SKILLEDTRADESBC

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
SkilledTradesBC
Province of British Columbia

SKILLED TRADES BC

TABLE OF CONTENTS

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:

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

They also demonstrate the ability to:

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

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

SAFETY ADVISORY

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

Acknowledgements

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

- K. Poisson, Coast Mountain Bus Company (Apprenticship 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 (Superviser)
- L. Richardson, Resource Training Organization (Manager, Program Standards)
- R. Scales, SkilledTradesBC (Manager, Program Standards)

Industry Subject Matter Experts retained to assist in the development of Program Outline content:

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

Facilitators:

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

SkilledTradesBC would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Heavy 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
Program Credentialing Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program, and pathway to completion
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	View the competencies they will achieve as a result of program completion
Training Topics and Suggested Time Allocation	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application
Program Content	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	Provides detailed information on program content and performance expectations for demonstrating competency
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors

Section 2

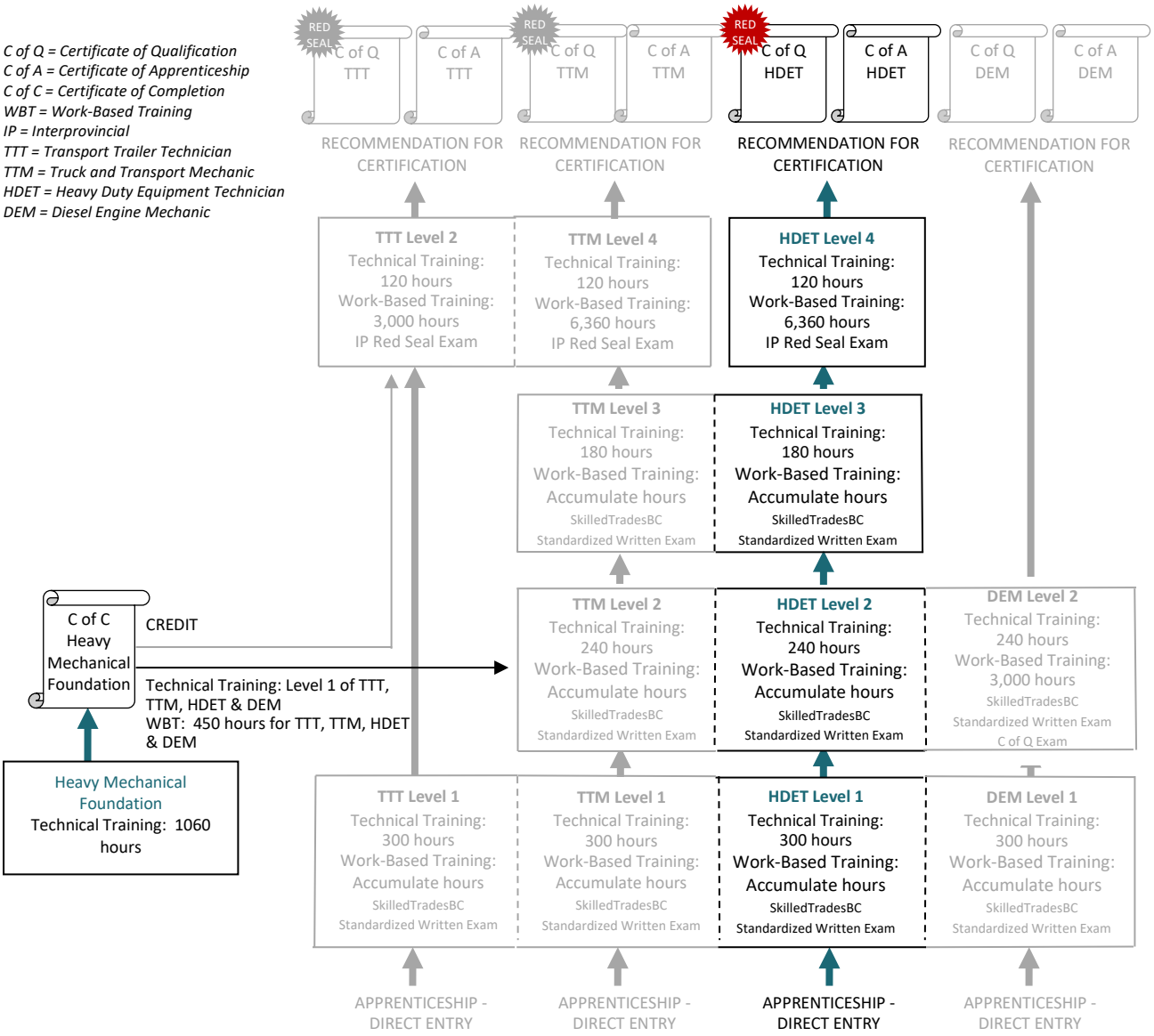
PROGRAM OVERVIEW

Heavy Duty Equipment Technician

Program Credentialing Model

Apprenticeship Pathway

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



CROSS-PROGRAM CREDITS

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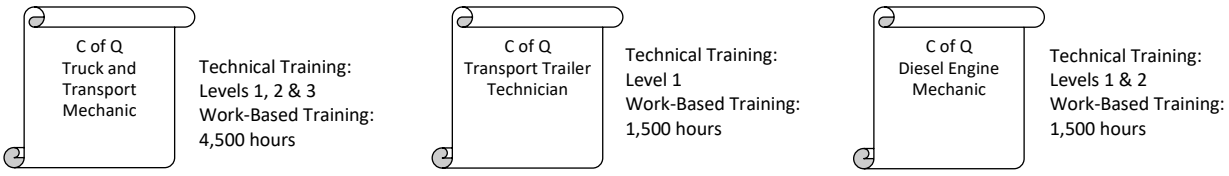
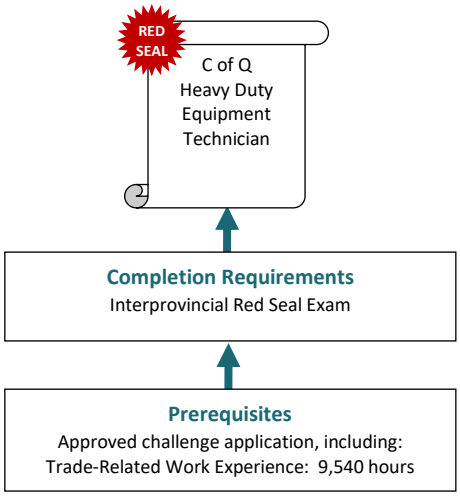


