

SKILLED**TRADES**^{BC}

PROGRAM OUTLINE

Steamfitter/Pipefitter

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STEAMFITTER/PIPEFITTER HARMONIZED PROGRAM OUTLINE

**APPROVED BY INDUSTRY
OCTOBER 2017**

**BASED ON
RSOS 2015**

**Developed by
SkilledTradesBC
Province of British Columbia**

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Section 1

INTRODUCTION

Steamfitter/Pipefitter

Foreword

The revised Steamfitter/Pipefitter Program Outline is intended as a guide for instructors, apprentices, and employers of apprentices as well as for the use of industry organizations, regulatory bodies, and provincial and federal governments. It reflects updated standards based on the new Steamfitter/Pipefitter Red Seal Occupational Standard (2015) and British Columbia industry and instructor subject matter experts.

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

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

Each competency is to be evaluated through the use of written examination in which the learner must achieve a minimum of 70% in order to receive a passing grade for that competency. The types of questions used on these exams must reflect the cognitive level indicated by the learning objectives and the learning tasks listed in the related competencies.

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

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

SAFETY ADVISORY

Be advised that references to the 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 Occupational Analysis Chart was prepared with the advice and direction of an industry steering committee convened initially by SkilledTradesBC. Members include:

- Al Phillips, UA Piping Industry College of BC
- Darin Sinal, Teck Metals (Trail)
- Gord Wickett, SeaSpan Victoria Shipyards
- Patrick Waunch, Rambow Mechanical
- Rob Marchiori, Ram Mechanical

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

- Alan Leckie, United Association of Plumbers and Pipefitters
- Blair Hunter, Howe Sound Pulp and Paper
- Catlin Jones, SeaSpan Vancouver Shipyards
- Lorne Sweet, British Columbia Institute of Technology
- Rob Marchiori, Ram Mechanical
- Will Schwarz, UA Piping Industry College of BC

Facilitators:

- Angela Caughy
- Farrell Zecchel

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

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

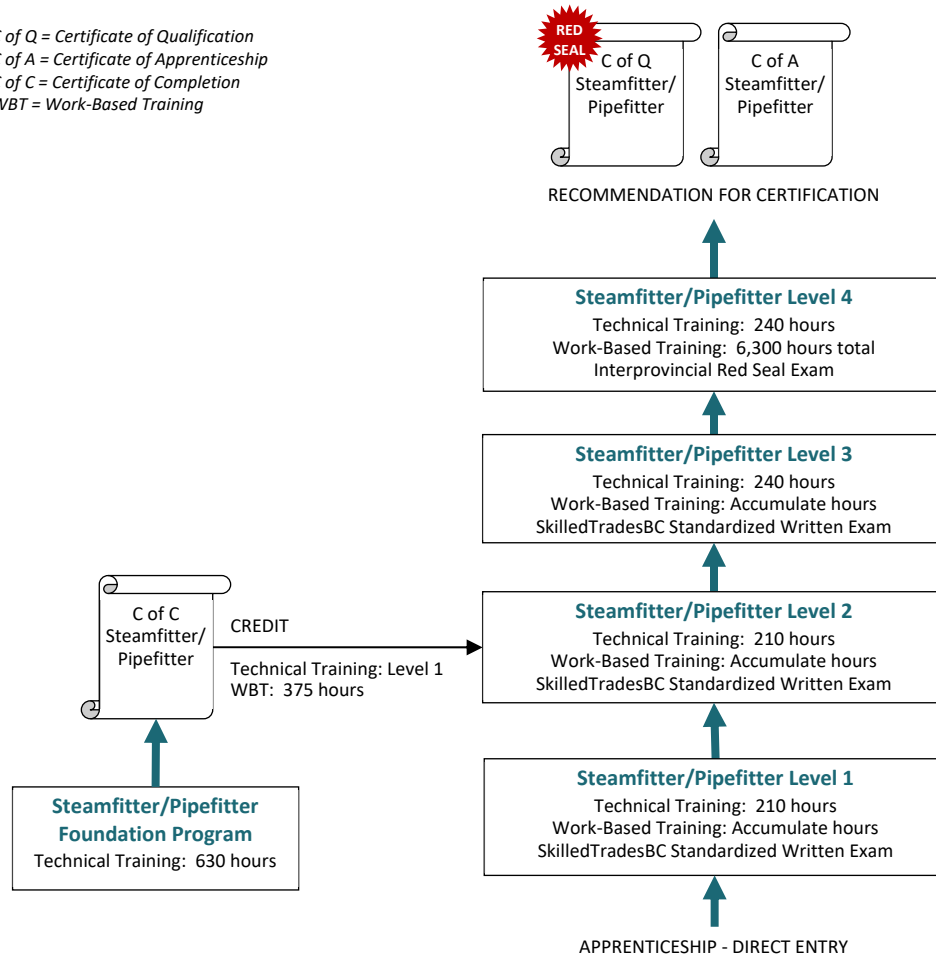
Section 2

PROGRAM OVERVIEW

Steamfitter/Pipefitter

Program Credentialing Model

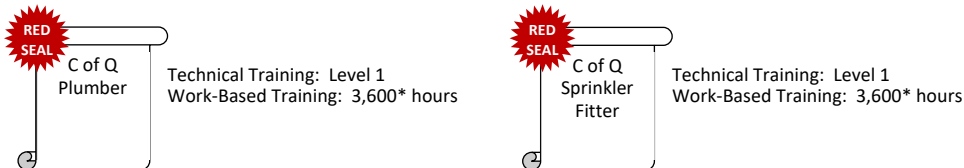
C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work-Based Training



