sean Bennett) 3rd Edition, ISBN 0-8273-8574-9
  - FOS Electronic and Electrical Systems (Deere), ISBN 0-86691-240-1
  - FOS Engine Systems (Deere), ISBN 0-86691-246-0

### Level Three

- Heavy Duty Truck Systems 5th Edition (Norman/Scharff/Cosinchock), ISBN 0-7668-1340-1
- Alberta Trades Training Modules, Queens Printer

**Level Four**

- Heavy Duty Truck Systems 5th Edition (Norman/Scharff/Cosinchock), ISBN 0-7668-1340-1
- Alberta Trades Training Modules, Queens Printer
- FOS Hydraulics (Deere) ISBN 0-86691-239-0

or

- Vickers Mobile Hydraulics, ISBN 0-9634162-5-1
- FOS Tracks and Tires, Bearings and Seals ISBN 0-86691-227-4

**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 journeyman.

### Instructional Experience and Education

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

- Grade 12 or equivalent
- Instructors Diploma



# Appendices



# Appendix A

## Assessment Guidelines



## Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:		HEAVY DUTY EQUIPMENT TECHNICIAN LEVEL 1 000011	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	Occupational Skills	10%	10%
B	Brakes	19%	19%
C	Hydraulics	15%	15%
D	Electrical	17%	17%
E	Frames, Steering and Suspension	19%	19%
F	Trailer	10%	10%
G	Heating, Ventilation and Air Conditioning	5%	5%
J	Structural Components and Accessories	5%	5%
	<b>Total</b>	<b>100%</b>	<b>100%</b>
<b>In-school theory / practical subject competency weighting</b>		50%	50%
<b>Final in-school percentage score</b>		IN-SCHOOL %	

<b>In-school Percentage Score</b> Combined theory and practical subject competency multiplied by	80%
<b>Standard Level Exam Percentage Score</b> The exam score is multiplied by	20%
<b>Final Percentage Score</b>	FINAL%





<b>PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:</b>		<b>HEAVY DUTY EQUIPMENT TECHNICIAN LEVEL 2 000011</b>	
<b>LINE</b>	<b>SUBJECT COMPETENCIES</b>	<b>THEORY WEIGHTING</b>	<b>PRACTICAL WEIGHTING</b>
D	Electrical	40%	40%
H	Engines and Supporting Systems	60%	60%
	<b>Total</b>	<b>100%</b>	<b>100%</b>
<b>In-school theory / practical subject competency weighting</b>		50%	50%
<b>Final in-school percentage score</b>		IN-SCHOOL %	

<b>In-school Percentage Score</b> Combined theory and practical subject competency multiplied by	80%
<b>Standard Level Exam Percentage Score</b> The exam score is multiplied by	20%
<b>Final Percentage Score</b>	FINAL%



PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:		HEAVY DUTY EQUIPMENT TECHNICIAN LEVEL 3 000011	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
I	Powertrains		
	I1 Describe Power Transfer Systems	6%	0%
	I3 Diagnose and Repair Clutches	9%	10%
	I5 Diagnose and Repair Manual Transmissions	11%	10%
	I6 Diagnose and Repair Automated Systems	8%	5%
	I9 Diagnose and Repair Automatic Transmissions and Torque Converters	12%	15%
	I10 Diagnose and Repair Power Shift Transmissions	12%	15%
	I12 Diagnose and Repair Drivelines	8%	5%
	I14 Diagnose and Repair Drive Axles	12%	10%
	I16 Diagnose and Repair Final Drives	8%	15%
	I17 Diagnose and Repair Driveline Retarders	5%	5%
	I18 Diagnose and Repair Winches	5%	5%
	I19 Diagnose and Repair Power Take-offs and Transfer Cases	4%	5%
	<b>Total</b>	<b>100%</b>	<b>100%</b>
<b>In-school theory / practical subject competency weighting</b>		50%	50%
<b>Final in-school percentage score</b>		IN-SCHOOL %	

<b>In-school Percentage Score</b> Combined theory and practical subject competency multiplied by	80%
<b>Standard Level Exam Percentage Score</b> The exam score is multiplied by	20%
<b>Final Percentage Score</b>	FINAL%



PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:		HEAVY DUTY EQUIPMENT TECHNICIAN LEVEL 4 000011	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
C	Hydraulics	55%	55%
D	Electrical	10%	10%
E	Frames, Steering and Suspension	25%	25%
J	Structural Components and Accessories	10%	10%
	<b>Total</b>	<b>100%</b>	<b>100%</b>
<b>In-school theory / practical subject competency weighting</b>		50%	50%

<p><b>Final in-school percentage score</b></p> <p>Apprentices must achieve a minimum 70% as the final in-school percentage score to be eligible to write the Interprovincial Red Seal exam.</p>	<p>IN-SCHOOL %</p>
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**All apprentices who complete Levels 1-4 of the Heavy Duty Equipment Technician program with a FINAL level percentage score of 70% or greater will write the Interprovincial Red Seal examination as their final assessment.**

**ITA will enter the apprentices' Heavy Duty Equipment Technician Interprovincial Red Seal examination percentage score in ITA Direct Access.**

**A minimum percentage score of 70% on the examination is required for a pass.**