Challenge Pathway

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

C of Q = Certificate of Qualification



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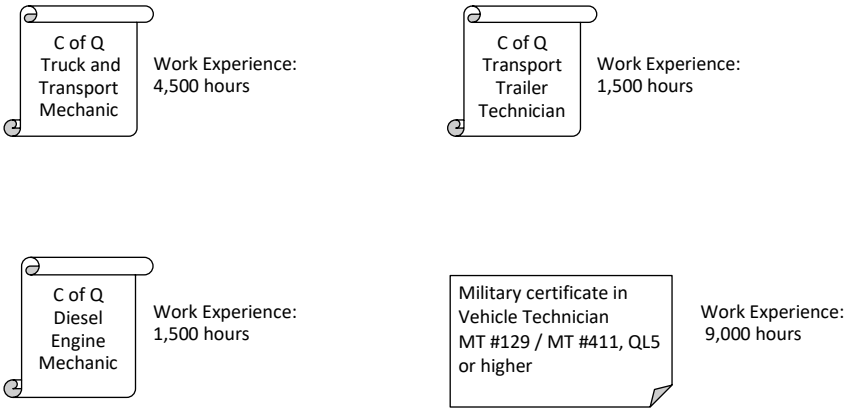

Occupational Analysis Chart

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, off-highway tractors, off-highway trucks, forklifts, wheeled and tracked vehicles of all types used in construction, logging, sawmill, manufacturing, mining and other similar industry.

Occupational Skills A	Use Safe Work Practices A1	Use Hand Tools, Power Tools, and Shop Equipment A4	Use Fasteners and Fittings A5	Lift and Support Loads A6	Operate Equipment A7	Use Shop Resources and Record Keeping Practices A8
	1	1	1	1	1	1
	Service Winch Wire Rope A9	Identify Lubricants A10	Service Bearings and Seals A11	Use Electronic Media A13	Use Cutting and Welding Equipment A14	Describe Diagnostic Procedures A16
	1	1	1	1	1	1
Brakes B	Service and Repair Hydraulic Brakes B1	Service and Repair Hydraulic Power Brakes B2	Service and Repair Air Brakes B3			
	1	1	1			
Hydraulics C	Describe Hydraulic Systems C1	Service Hydraulic Components C2	Diagnose and Repair Advanced Hydraulic Systems C3			
	1	1	4			
Electrical D	Describe Electricity D1	Use Electrical Testing Instruments D2	Service and Diagnose Batteries D3	Service Charging Systems D4	Diagnose and Repair Charging Systems D5	Service Starting Systems D6
	1	1	1	1	2	1

	Diagnose and Repair Starting Systems D7	Service Electrical Circuits D8	Diagnose and Repair Electrical Components and Systems D9	Diagnose and Repair Electronic Components and Systems D10	Diagnose and Repair Vehicle Management Systems D11	Service, Diagnose and Repair Electric Drive Systems D13
	2	1	2	2	2	4
Frames, Steering and Suspension **E**	Service and Diagnose Tires, Wheels, and Hubs E1	Service Steering Systems E2	Service, Diagnose and Repair Suspension Systems E4	Diagnose and Repair Frames E6	Diagnose and Repair Wheeled Equipment Steering E8	Diagnose and Repair Track Machine Steering E9
	1	1	1	1	4	4
	Diagnose and Repair Undercarriage E10					
	4					
Trailer **F**	Service Landing Gear and Trailer Accessories F1	Service and Repair Coupling Systems F2	Service, Diagnose and Repair Trailer Body Components F3	Service, Diagnose and Repair Heating and Refrigeration Systems F4		
	1	1	1	1		
Heating, Ventilation and Air Conditioning **G**	Describe Heating and Air Conditioning Fundamentals G1	Diagnose and Repair Heating and Air Conditioning Systems G2				
	1	1				
Engines and Supporting Systems **H**	Describe Engine Fundamentals H1	Diagnose and Repair Engine Support Systems H3	Diagnose and Repair Diesel Supply Systems H5	Describe Alternative Fuel Systems H7	Diagnose Engines and Components H8	Remove Engines and Components H10
	2	2	2	2	2	2

	Describe Diesel Fuel Injection Fundamentals H11	Diagnose and Repair Mechanical Fuel Injection Systems H12	Diagnose and Repair Electronic Diesel Fuel Systems H13	Diagnose and Repair Diesel Emissions Systems H14	Diagnose and Repair Engine Brakes H15	
	2	2	2	2	2	
Powertrains **I**	Describe Power Transfer Systems I1	Diagnose and Repair Clutches I3	Diagnose and Repair Manual Transmissions I5	Diagnose and Repair Automated Systems I6	Diagnose and Repair Automatic Transmissions and Torque Converters I9	Diagnose and Repair Power Shift Transmissions I10
	3	3	3	3	3	3
	Diagnose and Repair Drivelines I12	Diagnose and Repair Drive Axles I14	Diagnose and Repair Final Drives I16	Diagnose and Repair Driveline Retarders I17	Diagnose and Repair Winches I18	Diagnose and Repair Power Take-offs and Transfer Cases I19
	3	3	3	3	3	3
Structural Components and Accessories **J**	Identify Protective Structures J1	Service Cab Structures J2	Diagnose and Repair Working Attachments J4	Diagnose and Repair Pneumatic Systems J5		
	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
Line A	**OCCUPATIONAL SKILLS**	**18%**	**55%**	**45%**	**100%**
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		✓		
Line B	**BRAKES**	**17%**	**30%**	**70%**	**100%**
B1	Service and Repair Hydraulic Brakes		✓	✓	
B2	Service and Repair Hydraulic Power Brakes		✓	✓	
B3	Service and Repair Air Brakes		✓	✓	
Line C	**HYDRAULICS**	**13%**	**40%**	**60%**	**100%**
C1	Describe Hydraulic Systems		✓		
C2	Service Hydraulic Components		✓	✓	
Line D	**ELECTRICAL**	**17%**	**55%**	**45%**	**100%**
D1	Describe Electricity		✓		
D2	Use Electrical Testing Instruments		✓	✓	
D3	Service and Diagnose Batteries		✓	✓	
D4	Service Charging Systems		✓	✓	
D6	Service Starting Systems		✓	✓	
D8	Service Electrical Circuits		✓	✓	
Line E	**FRAMES, STEERING AND SUSPENSION**	**14%**	**30%**	**70%**	**100%**
E1	Service and Diagnose Tires, Wheels, and Hubs		✓	✓	
E2	Service Steering Systems		✓	✓	
E4	Service, Diagnose and Repair Suspension Systems		✓	✓	
E6	Diagnose and Repair Frames		✓	✓	
Line F	**TRAILER**	**10%**	**35%**	**65%**	**100%**