CROSS-PROGRAM CREDITS

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

Please note: Certifications obtained outside of British Columbia may not be eligible for the same credit towards certification in this trade. Please contact SkilledTradesBC to verify the Cross-Program Credits applicable to out-of-province certifications



**Individuals who are holders of more than one of these credentials will only be awarded credit for 3,600 hours total*

Occupational Analysis Chart

STEAMFITTER/PIPEFITTER

Occupation Description: Steamfitter/Pipefitters lay out, assemble, fabricate, maintain, repair and service equipment and piping systems carrying water, steam, fluids, gases, chemicals and fuel in various systems such as heating, cooling, lubricating and process piping systems. They read and interpret drawings, specifications and codes to determine layout, type and size of pipe, and tools to use. They measure, cut, thread, groove, bend, solder, braze, assemble and install metal, plastic and fiberglass pipes, valves and fittings. As well, they must be able to join and secure pipe sections of related equipment. They check systems for leaks. Steamfitters/Pipefitters also do general maintenance work including replacement of worn components.

PERFORM SAFETY RELATED FUNCTIONS A	Maintain Safe Work Environment A1 1	Use Personal Protective Equipment (PPE) and Safety Equipment A2 1	Perform Lock-Out Procedures A3 1	Practice Fire Prevention A4 1		
USE TOOLS AND EQUIPMENT B	Use Common Tools and Equipment B1 1	Use Access Equipment B2 1	Use Rigging, Hoisting, Lifting and Positioning Equipment B3 1 2 4	Rig Loads for Cranes B4 1 4	Use Welding Equipment B5 1 2	Use Soldering and Brazing Equipment B6 1
	Use Oxy-Fuel Equipment B7 1	Use Technical Instruments and Testers B8 2				
PERFORM ROUTINE TRADE ACTIVITIES C	Use Mathematics and Science C1 1 2	Interpret Drawings and Specifications C2 1 2 3 4	Use Codes, Regulations and Standards C3 1 2 3	Use Manufacturer and Supplier Documentation C4 2		
PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS D	Install Valves D1 1	Install Fittings D2 1	Penetrate Structures D3 1	Layout and Install Piping and Tubing D4 1 2	Perform Maintenance, Troubleshooting, Repairs and Testing on Valves D5 1	

HARMONIZED PROGRAM OUTLINE

Program Overview

PERFORM FABRICATION <div>E</div>	Fabricate Brackets, Supports, Hangers, Guides and Anchors <div>E1</div>	Fabricate Piping System Components <div>E2</div>			
	<div>1</div> <div></div> <div></div> <div></div> <div></div>	<div></div> <div>2</div> <div></div> <div></div> <div></div>			
USE COMMUNICATION TECHNIQUES <div>F</div>	Use Communication Techniques <div>F1</div>	Use Mentoring Techniques <div>F2</div>			
	<div>1</div> <div></div> <div></div> <div></div> <div></div>	<div></div> <div></div> <div></div> <div>4</div> <div></div>			
INSTALL HEAT TRACING SYSTEMS Level 2: Liquid Level 3: Steam <div>G</div>	Install Heat Tracing Systems <div>G1</div>	Repair and Test Heat Tracing Systems <div>G2</div>			
	<div></div> <div>2</div> <div>3</div> <div></div> <div></div>	<div></div> <div>2</div> <div>3</div> <div></div> <div></div>			
INSTALL HYDRONIC SYSTEMS <div>H</div>	Interpret Heating and Cooling Systems <div>H1</div>	Install Equipment for Hydronic Systems <div>H2</div>	Install Piping for Hydronic Systems <div>H3</div>	Test Hydronic Systems <div>H4</div>	Repair Hydronic Systems <div>H5</div>
	<div></div> <div>2</div> <div></div> <div></div> <div></div>	<div></div> <div>2</div> <div>3</div> <div></div> <div></div>	<div></div> <div>2</div> <div>3</div> <div></div> <div></div>	<div></div> <div></div> <div>3</div> <div></div> <div></div>	<div></div> <div></div> <div>3</div> <div></div> <div></div>
INSTALL STEAM SYSTEMS Level 3: Low pressure Level 4: High pressure <div>I</div>	Install Equipment for Steam Systems <div>I1</div>	Install Piping for Steam and Condensate Systems <div>I2</div>	Test Steam and Condensate Systems <div>I3</div>	Repair Steam and Condensate Systems <div>I4</div>	
	<div></div> <div></div> <div>3</div> <div>4</div> <div></div>	<div></div> <div></div> <div>3</div> <div>4</div> <div></div>	<div></div> <div></div> <div>3</div> <div>4</div> <div></div>	<div></div> <div></div> <div>3</div> <div>4</div> <div></div>	
INSTALL INDUSTRIAL WATER AND WASTE SYSTEMS <div>J</div>	Install Equipment for Industrial Water and Waste Systems <div>J1</div>	Install Piping for Industrial Water and Waste Systems <div>J2</div>	Test Industrial Water and Waste Systems <div>J3</div>	Repair Industrial Water and Waste Systems <div>J4</div>	
	<div></div> <div></div> <div>3</div> <div></div> <div></div>	<div></div> <div></div> <div>3</div> <div></div> <div></div>	<div></div> <div></div> <div>3</div> <div></div> <div></div>	<div></div> <div></div> <div>3</div> <div></div> <div></div>	