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
F1	Service Landing Gear and Trailer Accessories		✓	✓	
F2	Service and Repair Coupling Systems		✓	✓	
F3	Service, Diagnose and Repair Trailer Body Components		✓	✓	
F4	Service, Diagnose and Repair Heating and Refrigeration Systems		✓	✓	
Line G	**HEATING, VENTILATION AND AIR CONDITIONING**	**8%**	**50%**	**50%**	**100%**
G1	Describe Heating and Air Conditioning Fundamentals		✓		
G2	Diagnose and Repair Heating and Air Conditioning Systems		✓	✓	
Line J	**STRUCTURAL COMPONENTS AND ACCESSORIES**	**3%**	**90%**	**10%**	**100%**
J1	Identify Protective Structures		✓		
J2	Service Cab Structures		✓	✓	
	Total Percentage for Heavy Duty Equipment Technician Level 1	**100%**			

Training Topics and Suggested Time Allocation

Heavy Duty Equipment Technician – Level 2

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line D	**ELECTRICAL**	**25%**	**40%**	**60%**	**100%**
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		✓	✓	
Line H	**ENGINES AND SUPPORTING SYSTEMS**	**75%**	**50%**	**50%**	**100%**
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		✓	✓	
	Total Percentage for Heavy Duty Equipment Technician Level 2	**100%**			

Training Topics and Suggested Time Allocation

Heavy Duty Equipment Technician – Level 3

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line I	**POWERTRAINS**	**100%**	**50%**	**50%**	**100%**
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		✓	✓	
	Total Percentage for Heavy Duty Equipment Technician Level 3	**100%**			

Training Topics and Suggested Time Allocation

Heavy Duty Equipment Technician – Level 4

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

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	CONTENT

1. Apply personal safety precautions and procedures	• 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

2. Lock out heavy duty equipment prior to service	• WorkSafeBC requirements • Electrical isolation (Night switch) • Tag • Key storage
3. Locate shop emergency equipment and procedures	• Emergency shutoffs • Fire control systems • Eye wash facilities • Emergency exits • First aid facilities • Emergency contact/phone numbers

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

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

9. Describe fire suppression systems	• 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	CONTENT

1. Use protective equipment associated with the use of tools and shop equipment	• Personal Protective Equipment
	  ○ Head
	  ○ Hands
	  ○ Lungs
	  ○ Eyes
	  ○ Ears
	  ○ Feet
	  ○ Clothing
	• Screening
	• Guarding
	• Ventilation
	• Clean up

2. Apply lock-out procedures to shop equipment	• WorkSafeBC lock-out procedures • Electrical isolation • Tags • Locks

3. Select, use and maintain hand tools	• Hand tool safety
	  ○ Safety practices
	  ○ Work with a safe attitude
	  ○ Tool selection
	  ○ Organize work area
	  ○ Correct usage of hand tools
	  ○ Maintain hand tools
	  ○ Safe tool handling
	  ○ Safe tool storage
	• Hazards
	• Wrenches
	• Screwdrivers
	• Cutting tools
	• Hammers
	• Chisels/punches
	• Pry bars

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

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

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A5 Use Fasteners and Fittings

Objectives

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

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

LEARNING TASKS	CONTENT

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

2. Cut and repair internal and external threads	• Taps • Dies • Thread repair

3. Select use and repair tubing, pipe and fittings	• Tubing
	  ○ Types
	  ○ Sizing
	  ○ Applications
	• Pipe
	  ○ Types
	  ○ Sizing
	• Threads
	  ○ Applications
	• Fitting
	  ○ Types
	  ○ Sizing
	  ○ Applications
	• Assembly procedures
	• Sealants
	• Cutting, bending and flaring

LEARNING TASKS	CONTENT

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

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A6 Lift and Support Loads

Objectives

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

- Apply the WorkSafeBC Safety Regulations to lifting and blocking applications.
- Select, use and maintain lifting and blocking equipment.
- Lift and move loads.

LEARNING TASKS	CONTENT

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

2. Determine load weight	• Manufacturer's specification • Estimation
3. Select, use and maintain jacks	• Types • Capacities
4. Select, use and maintain stands and blocking	• Manufacturer's procedures • Types • Capacities • Bridging
5. Select, use and maintain wire ropes, chains and lifting straps	• Types • Capacities • Inspection • Rating tags • Rigging and lifting attachments
6. Use fibre rope knots, bends and hitches	• Types • Uses • Care and maintenance

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

8. Select, use and maintain hoisting equipment	• Types • Capacities • Operation

LEARNING TASKS	CONTENT
9. Lift, hoist and move loads	• Determine safe working load • Lifting and rigging procedures • Regulations and specifications

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A7 Operate Equipment

Objectives

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

- Perform pre-start and walk around inspections.
- Start, move, secure and stop equipment.
- Obtain forklift operation training.

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

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

5. Start, operate and shut down selected equipment	• Pre-start and walk around • Use of starting aids • Moving • Securing and shutting down
6. Lock-out heavy duty equipment prior to service	• WorkSafeBC requirements • Electrical isolation (Night switch) • Tag • Key in pocket

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

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A8 Use Shop Resources and Record Keeping Practices

Objectives

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

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

LEARNING TASKS	CONTENT

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

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

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

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A9 Service Winch Wire Rope

Objectives

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

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

LEARNING TASKS	CONTENT

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

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

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A10 Identify Lubricants

Objectives

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

- Identify and select lubricants.

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

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

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

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

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

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A11 Service Bearings and Seals

Objectives

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

- Select and service bearings and seals.

LEARNING TASKS	CONTENT

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

2. Select and service bearings	• Removal • Clean • Inspection • Lubrication • Storage • Installation • Adjustments

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

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

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A13 Use Electronic Media

Objectives

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

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

LEARNING TASKS	CONTENT

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

2. Use electronic media	• Digital Camera • Digital Video

Line (GAC): A OCCUPATIONAL SKILLS

Competency: A14 Use Cutting and Welding Equipment

Objectives

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

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

LEARNING TASKS	CONTENT
1. Identify regulations with respect to welding	• WorkSafeBC Safety Regulations
2. Identify metals	• Metals and alloys • Teminology • Shapes • Storage and handling
3. Identify oxy-acetylene components	• Gases • Valves and regulators • Cylinders • Hoses and fittings • Cutting torches and tips • Safety precautions • Blow back • Check valves
4. Use oxy-acetylene equipment	• Assembly procedures • Operation procedures • Lighting • Pressures • Adjusting • Shut down procedures • Leak testing • Storage
5. Cut mild steel with oxy-acetylene equipment	• Set-up • Freehand cuts • Guided cuts • Hole piercing
6. Weld mild steel with oxy-acetylene equipment	• Principles of fusion welding

LEARNING TASKS	CONTENT
	• Filler metal • Flux • Welding tips • Flame • Technique • Basic joints
7. Braze lap joints with oxy-acetylene equipment	• Brazing set-up • Brazing techniques

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

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

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

Line (GAC): B BRAKES

Competency: B1 Service and Repair Hydraulic Brakes

Objectives

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

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

LEARNING TASKS	CONTENT
1. Describe the principles of braking	• Friction • Definition • Coefficient • Heat • Absorbing • Dissipating • Effects of speed and weight • Brake fade

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

3. Review hydraulic principles	• Pressure, force and area

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

LEARNING TASKS	CONTENT

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

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

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

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

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

Achievement Criteria

Performance	B1 Service and Repair Hydraulic Brakes
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with hydraulic disk and drum brakes
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): B BRAKES

Competency: B2 Service and Repair Hydraulic Power Brakes

Objectives

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

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

LEARNING TASKS	CONTENT

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

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

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

LEARNING TASKS	CONTENT
5. Diagnose hydraulic anti-lock braking systems	• Manufacturer's diagnostic procedures • Road test • Diagnostic codes • Components • Inspection • Testing
6. Repair hydraulic anti-lock braking systems	• Inspection • Remove • Repair/replace • Install • Adjustments • Verify system operation • Diagnostic codes

Achievement Criteria

Performance: B2 Service and Repair Hydraulic Power Brakes

Conditions: The learner will require:

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

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

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

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

Line (GAC): B BRAKES

Competency: B3 Service and Repair Air Brakes

Objectives

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

- Describe the principles of braking.
- Describe the principles of pneumatics.
- Describe air brake schedules and components.
- Service air brake systems.
- Repair a wheel brake assembly.
- Describe and perform a pre-trip inspection.

LEARNING TASKS	CONTENT
1. Describe the principles of braking	• Friction • Definition • Coefficient • Heat • Absorbing • Dissipating • Effects of speed and weight • Brake fade • Water cooling
2. Describe the principles of pneumatics	• Characteristics of air • Relationship between force, pressure and area • Effects of heat on air • Time lag • Pneumatic balance

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

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

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

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

Achievement Criteria

Performance: B3 Service and Repair Air Brakes

Conditions: The learner will require:

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

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

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

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

Line (GAC): C HYDRAULICS

Competency: C1 Describe Hydraulic Systems

Objectives

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

- Describe the principles of hydraulics.
- Describe the basic components of a hydraulic system.
- Describe the types of hydraulic systems.

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

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

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

LEARNING TASKS	CONTENT

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

Line (GAC): C HYDRAULICS

Competency: C2 Service Hydraulic Components

Objectives

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

- Describe selected hydraulic components.
- Select hydraulic fluids for applications.
- Select and assemble hydraulic hoses and fittings.
- Demonstrate safe work procedures for hydraulic systems service.
- Perform scheduled maintenance on hydraulic systems.

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

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

4. Assemble hydraulic hoses and fittings	• Permanent • Reusable

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

Achievement Criteria

Performance	C2 Service Hydraulic Components
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with mobile hydraulic systems
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): D ELECTRICAL

Competency: D1 Describe Electricity

Objectives

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

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

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

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

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

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

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

Line (GAC): D ELECTRICAL

Competency: D2 Use Electrical Testing Instruments

Objectives

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

- Use electrical measuring devices.

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

Line (GAC): D ELECTRICAL

Competency: D3 Service and Diagnose Batteries

Objectives

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

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

LEARNING TASKS	CONTENT

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

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

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

LEARNING TASKS	CONTENT

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

5. Service batteries	• Safety precautions • Inspection • Cleaning • Terminal servicing • Charging • Replacement • Scheduled maintenance • Storage and handling
6. Diagnose batteries	• Specific gravity • Open circuit voltage test • Load test • 3 minute fast charge test • Battery Impedance test
7. Use booster batteries	• Safety • Voltage ○ 6/12/24 • Polarity

Achievement Criteria

Performance: D3 Service and Diagnose Batteries

Conditions: The learner will require:

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

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

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

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

Line (GAC): D ELECTRICAL

Competency: D4 Service Charging Systems

Objectives

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

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

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

Achievement Criteria

Performance	D4 Service Charging Systems
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with functional charging circuit
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): D ELECTRICAL

Competency: D6 Service Starting Systems

Objectives

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

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

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

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

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

Achievement Criteria

Performance	D6 Service Starting Systems
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with functional starter circuit
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of context***

Line (GAC): D ELECTRICAL

Competency: D8 Service Electrical Circuits

Objectives

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

- Service electrical circuits.
- Describe trailer wiring.

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

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

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

Achievement Criteria

Performance	D8 Service Electrical Circuits
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with electrical and electronic 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	CONTENT

1. Describe tires and rims	• Types of tires
	  ○ Radial
	  ○ Bias
	• Rating
	  ○ Load range
	  ○ Size
	  ○ Ply
	• Types of rims
	  ○ Dayton
	  ○ Hub pilot
	  ○ Stud pilot

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

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

LEARNING TASKS	CONTENT

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

5. Diagnose wheel hubs	• Inspection • Testing

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

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

Achievement Criteria

Performance: E1 Service and Diagnose Tires, Wheels and Hubs

Conditions: The learner will require:

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

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

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

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

Line (GAC): E FRAMES, STEERING, AND SUSPENSION

Competency: E2 Service Steering Systems

Objectives

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

- Describe steering systems.
- Service steering systems.

LEARNING TASKS	CONTENT

1. Describe basic steering systems fundamentals	• Types
	  ○ Truck power assist
	  ○ Track steering
	  ○ Wheeled equipment steering
	• Truck System Components
	  ○ Kingpins
	  ○ Tie-rod ends
	  ○ Drag link
	  ○ Tie rod
	  ○ Spindle
	  ○ Steering arms
	• Track system components
	• Wheeled system components

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

Achievement Criteria

Performance	E2 Service Steering Systems
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with various steering systems
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): E FRAMES, STEERING, AND SUSPENSION

Competency: E4 Service, Diagnose and Repair Suspension Systems

Objectives

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

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

LEARNING TASKS	CONTENT

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

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

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

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

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

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

Achievement Criteria

Performance	E4 Service, Diagnose and Repair Suspension Systems
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with various suspension systems
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): E FRAMES, STEERING, AND SUSPENSION

Competency: E6 Diagnose and Repair Frames

Objectives

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

- Describe types of frames.
- Diagnose and repair frames.