HARMONIZED PROGRAM OUTLINE

Program Overview

APPLY ELECTRICAL CONCEPTS K	Use the Principles of Electricity K 1	Use Electrical Wiring Diagrams and Schematics K2	Apply Single Phase Motor Theory K3	Apply Three Phase Motor Theory K4	Apply Wiring Practices K5	Interpret the Canadian Electrical Code (CEC) K6
	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 4 <input type="checkbox"/>	<input type="checkbox"/> 4 <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>
PLAN GAS-FIRED SYSTEMS INSTALLATIONS L	Size Piping and Tubing Systems L1	Select Regulators, Valves and Valve Trains Components L2	Select Gas-Fired Appliances L3	Select Flame Safeguards L4	Select Burners L5	Plan a Project L6
	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 4 <input type="checkbox"/>
INSTALL FUEL SYSTEMS M	Install Equipment for Fuel Systems M1	Install Piping and Tubing for Fuel Systems M2	Install Regulators, Valves and Valve Train Components M3	Install Air Supply Systems M4	Test Fuel Systems M5	Repair Fuel Systems M6
	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 4 <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>
	Commission Fuel/Air Delivery Systems M7					
	<input type="checkbox"/> 4 <input type="checkbox"/>					
INSTALL MEDICAL GAS SYSTEMS N	Install Equipment for Medical Gas Systems N1	Install Piping and Tubing for Medical Gas Systems N2	Test Medical Gas Systems N3	Repair Medical Gas Systems N4		
	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/>		
INSTALL PROCESS PIPING SYSTEMS O	Install Equipment for Process Piping Systems O1	Install Piping for Process Piping Systems O2	Test Process Piping Systems O3	Repair Process Piping Systems O4		
	<input type="checkbox"/> 4 <input type="checkbox"/>	<input type="checkbox"/> 4 <input type="checkbox"/>	<input type="checkbox"/> 4 <input type="checkbox"/>	<input type="checkbox"/> 4 <input type="checkbox"/>		

HARMONIZED PROGRAM OUTLINE

Program Overview

INSTALL HYDRAULIC SYSTEMS P	Install Equipment for Hydraulic Systems P1	Install Piping, Tubing and Hoses for Hydraulic Systems P2	Test Hydraulic Systems P3	Repair Hydraulic Systems P4
	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>
INSTALL COMPRESSED AIR AND PNEUMATIC SYSTEMS Q	Install Equipment for Compressed Air and Pneumatic Systems Q1	Install Piping and Tubing for Compressed Air and Pneumatic Systems Q2	Test Compressed Air and Pneumatic Systems Q3	Repair Compressed Air and Pneumatic Systems Q4
	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>
INSTALL HEAT RECOVERY SYSTEMS R	Install Equipment for Heat Recovery Systems R1	Install Piping for Heat Recovery Systems R2	Test Heat Recovery Systems R3	Repair Heat Recovery Systems R4
	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>
INSTALL HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION SYSTEMS (HVACR) S	Install Equipment for HVACR Systems S1	Install Piping for HVACR Systems S2	Test HVACR Systems S3	Repair HVACR Systems S4
	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>
INSTALL SPECIALTY SYSTEMS T	Install Equipment for Specialty Systems T1	Install Piping for Specialty Systems T2	Test Specialty Systems T3	Repair Specialty Systems T4
	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>
PERFORM COMMISSIONING U	Prepare System for Commissioning, Start-up and Turnover U1	Balance and Commission Systems U2		
	<div><div></div><div></div><div></div><div>4</div><div></div></div>	<div><div></div><div></div><div></div><div>4</div><div></div></div>		

INSTALL MARINE SYSTEMS V	Perform Penetration and Layout of Marine Structures and Piping V1					Install Piping for Marine Systems V2					Repair Marine Piping Systems V3				
		2					2					2			
INSTALL BACKFLOW PREVENTION W	Install Cross Connection Assemblies and Devices W1					Test Cross Connection Assemblies and Devices W2					Troubleshoot and Repair Cross Connection Assemblies and Devices W3				
			3					3					3		

Training Topics and Suggested Time Allocation: Level 1

STEAMFITTER/PIPEFITTER – LEVEL 1

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line A	PERFORM SAFETY RELATED FUNCTIONS	7%	90%	10%	100%
A1	Maintain Safe Work Environment		✓		
A2	Use Personal Protective Equipment (PPE) and Safety Equipment		✓		
A3	Perform Lock-Out Procedures		✓	✓	
A4	Practice Fire Prevention		✓		
Line B	USE TOOLS AND EQUIPMENT	27%	60%	40%	100%
B1	Use Common Tools and Equipment		✓	✓	
B2	Use Access Equipment		✓		
B3	Use Rigging, Hoisting Lifting and Positioning Equipment		✓	✓	
B4	Rig Loads for Cranes		✓		
B5	Use Welding Equipment		✓	✓	
B6	Use Soldering and Brazing Equipment		✓	✓	
B7	Use Oxy-Fuel Equipment		✓	✓	
Line C	PERFORM ROUTINE TRADE ACTIVITIES	26%	80%	20%	100%
C1	Use Mathematics and Science		✓		
C2	Interpret Drawings and Specifications		✓	✓	
C3	Use Codes, Regulations and Standards		✓		
Line D	PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS	23%	80%	20%	100%
D1	Install Valves		✓		
D2	Install Fittings		✓		
D3	Penetrate Structures		✓		
D4	Layout and Install Piping and Tubing		✓	✓	
D5	Perform Maintenance, Troubleshooting, Repairs and Testing on Valves		✓		
Line E	PERFORM FABRICATION	14%	10%	90%	100%
E1	Fabricate Brackets, Supports, Hangers, Guides and Anchors		✓	✓	
Line F	USE COMMUNICATION TECHNIQUES	3%	100%	0%	100%
F1	Use Communication Techniques		✓		
Total Percentage for Steamfitter/Pipefitter Level 1		100%			