LEARNING TASKS	CONTENT

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

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

LEARNING TASKS

3. Repair Frames

CONTENT

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

Achievement Criteria

Performance	E6 Diagnose and Repair Frames
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with various frame configurations
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): F TRAILER

Competency: F1 Service Landing Gear and Trailer Accessories

Objectives

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

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

LEARNING TASKS	CONTENT

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

2. Service and repair lift gates, landing gears and	• Inspect

LEARNING TASKS	CONTENT
winches	○ 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

Line (GAC): F TRAILER

Competency: F2 Service and Repair Coupling Systems

Objectives

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

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

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

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

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

LEARNING TASKS	CONTENT

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

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

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

Achievement Criteria

Performance Conditions — F2 Service and Repair Coupling Systems

The learner will require:

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

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

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

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

Line (GAC): F TRAILER

Competency: F3 Service, Diagnose and Repair Trailer Body Components

Objectives

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

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

LEARNING TASKS	CONTENT

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

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

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

Achievement Criteria

Performance	F3 Service, Diagnose and Repair Trailer Body Components
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with a variety of trailer bodies
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

Line (GAC): F TRAILER

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

Objectives

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

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

LEARNING TASKS	CONTENT

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

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

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

Achievement Criteria

Performance	F4 Service, Diagnose and Repair Heating and Refrigeration Systems
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with refrigeration units
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

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

Competency: G1 Describe Heating and Air Conditioning Fundamentals

Objectives

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

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

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

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

LEARNING TASKS	CONTENT
3. Describe the design and operation of heating and air conditioning systems	• Heater • Refrigeration cycle • Compressor • Evaporator • Condenser • Receiver-drier/accumulator • Orifice tubes/expansion valves • Refrigerant • Lubricants • Controls • Sensors
4. Describe the impact of CFCs on the environment	• Ozone depletion • Global warming
5. Identify legislation/agreements dealing with the use and handling of CFCs	• International • Montreal Protocol On Substances that deplete the Ozone Layer • Kyoto Protocol to the United Nations framework Convention on Climate Change • Canadian Environmental Protection Act • Provincial regulations • Ozone Depleting Substances And Other halocarbons Regulation • Waste Management Act • Training requirements • Environmental awareness training course on ozone depleting substance control • Certification • CFC Handling • Conservation objectives

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

Competency: G2 Diagnose and Repair Heating and Air Conditioning Systems

Objectives

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

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

LEARNING TASKS	CONTENT
1. Diagnose heating and air conditioning systems	• Diagnostic procedures • Manufacturer's procedures • Performance test • Diagnostic codes • Components • Inspection • Sensory inspection • Visual • Audible • Smell • Touch • Testing • Vacuum • Electrical • Mechanical • Pressure • Leak detection methods
2. Repair heating and air conditioning systems	• Recovering, evacuation and recharging • Pressure/leak testing • Environmental considerations • Removing and replacing components • Verify system operations
3. Describe the impact of CFCs on the environment	• Ozone depletion • Global warming

LEARNING TASKS	CONTENT
4. Identify legislation/agreements dealing with the use and handling of CFCs	• International • Montreal Protocol On Substances that deplete the Ozone Layer • Kyoto Protocol to the United Nations framework Convention on Climate Change • 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	CONTENT
1. Describe structural components	• Roll Over Protective Structure (ROPS) • Falling Objects Protective Structure (FOPS) • Operator Protective Structure (OPS)
2. Describe inspection procedures	• Cracks • Dents • Fatigue
3. Identify operational regulations	• Components • Safety glass • Screens • Service/diagnose/repair

Line (GAC): J STRUCTURAL COMPONENTS & ACCESSORIES

Competency: J2 Service Cab Structures

Objectives

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

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

LEARNING TASKS	CONTENT

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

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

Achievement Criteria

Performance	J2 Service Cab Structures
Conditions	The learner will require: • Tools • Test equipment • Manufacturer's Specifications • A work place or training environment • Equipment with cab structures
Criteria	The learner will be competent once the performance criteria is met: • Followed safe work practices throughout entire task including lock out procedures • Conducted in a logical manner • Conducted according to manufacturer's specifications • Conducted according to work place requirements ***Throughout the term of the apprenticeship, the learner must conduct the above performance a multiple of times and in a variety of contexts***

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	CONTENT
1. Review the charging systems	• Components • Operation

2. Describe the design and operation of alternator assemblies	• Alternator
	  ○ Rotor
	  ○ Stator
	  ○ Rectifier
	  ○ Brushes
	• Regulators
	• Field circuits
	• Drive
	• Cooling

3. Diagnose charging systems	• Inspection
	• Operation
	• Testing
	  ○ System tests
	  ○ Component tests
	  ○ Voltage drop
	  ○ Shorts
	  ○ Opens
	  ○ Grounds
	  ○ High resistance
	• Adjustments
	• Diagnostic codes

LEARNING TASKS	CONTENT
4. Repair charging system components	• 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	• Components • Operation

2. Describe the design and operation of starting motor assemblies	• Motor
	  ○ Series
	  ○ Parallel
	• Drives
	• Solenoids
	• Control circuits
	  ○ Relays
	  ○ Switches
	  ○ Electronic Contol Unit (ECU)
	• Armature
	• Winding
	• Brushes
	• Counter-Electromotive Force (CEMF)

3. Diagnose starting systems	• Inspection
	• Operation
	• Testing
	  ○ System test
	  ○ Component test
	  ○ Voltage drop
	  ○ Shorts
	  ○ Opens
	  ○ Grounds
	  ○ High resistance

LEARNING TASKS	CONTENT
4. Repair starting system components	• 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	CONTENT
1. Review the electrical systems	• Components • Operation
2. Diagnose components and systems	• Sensory inspection • Diagnostic tools • Test procedure • Wiring schematics
3. Repair components and systems	• 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

Line (GAC): D ELECTRICAL

Competency: D10 Diagnose and Repair Electronic Components and Systems

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe components of the electronic system	• Components
	  ○ LED
	  ○ Actuators
	  ○ Circuit board
	  ○ Multi-function controls
	  ○ Wiring
	  ○ Connectors
	  ○ Data links
	  ○ Communication plug
	  ○ Sensors
	  ○ Electronic Control Module (ECM)
	  ○ Termination resistors
	• CAN data bus
	  ○ J1587
	  ○ J1708
	  ○ J1939
	• Supplemental restrainant system
	• GPS

2. Diagnose electronic components and systems	• Diagnostic tools • OEM test procedure • Sensory inspection • Schematics
3. Repair electronic components and systems	• Replace components • Electrostatic discharge • Calibrate • Reprogram • Repair wiring and connectors

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	CONTENT

1. Describe vehicle management systems	• Dash displays
	• Electronic Control Module (ECM)
	• Satellite tracking
	• Multiplexing
	  ○ CAN data bus
	  – J1587
	  – J1708
	  – J1939
	• Communication protocols

2. Diagnose vehicle management systems	• Diagnostic procedures • Interpret test results • Test equipment • Codes
3. Repair vehicle management systems	• 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	CONTENT

1. Describe the combustion process	• 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

2. Describe terminology and perform calculations related to engines	• 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	CONTENT

3. Describe internal combustion engine classifications	• 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

4. Describe the operation of four stroke internal combustion engines	• Stroke Cycle
	  ○ Intake
	  ○ Compression
	  ○ Power
	  ○ Exhaust
	• Scavenging

5. Describe the operation of two stroke internal combustion engines	• Stroke Cycle
	  ○ Intake
	  ○ Compression
	  ○ Power
	  ○ Exhaust
	• Scavenging

Line (GAC): H ENGINES AND SUPPORTING SYSTEMS

Competency: H3 Diagnose and Repair Engine Support Systems

Objectives

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

- Describe engine support systems.
- Diagnose and repair engine support systems.

LEARNING TASKS	CONTENT

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

2. Diagnose cooling systems	• Operational test
	• Diagnostic codes
	• Components
	• Inspection
	• Testing
	  ○ Pressure
	  ○ Specific gravity
	  ○ Additives

3. Repair systems and their components	• Inspection • Remove • Repair/replace • Rebuild • Install • Adjustments • Verify system operation • Diagnostic codes

LEARNING TASKS	CONTENT

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

5. Diagnose lubrication systems	• Pressure tests • Diagnostic codes • Components • Inspection • Testing
6. Repair lubrication systems and components	• Remove • Repair/replace • Rebuild • Install • Adjustments • Verify system operation

7. Describe air induction systems	• Types
	• Components
	  ○ Filters
	  ○ Ducting
	  ○ Coolers
	  ○ Warning devices
	• Naturally aspirated type
	• Boosted type
	• Operation

8. Diagnose air induction systems	• Diagnostic codes • Components • Inspection • Testing
9. Repair air induction systems and components	• Precautions • Inspection • Remove • Repair/replace • Install • Verify system operation

LEARNING TASKS	CONTENT

10. Describe exhaust systems	• Types
	  ○ Marine
	  ○ Conventional
	• Components
	  ○ Mufflers
	  ○ Manifold
	  ○ Emission systems
	• Operation

11. Diagnose exhaust systems	• Components • Inspection • Testing
12. Repair exhaust systems and their components	• 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

Line (GAC): H ENGINES AND SUPPORTING SYSTEMS

Competency: H5 Diagnose and Repair Diesel Supply Systems

Objectives

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

- Describe diesel fuel supply circuits and their components.
- Perform diagnostics and repairs on diesel supply circuits.

LEARNING TASKS	CONTENT

1. Describe diesel fuel supply circuits	• Types
	• Components
	  ○ Tank
	  ○ Lines
	  ○ Primary/secondary filter
	  ○ Water separators
	  ○ Pumps
	• Operation

2. Diagnose diesel fuel supply circuits	• Diagnostic codes
	• Components
	• Inspection
	• Testing
	• Pressure
	  ○ Vacuum
	  ○ Air leaks
	  ○ Flow

3. Repair diesel fuel supply circuits	• Remove • Repair/replace • Rebuild • Install • Adjustments • Verify system operation

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	CONTENT
1. Describe the characteristics of liquefied petroleum gas (LPG)	• Physical properties • Heat value • Storage considerations
2. Identify the components that make up an LPG fuel system	• Tank • Lines • Filters • Valves
3. Describe the characteristics of compressed natural gas (CNG) and liquefied natural gas (LNG)	• Physical properties • Heat value • Storage considerations
4. Identify the components that make up an CNG/LNG fuel system	• 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 xmoke
  - 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	CONTENT
1. Describe the construction and operation of engine components	• Head • Valve train • Block • Internal components • Attachments

2. Prepare for overhaul	• Safety
	• Types of overhaul
	  ○ Inframe
	  ○ Removal
	• Cleaning
	• Removal of attachments
	• Environmental concerns

3. Disassemble engine	• Inspection • Failure analysis • Engine measurements • Determine parts and component requirements • Cleaning and care of components
4. Repair or replace components	• Crankshaft • Camshaft • Liners • Pistons • Bearings

LEARNING TASKS	CONTENT

5. Reassemble an engine	• Assembly measurements
	  ○ Liner protrusion
	  ○ Ring gap
	  ○ Bearing clearance
	  ○ End play
	• Pre-lube of components
	• Timing
	• Mounting of attachments
	• Prepare for installation or storage

6. Perform break-in of engine	• 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	CONTENT

1. Describe characteristics of diesel fuel	• Types
	  ○ Low sulfur
	  ○ Ultra low sulfur
	  ○ Bio-diesel
	• Grades
	• Characteristics
	  ○ Viscosity
	  ○ Cetane
	  ○ Rating
	  ○ Number
	  ○ Flash point
	  ○ Cloud point
	  ○ Sulfur content
	  ○ API gravity
	• Distilation
	• Summer/winter fuel
	• Storage
	• Disposal
	• Safety precautions

2. Describe the combustion process	• Compression ignition • Stages of combustion • Direct injection • Indirect njection

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	CONTENT
1. Describe the theory of diesel fuel injection	• Requirements of injection systems • Principles • Governors

2. Describe fuel injection systems	• Principles
	  ○ Hydraulically actuated
	  ○ Mechanically actuated
	  ○ Low pressure
	  ○ High pressure

3. Diagnose fuel injection systems	• Procedures • Inspection • Testing
4. Repair fuel injection systems	• Injector replacement • Injector adjustment • Pump timing • Repair/replace
5. Describe hydraulic and mechanical injectors	• Types • Components • Operations
6. Diagnose hydraulic and mechanical injectors	• 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
1. Describe electronic control of diesel fuel systems	• Components • Operation • Inputs • Processing • Outputs

2. Identify electronic diesel fuel systems	• Types
	• Partial authority
	  ○ Port and helix
	  ○ Distributor
	• Full authority
	• Electronic Unit Injectors (EUI)
	• Electronic Unit Pump (EUP)
	• Hydraulic Electronic Unit Injector (HEUI)
	• High Pressure Injector – Time Pressure (HPI-TP)
	• High Pressure Common Rail (HPCR)