Training Topics and Suggested Time Allocation: Level 2

STEAMFITTER/PIPEFITTER – LEVEL 2

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line B	USE TOOLS AND EQUIPMENT	17%	60%	40%	100%
B3	Use Rigging, Hoisting, Lifting and Positioning Equipment		✓	✓	
B5	Use Welding Equipment		✓	✓	
B8	Use Technical Instruments and Testers		✓		
Line C	PERFORM ROUTINE TRADE ACTIVITIES	14%	70%	30%	100%
C1	Use Mathematics and Science		✓		
C2	Interpret Drawings and Specifications		✓	✓	
C3	Use Codes, Regulations and Standards		✓		
C4	Use Manufacturer and Supplier Documentation		✓		
Line D	PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS	6%	100%	0%	100%
D4	Layout and Install Piping and Tubing		✓		
Line E	PERFORM FABRICATION	17%	20%	80%	100%
E2	Fabricate Piping System Components		✓	✓	
Line G	INSTALL HEAT TRACING SYSTEMS (LIQUID)	3%	100%	0%	100%
G1	Install Heat Tracing Systems		✓		
G2	Repair and Test Heat Tracing Systems		✓		
Line H	INSTALL HYDRONIC SYSTEMS	14%	100%	0%	100%
H1	Interpret Heating and Cooling Systems		✓		
H2	Install Equipment for Hydronic Systems		✓		
H3	Install Piping for Hydronic Systems		✓		
Line K	APPLY ELECTRICAL CONCEPTS	11.5%	100%	0%	100%
K1	Use the Principles of Electricity		✓		
Line L	PLAN GAS-FIRED SYSTEMS INSTALLATIONS	6%	100%	0%	100%
L3	Select Gas-Fired Appliances		✓		
Line V	INSTALL MARINE SYSTEMS	11.5%	70%	30%	100%
V1	Perform Penetration and Layout of Marine Structures and Piping		✓		
V2	Install Piping for Marine Systems		✓	✓	
V3	Repair Marine Piping Systems		✓		
Total Percentage for Steamfitter/Pipefitter Level 2		100%			

Training Topics and Suggested Time Allocation: Level 3

STEAMFITTER/PIPEFITTER – LEVEL 3

			% of Time Allocated to:			
			% of Time	Theory	Practical	Total
Line C	PERFORM ROUTINE TRADE ACTIVITIES	8%	40%	60%	100%	
C2	Interpret Drawings and Specifications		✓	✓		
C3	Use Codes, Regulations and Standards		✓			
Line G	INSTALL HEAT TRACING SYSTEMS (STEAM)	3%	100%	0%	100%	
G1	Install Heat Tracing Systems		✓			
G2	Repair and Test Heat Tracing Systems		✓			
Line H	INSTALL HYDRONIC SYSTEMS	13%	70%	30%	100%	
H2	Install Equipment for Hydronic Systems		✓	✓		
H3	Install Piping for Hydronic Systems		✓	✓		
H4	Test Hydronic Systems		✓			
H5	Repair Hydronic Systems		✓			
Line I	INSTALL STEAM SYSTEMS (LOW PRESSURE)		13%	100%	0%	100%
I1	Install Equipment for Steam Systems	✓				
I2	Install Piping for Steam and Condensate Systems	✓				
I3	Test Steam and Condensate Systems	✓				
I4	Repair Steam and Condensate Systems	✓				
Line J	INSTALL INDUSTRIAL WATER AND WASTE SYSTEMS	10%	100%	0%	100%	
J1	Install Equipment for Industrial Water and Waste Systems		✓			
J2	Install Piping for Industrial Water and Waste Systems		✓			
J3	Test Industrial Water and Waste Systems		✓			
J4	Repair Industrial Water and Waste Systems		✓			
Line K	APPLY ELECTRICAL CONCEPTS	15%	80%	20%	100%	
K2	Use Electrical Wiring Diagrams and Schematics		✓	✓		
K5	Apply Wiring Practices		✓			
K6	Interpret the Canadian Electrical Code (CEC)		✓			
Line L	PLAN GAS-FIRED SYSTEMS INSTALLATIONS	18%	100%	0%	100%	
L1	Size Piping and Tubing Systems		✓			
L2	Select Regulators, Valves and Valve Train Components		✓			
L4	Select Flame Safeguards		✓			
L5	Select Burners		✓			
Line M	INSTALL FUEL SYSTEMS	10%	100%	0%	100%	
M1	Install Equipment for Fuel Systems		✓			
M2	Install Piping and Tubing for Fuel Systems		✓			
M3	Install Regulators, Valves and Valve Train Components		✓			
M5	Test Fuel Systems		✓			
M6	Repair Fuel Systems		✓			

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line N	INSTALL MEDICAL GAS SYSTEMS	5%	100%	0%	100%
N1	Install Equipment for Medical Gas Systems		✓		
N2	Install Piping and Tubing for Medical Gas Systems		✓		
N3	Test Medical Gas Systems		✓		
N4	Repair Medical Gas Systems		✓		
Line W	INSTALL BACKFLOW PREVENTION	5%	100%	0%	100%
W1	Install Cross Connection Assemblies and Devices		✓		
W2	Test Cross Connection Assemblies and Devices		✓		
W3	Troubleshoot and Repair Cross Connection Assemblies and Devices		✓		
Total Percentage for Steamfitter/Pipefitter Level 3		100%			