3. Describe the necessary conditions for the engine to start	• Power to ECM • Connections • Fuses • Grounds • Engine Position Signal • Sensor/adjustment • Fuel supply
4. Diagnose full authority (EUI, EUP, HEUI, HPI-TP, HPCR) fuel systems	• Diagnostic procedures • Operational test • Diagnostic codes • Components • Inspection

LEARNING TASKS	CONTENT
5. Repair full authority (EUI, EUP, HEUI, HPI-TP, HPCR) fuel systems	• Testing • 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	CONTENT
1. Describe the causes and effects of harmful emissions	• Combustion process • Byproducts • Causes • Effects • Environmental • Health • Smog • Solutions • Legislation

2. Describe the emission systems on diesel engines	• Systems
	• Components and controls
	  ○ Diesel particulate filters (DPF)
	  ○ Selective catalytic reduction (SCR)
	  ○ Oxygen catalyist (OC)
	  ○ Exhaust gas recirculation (EGR)
	  ○ Sensors
	• Exhaust systems
	• Operation

3. Diagnose emission systems on diesel engines	• Diagnostic codes • Components • Inspection • Testing

LEARNING TASKS	CONTENT

4. Repair emission systems on diesel engines	• 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	CONTENT

1. Describe engine brakes	• Types
	  ○ Compression
	  ○ Exhaust
	  ○ Hydraulic
	• Components
	• Operation

2. Diagnose engine brakes	• Diagnostic procedures • Diagnostic codes • Inspection • Testing
3. Repair engine brakes	• 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	CONTENT
1. Describe methods of transferring power	• Fluids • Shafts • Belts • Chains • Gears

2. Describe the principles of power transfer	• 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	CONTENT

1. Review principles and operation of clutches and related components	• Types
	  ○ Friction
	  ○ Wet/dry
	  ○ Single/multi-disc
	  ○ Mechanical
	  ○ Jaw
	  ○ Magnetic
	  ○ Band
	• Components
	• Operation

2. Diagnose clutches and related components	• Diagnostic procedures • Operational test • Components • Inspection

3. Repair clutches and related components	• 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	CONTENT

1. Describe the principles and operation of manual transmissions	• Types
	  ○ Single countershaft
	  ○ Multiple countershaft
	• Components
	• Transmission operation
	• Shifting operation
	  ○ Mechanical
	  ○ Pneumatic
	• Lubrication

2. Diagnose manual transmissions	• Inspection • Components and controls • Testing
3. Repair manual transmissions	• 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	CONTENT
1. Describe the principles and operation of automated transmissions	• Types • Components • Transmission operation • Lubrication
2. Diagnose an automated transmission	• Diagnostic procedures • Diagnostic codes • Inspection • Components and controls • Testing
3. Repair an automated transmission	• 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	CONTENT

1. Describe the principles and operation of torque converters	• Types
	  ○ Radial
	  ○ Axial
	• Components
	• Operation
	  ○ Stages
	  ○ Phases
	• Lubrication

2. Describe the principles and operation of automatic transmissions	• Planetary gear sets • Combinations • Gear ratios • Types • Components • Hydraulic circuit diagrams • Electrical circuit diagrams • Operation • Power flow • Mechanical/hydraulic • Electronic/hydraulic • Controls • Lubrication

3. Diagnose torque converters and automatic transmissions	• Diagnostic codes
	• Pressure tests
	• Electrical/Electronic tests
	• Inspection
	• Components and controls
	• Testing
	  ○ Stall
	  ○ Temperature
	  ○ Pressure

LEARNING TASKS	CONTENT
4. Repair torque converters and automatic transmissions	• 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***

Line (GAC): I POWERTRAINS

Competency: I10 Diagnose and Repair Power Shift Transmissions

Objectives

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

- Describe the operation of power shift transmissions.
- Diagnose and repair power shift transmissions.

LEARNING TASKS	CONTENT

1. Describe the operation of power shift transmissions	• Types
	  ○ Multi-shaft
	  ○ Planetary
	• Torque divider
	• Construction
	• Hydraulic
	• Mechanical
	• Operation

2. Diagnose power shift transmissions	• Diagnostic procedures • Operational test • Diagnostic codes • Components • Powertrains • Clutches • Torque divider • Sensors • Valves • Solenoids • Inspection • Testing • Stall • Cool down • Pressure
3. Repair power shift transmissions	• Overhaul • Adjustments • Fluid level • Operational testing • Scheduled maintenance • Diagnostic codes

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***

Line (GAC): I POWERTRAINS

Competency: I12 Diagnose and Repair Drivelines

Objectives

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

- Describe drivelines and their components.
- Diagnose and repair drivelines and their components.

LEARNING TASKS	CONTENT

1. Describe drivelines and components	• Types
	• Components
	  ○ Ujoint
	  ○ Slipshaft
	  ○ Steady bearing
	• Operation
	• Working angles
	• Phasing

2. Diagnose drivelines and components	• Inspection
	• Components
	• Testing
	  ○ Run out
	  ○ Balance
	  ○ Angles
	  ○ Phasing

3. Repair drivelines and components	• Phasing • Alignment • Inspection • Repair/replace • Adjustments • Lubrication • Verify operation

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***

Line (GAC): I POWERTRAINS

Competency: I14 Diagnose and Repair Drive Axles

Objectives

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

- Describe the principles and operation of drive axles.
- Diagnose and repair drive axles.

LEARNING TASKS	CONTENT

1. Describe the principles and operation of drive axles	• Types
	  ○ Single axle
	  ○ Tandem axle
	  ○ Tridem axle
	• Components
	  ○ Differentials
	  ○ Axle shafts
	  ○ Lockers
	• Inter axle differentials
	• Multi-speed
	• Controls and circuits
	• Traction devices
	• Mounting
	• Operation
	• Lubrication

2. Diagnose drive axles	• Components
	• Inspection
	  ○ Vibration
	  ○ Noise
	• Testing
	• Fluid level and condition

3. Repair drive axles	• Visual inspections
	• Leaks
	• Securement of attachments
	• Check operation
	• Pre-inspection/post-inspection
	  ○ End play
	  ○ Backlash
	  ○ Patterns
	• Adjustments
	• Lubrication
	• Verify operation

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	CONTENT

1. Describe operation of final drives	• Types
	  ○ Inboard
	  ○ Outboard
	  ○ Planetary
	  ○ Chain
	  ○ Gear
	• Components
	• Operation

2. Diagnose final drives	• Diagnostic procedures • Operational test • Components • Inspection
3. Repair final drives	• 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	CONTENT

1. Describe driveline retarders	• Types
	  ○ Hydraulic
	  ○ Electric
	• Components
	• Operation

2. Diagnose driveline retarders	• Diagnostic procedures • Operational test • Components • Inspection
3. Repair driveline retarders	• 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	CONTENT

1. Describe winches	• Types
	  ○ Mechanical
	  ○ Electrical
	  ○ Hydraulic
	• Components
	  ○ Wire Rope
	  ○ Drums
	  ○ Clutch/brake
	• Operation

2. Diagnose winches	• Operational test • Components • Inspection
3. Repair winches	• 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

Line (GAC): I POWERTRAINS

Competency: I19 Diagnose and Repair Power Take-offs and Transfer Cases

Objectives

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

- Describe power take-offs and transfer cases.
- Diagnose and service power take-offs and transfer cases.