Training Topics and Suggested Time Allocation: Level 4

STEAMFITTER/PIPEFITTER – LEVEL 4

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line B	USE TOOLS AND EQUIPMENT	7.5%	70%	30%	100%
B3	Use Rigging, Hoisting, Lifting and Positioning Equipment		✓	✓	
B4	Rigs Loads for Cranes		✓		
Line C	PERFORM ROUTINE TRADE ACTIVITIES	5%	100%	0%	100%
C2	Interpret Drawings and Specifications		✓		
Line F	USE COMMUNICATION TECHNIQUES	0.5%	100%	0%	100%
F2	Use Mentoring Techniques		✓		
Line I	INSTALL STEAM SYSTEMS (HIGH PRESSURE)	12%	100%	0%	100%
I1	Install Equipment for Steam Systems		✓		
I2	Install Piping for Steam and Condensate Systems		✓		
I3	Test Steam and Condensate Systems		✓		
I4	Repair Steam and Condensate Systems		✓		
Line K	APPLY ELECTRICAL CONCEPTS	10%	100%	0%	100%
K3	Apply Single Phase Motor Theory		✓		
K4	Apply Three Phase Motor Theory		✓		
Line L	PLAN GAS-FIRED SYSTEMS INSTALLATIONS	5%	50%	50%	100%
L6	Plan a Project		✓	✓	
Line M	INSTALL FUEL SYSTEMS	7.5%	100%	0%	100%
M4	Install Air Supply Systems		✓		
M7	Commission Fuel/Air Delivery Systems		✓		
Line O	INSTALL PROCESS PIPING SYSTEMS	10%	100%	0%	100%
O1	Install Equipment for Process Piping Systems		✓		
O2	Install Piping for Process Piping Systems		✓		
O3	Test Process Piping Systems		✓		
O4	Repair Process Piping Systems		✓		
Line P	INSTALL HYDRAULIC SYSTEMS	7.5%	80%	20%	100%
P1	Install Equipment for Hydraulic Systems		✓		
P2	Install Piping, Tubing and Hoses for Hydraulic Systems		✓	✓	
P3	Test Hydraulic Systems		✓		
P4	Repair Hydraulic Systems		✓		
Line Q	INSTALL COMPRESSED AIR AND PNEUMATIC SYSTEMS	7.5%	80%	20%	100%
Q1	Install Equipment for Compressed Air and Pneumatic Systems		✓		

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Q2	Install Piping and Tubing for Compressed Air and Pneumatic Systems		✓	✓	
Q3	Test Compressed Air and Pneumatic Systems		✓		
Q4	Repair Compressed Air and Pneumatic Systems		✓		
Line R	INSTALL HEAT RECOVERY SYSTEMS		2.5%	100%	0%
R1	Install Equipment for Heat Recovery Systems		✓		
R2	Install Piping for Heat Recovery Systems		✓		
R3	Test Heat Recovery Systems		✓		
R4	Repair Heat Recovery Systems		✓		
Line S	INSTALL HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION SYSTEMS (HVACR)	10%			
S1	Install Equipment for HVACR Systems		✓		
S2	Install Piping for HVACR Systems		✓		
S3	Test HVACR Systems		✓		
S4	Repair HVACR Systems		✓		
Line T	INSTALL SPECIALTY SYSTEMS	10%	100%	0%	100%
T1	Install Equipment for Specialty Systems		✓		
T2	Install Piping for Specialty Systems		✓		
T3	Test Specialty Systems		✓		
T4	Repair Specialty Systems		✓		
Line U	PERFORM COMMISSIONING	5%	100%	0%	100%
U1	Prepare System for Commissioning, Start-up and Turnover		✓		
U2	Balance and Commission Systems		✓		
Total Percentage for Steamfitter/Pipefitter Level 4		100%			

Section 3

PROGRAM CONTENT

Steamfitter/Pipefitter

Level 1

Steamfitter/Pipefitter

Line (GAC): **A PERFORM SAFETY RELATED FUNCTIONS**
Competency: **A1 Maintain Safe Work Environment**

Objectives

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

- Manage workplace hazards.
- Use WHMIS.

LEARNING TASKS

1. Identify workplace hazards

CONTENT

- Short term hazards
 - Confined space
 - Elevations
 - Ladders
 - Work platforms
 - Electrical
 - Compressed gas
 - Explosive material
 - Gas
 - Dust
 - Air quality
 - Carbon monoxide limits
 - Dust
 - Asbestos
 - Excavations
 - Working around heavy equipment
 - Sharp objects
 - Lifting
 - Correct lifting posture
 - Discretion of lifter
 - Personal apparel
 - Clothing
 - Hair and beards
 - Jewelry
 - Safe attitude
 - Housekeeping
 - Horseplay
 - Respect for others' safety
 - Constant awareness of surroundings
- Long term hazards
 - Respiratory disease
 - Repetitive strain injuries
 - Excessive noise

LEARNING TASKS

CONTENT

2. Describe safety hazards and precautions when working at elevations

- Chemical exposure
- Hazards
 - Floor openings
 - Overhead hazards
 - Conditions below
 - Elements
 - Wind
 - Snow
 - Lightning
 - Rain
 - Sun
 - Access equipment
 - Housekeeping
- Precautions
 - Fall restraint
 - Guard rails
 - Safety lines
 - Equipment inspection
 - Fall arrest
 - Equipment inspection
 - Conditions below
 - Housekeeping
 - Proper clothes (PPE)

3. Manage workplace hazards

- Workplace Hazardous Materials Identification System (WHMIS)
 - Purpose
 - Material Safety Data Sheets (MSDS)
 - Labels
 - Symbols
 - Regulations
- Transportation of Dangerous Goods (TDG)
- Occupational Health and Safety (OHS) regulation
 - Rights and responsibilities
 - Inspections
 - General conditions
- WorkSafeBC standards
 - Emergency shutoffs
- Chemical hazard response
 - Eyewash facilities
 - Emergency shower

LEARNING TASKS

CONTENT

4. Describe site specific safety policies

- Evacuation plan
 - Marshalling/mustering areas
 - Emergency exits
 - Emergency contact/phone numbers
- Standards, acts and regulations
- Hazard assessment
 - Safety policy
 - Site conditions
- Types of meetings
 - Tool box
 - Safety committee

Achievement Criteria (Workplace)

Performance	The learner is aware of WHMIS and that it is a required certification.
Conditions	To be assessed in the workplace.
Criteria	Tasks must be performed within specifications and time frames acceptable to industry.

Line (GAC): **A PERFORM SAFETY RELATED FUNCTIONS**
Competency: **A2 Use Personal Protective Equipment (PPE) and Safety Equipment**

Objectives

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

- Use Personal Protective Equipment (PPE) and safety equipment.
- Maintain Personal Protective Equipment (PPE) and safety equipment.

LEARNING TASKS

1. Describe Personal Protective Equipment (PPE)

CONTENT

- Safety footwear
- Eye protection
- Ear protection
- Head protection
- Respiratory protection
 - Self-contained Breathing Apparatus (SCBA)/Positive pressure
 - Negative pressure
 - Half mask
 - Full face
- Clothing
 - High visibility workwear
 - Sun protection factor (SPF)
 - Gloves
 - Task specific
 - Fall protection
 - Fire retardant/resistant
- Types
 - Fire extinguishers
 - First-aid
 - Ventilation
 - Screens
- Procedures
- Storage
- Limitations
- Standards, acts and regulations
- Purpose
- Selection
- Operating procedures
- Training requirements
 - WorkSafeBC requirements
 - Job site requirements
- Inspection
- Maintenance
- Storage

2. Describe safety equipment

3. Use Personal Protective Equipment (PPE)

Line (GAC): **A PERFORM SAFETY RELATED FUNCTIONS**
Competency: **A3 Perform Lock-Out Procedures**

Objectives

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

- Identify and use lock-out procedures.

LEARNING TASKS

CONTENT

- | | |
|----------------------------|--|
| 1. Identify energy sources | <ul style="list-style-type: none"> • Electricity • Pressure • Kinetic |
| 2. Describe lock-out | <ul style="list-style-type: none"> • Understanding of system operation • Components requiring lock-out • Situations where lock-out is required • Lock-out equipment <ul style="list-style-type: none"> ○ Locks ○ Tags <ul style="list-style-type: none"> – Identification requirements ○ Chains ○ Support blocks ○ Blind flanges ○ Spades ○ Spectacle blinds |
| 3. Use lock-out procedures | <ul style="list-style-type: none"> • Procedures • Zero energy state <ul style="list-style-type: none"> ○ Disconnect ○ Depressurize ○ Isolate • Lock-out • Test |

Achievement Criteria

- | | |
|-------------|--|
| Performance | The learner will be able to perform electrical lock-out with verification. |
| Conditions | To be assessed during technical training.
The learner will be given: <ul style="list-style-type: none"> • Lock-out equipment • Isolation devices • Multi-meter • Lock and key • Tag • PPE |
| Criteria | The learner will be evaluated on: <ul style="list-style-type: none"> • Safety • Completion and verification of electrical lock-out procedures |

Line (GAC): **A PERFORM SAFETY RELATED FUNCTIONS**
Competency: **A4 Practice Fire Prevention**

Objectives

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

- Identify classes of fires.
- Select fire extinguishers for class of fire and relevant condition.

LEARNING TASKS

CONTENT

- | | |
|---|---|
| 1. Describe the conditions necessary to support a fire | <ul style="list-style-type: none"> • Air • Fuel • Heat |
| 2. Describe the classes of fires according to the materials being burned | <ul style="list-style-type: none"> • Class A • Class B • Class C • Class D • Symbols and colours |
| 3. Apply preventative fire safety precautions | <ul style="list-style-type: none"> • Hot work permit (site specific) • Handling and storage of flammable materials • Symbols • Fuels <ul style="list-style-type: none"> ○ Hydrocarbons <ul style="list-style-type: none"> – Diesel – Gasoline – Propane – Natural Gas ○ Wood waste ○ Chemical • Ventilation, including purging • Lubricants • Oily rags • Combustible metals • Aerosols • Fire extinguisher <ul style="list-style-type: none"> ○ Expiry date ○ Fill level |
| 4. Describe the considerations and steps to be taken prior to fighting a fire | <ul style="list-style-type: none"> • Warning others and fire department • Evacuation of others • Fire contained and not spreading • Personal method of egress |

LEARNING TASKS

CONTENT

- | | |
|---|---|
| 5. Describe the procedure for using a fire extinguisher | <ul style="list-style-type: none">• Training
• Extinguisher selection• P.A.S.S.<ul style="list-style-type: none">○ Pull○ Aim○ Squeeze○ Sweep |
|---|---|

Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B1 Use Common Tools and Equipment

Objectives

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

- Use hand, portable and stationary power tools.
- Describe measuring and leveling equipment.
- Inspect and maintain tools and equipment.