LEARNING TASKS	CONTENT
1. Describe power take-offs	• Types • Components • Operation • Drive Source • Mounting • Controls • Lubrication • Applications

2. Diagnose power take-offs	• Operational test
	• Components
	• Drivelines
	• Controls
	  ○ Mechanical
	  ○ Electrical/electronic
	• Inspection
	  ○ Leaks
	  ○ Noises
	  ○ Vibration

3. Repair power take-offs	• Remove • Repair/replace • Install • Adjustments ○ Backlash • Lubrication • Verify operation
4. Describe transfer cases	• Types • Components • Operation • Mounting • Controls • Lubrication

LEARNING TASKS	CONTENT
5. Diagnose transfer cases	• Diagnostic codes • Operational test • Inspection • Components and controls • Drivelines
6. Repair transfer cases	• 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

Line (GAC): C HYDRAULICS

Competency: C3 Diagnose and Repair Advanced Hydraulic Systems

Objectives

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

- Diagnose hydraulic systems.
- Repair hydraulic systems and components.
- Repair electronic hydraulic systems.

LEARNING TASKS	CONTENT

1. Describe hydraulic systems and components	• Pumps
	  ○ Vane
	  ○ Gear
	  ○ Piston
	  – Pressure compensated
	  – Load sensing (HD only)
	• Actuators
	  ○ Cylinders
	  ○ Motors
	• Valves
	  ○ Pressure
	  ○ Flow
	  ○ Directional
	• System types
	  ○ Closed loop
	  ○ Open loop

2. Diagnose hydraulic systems	• Safety precautions
	• Diagnostic procedures
	• Test equipment
	  ○ Pressure gauges
	  ○ Flow meters
	  ○ Temperature sensors
	• Cycle times
	• Diagnostic codes
	• Manufacturer's procedures

3. Repair hydraulic systems and components	• Safety precautions
	• Components
	  ○ Reservoirs
	  ○ Pumps
	  ○ Actuators
	  ○ Control valves
	  ○ Accumulators

LEARNING TASKS	CONTENT
	○ Coolers ○ Connecting lines • Fluids • Inspection • Remove/install • Repair/replace • System flushing
4. Repair electronic hydraulic systems	• 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	CONTENT
1. Describe an electrical drive system	• Operation • Components • Safety ○ High voltage
2. Service electric drive systems	• Coolant • Cooling fans
3. Diagnose electric drive systems	• Codes • Test procedures

4. Repair electric drive systems	• 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

Line (GAC): E FRAMES, STEERING AND SUSPENSION

Competency: E8 Diagnose and Repair Wheeled Equipment Steering

Objectives

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

- Describe the construction and operation of power steering systems.
- Diagnose and repair power steering systems.

LEARNING TASKS	CONTENT

1. Describe power steering systems	• Types
	  ○ Orbital
	  ○ Hydraulic
	  ○ Emergency
	• Components
	• Operation

2. Diagnose power steering systems	• Diagnostic procedures • Safety precautions/lockouts • Inspection • Testing ○ Pressure/flow
3. Repair steering systems	• Inspection • Remove • Repair/replace • Install • Adjustments • Lubrication • Verify system operation

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	CONTENT

1. Describe steering systems	• Types
	  ○ Steering clutch
	  ○ Hydrostatic
	  ○ Differential
	• Components
	• Operation

2. Diagnose steering systems	• Operation • Components • Inspection • Testing
3. Repair steering systems	• 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	CONTENT

1. Describe undercarriages	• Types
	  ○ Excavator
	  ○ Crawler, Dozer/Loader
	  ○ Crane/Shovel
	  ○ Tank
	  ○ Rock drill
	• Components
	• Operation

2. Diagnose and repair undercarriages	• 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

Line (GAC): J STRUCTURAL COMPONENTS AND ACCESSORIES

Competency: J4 Diagnose and Repair Working Attachments

Objectives

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

- Describe wheel working attachments.
- Diagnose and repair working attachments.

LEARNING TASKS	CONTENT

1. Describe working attachments	• Types
	  ○ Blades and frames
	  ○ Buckets
	  ○ Booms and arms
	  ○ Rippers and arms
	  ○ Tamper
	  ○ Rock breaker
	  ○ Grapple
	• Components
	• Operation

2. Diagnose working attachments	• Diagnostic codes • Operational test • Components • Inspection
3. Repair working attachments	• Repair/replace • Adjustments • Lubrication • Scheduled maintenance

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	CONTENT

1. Describe industrial air compressors	• Types
	  ○ Reciprocating
	  ○ Rotary vane
	  ○ Rotary screw
	• Components
	• Operation

2. Service industrial air compressors	• Adjustments • Lubrication • Scheduled maintenance
3. Diagnose and repair industrial air compressors	• 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 visabilty coveralls
- Mechanics gloves

Reference Materials

Recommended Resources

- SkilledTradesBC www.itabc.ca
- WorkSafeBC www.worksafebc.com

Foundation

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

or

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

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

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 journeyperson.

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: SKILLEDTRADESBC PORTAL 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%
	Total	**100%**	**100%**
In-school theory / practical subject competency weighting		50%	50%
Final in-school percentage score		IN-SCHOOL %	

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

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

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

PROGRAM: IN-SCHOOL TRAINING: SKILLEDTRADESBC PORTAL 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%
	Total	**100%**	**100%**
In-school theory / practical subject competency weighting		50%	50%
Final in-school percentage score		IN-SCHOOL %	

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

PROGRAM: IN-SCHOOL TRAINING: SKILLEDTRADESBC PORTAL 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%
	Total	**100%**	**100%**
In-school theory / practical subject competency weighting		50%	50%

Final in-school percentage score Apprentices must achieve a minimum 70% as the final in-school percentage score to be eligible to write the Interprovincial Red Seal exam.	IN-SCHOOL %

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.

SkilledTradesBC will enter the apprentices' Heavy Duty Equipment Technician Interprovincial Red Seal examination percentage score in SkilledTradesBC Portal.

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