LEARNING TASKS

1. Describe hand tools

CONTENT

- Wrenches
- Pliers
- Screwdrivers
- Cutting tools
- Measuring and marking tools
- Bracing and securing tools
- Hammering tools
- Leveling tools
 - Spirit level (standard)
 - Builders level (transit)
 - Laser levels
 - Plumb bob
- Chiseling tools
- Squaring tools
- Threading tools
- Flaring and swaging tools
- Compression benders
- Types
 - Electric
 - Pneumatic
 - Hydraulic
- Cutting tools
- Grinding and abrasive tools
- Threading tools
- Drilling, boring and coring tools
- Hydraulic benders
- Grooving tools
- Specialty tools
 - Magnetic drill press
 - Fusion tools
 - Pressing tool (Propress™)

2. Describe portable power tools

LEARNING TASKS

CONTENT

3. Describe stationary power tools

- Extruded T (T-Drill™)
- Bevellers
- Accessories
- Cutting tools
- Grinding and abrasive tools
- Threading tools
- Hydraulic benders
- Drill press
- Grooving tools
- Specialty tools
 - Boring press
 - Hydraulic press

4. Describe pressure measuring tools

- Accessories
- Manometers
 - Types
 - Filling
 - Fluids
- Mechanical gauges
 - Analog
 - Digital
 - Standard
 - Compound

5. Use hand tools and equipment

- Types
- Parts
- Applications
- Procedures
- Safety
- Adjustment
- Inspection
- Maintenance
- Storage

6. Describe leveling equipment to establish elevations

- Grade and elevation calculations
- Procedures
- Inspection
- Adjustment
- Maintenance
 - Manufacturers' specifications
- Storage

Line (GAC):	B	USE TOOLS AND EQUIPMENT
Competency:	B2	Use Access Equipment

Objectives

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

- Select and use ladders and elevated platforms.

LEARNING TASKS

CONTENT

1. Describe ladders and elevated platforms
 - Types
 - Ladders
 - Platforms
 - Lifts
 - Aerial Work Platform (AWP)
 - Applications
 - Safety
 - Fall arrest equipment
 - Fall restraint equipment
 - Hazard recognition
 - Standards, acts and regulations
 - Site certification requirements
 - Equipment certifications
 - Employer responsibilities
2. Use ladders and elevated platforms
 - Selection
 - Operating procedures
 - Limitations
 - Securing
 - Inspection
 - Maintenance
 - Storage

Line (GAC): **B USE TOOLS AND EQUIPMENT**
Competency: **B3 Use Rigging, Hoisting, Lifting and Positioning Equipment**

Objectives

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

- Use hoisting, lifting and rigging equipment.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| 1. Describe lifting and hoisting | <ul style="list-style-type: none"> • Principles <ul style="list-style-type: none"> ○ Mechanical advantage ○ Balance points ○ Safety ○ Estimation of weights ○ Equipment capacities ○ Equipment selection ○ Lifting location ○ Operating procedures ○ Communication/hand signals ○ Securing of loads • Certification requirements • Lift plan |
| 2. Describe lifting and hoisting equipment | <ul style="list-style-type: none"> • Chain falls • Come-alongs • Cranes • Loaders • Tirsors™ • Tuggers • Inspection • Maintenance |
| 3. Describe rigging equipment | <ul style="list-style-type: none"> • Chains • Shackles • Slings/chokes • Snatch blocks • Softeners • Spreader bars • Equalizers • Tag lines • Turnbuckles • Storage • Inspection • Disposal |

LEARNING TASKS

CONTENT

4. Describe lifting and hoisting communication

- Maintenance
- Hand signals
- Audible signals
- Communication with the operator
- Communication with others

5. Select slings

- Sling characteristics
- Load
 - Load factor labels
 - Material type
 - Sling lengths
 - Sling angles

6. Describe knots, bends and hitches

- Types
 - Bowline
 - Cat's paw
 - Carrick Bend
 - Clove hitch
 - Half hitch
 - Reef knot
 - Sheet bend

7. Tie knots and hitches

- Purposes
- Limitations
- Bowline
- Clove hitch
- Half hitch

8. Use hoisting, lifting and rigging equipment

- Safety
- Working load limit (WLL)
- Lift plan
- Communication
 - Hand signals
 - Audible signals
- Inspection
- Maintenance
- Storage
- Disposal

Achievement Criteria

Performance The learner will be able to:

- Perform a basic lift.

Conditions To be assessed during technical training.

	The learner will be given:
	<ul style="list-style-type: none"> • Tools and equipment • Specifications
Criteria	<p>The learner will be evaluated on:</p> <ul style="list-style-type: none"> • Following all site safety rules • Lift plan (verbal) • Communication with operator and others • Visual check of lifting equipment • Checking equipment capacity • Attaching the correct rigging configuration • Attaching load correctly to the lifting hook • Centering lifting hook above load before lifting • Hoisting load correctly • Lowering load correctly • Returning rigging to designated storage place • Using all equipment in a safe manner

Line (GAC):	B	USE TOOLS AND EQUIPMENT
Competency:	B4	Rig Loads for Cranes

Objectives

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

- Describe crane safety.
- Describe crane types.

LEARNING TASKS

1. Describe crane safety

CONTENT

- ## 2. Describe crane types

- Lift sequencing
- Secure area
- Knowledge of crane components
- Crane procedures
 - Load charts
 - Outriggers
 - Walk-around inspection
- Hazards
- Communication
 - Hand signals
 - Audible signals
- Boom trucks
- Carry deck
- Conventional
- Crawler
- Gantry/Overhead
- Jib
- Rubber tire
- Tower

Line (GAC):	B	USE TOOLS AND EQUIPMENT
Competency:	B5	Use Welding Equipment

Objectives

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

- Identify common welding processes, types, positions, joints and symbols.
- Use welding equipment.

LEARNING TASKS

1. Describe metallurgy
2. Describe safety requirements and precautions for arc welding
3. Identify welding processes, types, positions, joints and symbols

CONTENT

- Ductility
- Elasticity
- Malleability
- Tensile strength
- PPE
 - Eye protection
 - Welding helmets
 - Hearing protection
 - Radiation protection
 - Respiratory protection
- Electric shock
- Fire and explosion prevention
- Ventilation
- Processes
 - SMAW
 - GTAW
 - GMAW
- Types
 - Bead
 - Tack
 - Fillet
 - Groove
- Positions
 - Flat (1)
 - Horizontal (2)
 - Vertical (3)
 - Overhead (4)
 - 6G
- Welding joints
 - Butt
 - Lap
 - Tee
 - Corner

LEARNING TASKS

CONTENT

- | | |
|---|---|
| | <ul style="list-style-type: none"> ○ Edge • Welding symbols <ul style="list-style-type: none"> ○ Arrows ○ Weld-all-around ○ Field ○ Contour and finish ○ Location |
| 4. Describe the arc welding process and equipment | <ul style="list-style-type: none"> • Codes, regulations and standards • Arc welding circuit • AC and DC power sources • Electrode holders • Ground clamps • Welding cables • Grinders • Electrodes • Maintenance • Distortion control <ul style="list-style-type: none"> ○ Pre-heat ○ Post-heat • Storage |
| 5. Use arc welding equipment | <ul style="list-style-type: none"> • Set-up • Grinders • Amperage adjustment • Polarity selection • Weld faults • Shut down |

Achievement Criteria

- | | |
|-------------|---|
| Performance | The learner will be able to tack two pieces of plate together. |
| Conditions | The learner will be given: <ul style="list-style-type: none"> • PPE • Welding equipment • Materials • Tools |
| Criteria | The learner will be evaluated on: <ul style="list-style-type: none"> • Safety • Set-up • Technique • Appearance |

Line (GAC): **B USE TOOLS AND EQUIPMENT**
Competency: **B6 Use Soldering and Brazing Equipment**

Objectives

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

- Describe air-fuel and oxy-fuel equipment to braze and solder.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| 1. Describe the soldering and brazing process | <ul style="list-style-type: none"> • Principles • Applications • Filler alloys • Equipment • Safety requirements <ul style="list-style-type: none"> ○ Fire protection equipment ○ Ventilation |
| 2. Describe the procedures for soldering and brazing | <ul style="list-style-type: none"> • Joint preparation and design • Flux selection • Flame for brazing • Purging |
| 3. Describe air-fuel and oxy-fuel equipment | <ul style="list-style-type: none"> • Cylinders • Regulators • Gauges • Spark arrestors • Torches • Inspection • Maintenance • Storage |
| 4. Use air-fuel and oxy-fuel equipment to braze and solder | <ul style="list-style-type: none"> • Safety • Flammable material recognition • Applications • Procedures <ul style="list-style-type: none"> ○ Setup ○ Take down ○ Tip selection ○ Alloy selection ○ Flux selection ○ Flux removal |

Achievement Criteria

Performance The learner will be able to braze and solder.

Conditions The learner will be given:

- Materials
- Tools and equipment
- Specifications/drawings

Criteria The learner will be evaluated on:

- Set-up/shut down
- Technique
- Accuracy
- Penetration
- Appearance
- Pressure test
- Bend test

Line (GAC): **B USE TOOLS AND EQUIPMENT**
Competency: **B7 Use Oxy-Fuel Equipment**

Objectives

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

- Use Oxy-Fuel cutting equipment.

LEARNING TASKS

1. Describe Oxy-Fuel cutting equipment and applications
2. Describe fuel gas precautions and procedures
3. Use Oxy-Fuel cutting equipment

CONTENT

- Safety
- Regulators
- Flashback arrestors
- Hoses
- Torches
- Torch attachments
- Tips
- Inspection
- Maintenance
- Storage
- Characteristics
- Delivery systems
- Cylinder handling and storage
- Hazards
- Fire prevention equipment
- Hot work permit
- Set-up procedures
 - Leak test
- Safe operating practices
 - PPE
 - Flashback prevention
 - Ventilation
- Flame temperatures
- Techniques
- Delivery system removal and storage

Achievement Criteria

Performance The learner will be able to cut plate with Oxy-Fuel equipment
Conditions To be assessed during technical training.
The learner will be given:

- Materials
- Tools and equipment
- Specifications/drawings

Criteria The learner will be evaluated on:

- Safe work practices
- Set-up/shut down
- Technique
- Accuracy
- Appearance

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**
Competency: **C1 Use Mathematics and Science**

Objectives

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

- Apply formulas.
- Calculate piping measurements and offsets.
- Perform conversions and heat load calculations.

LEARNING TASKS

1. Use formulas to calculate area
2. Use formulas to calculate volumes
3. Use formulas to calculate capacity
4. Transpose formulas
5. Perform conversions
6. Calculate piping measurements
7. Use the Pythagorean theorem of right angles

CONTENT

- Cross-sectional area of pipe
- Cylinders
- Rectangular tanks
- Imperial gallons
- US gallons
- Litres
- Processes
- Length
- Volume
- Capacity
- Area
- Mass
- Weight
- Heat energy
 - Kilowatts
 - BTUh
 - Gigajoules
- Temperature
 - Fahrenheit
 - Centigrade
 - Kelvin
 - Rankine
- Pressure
 - Absolute
 - Gauge
- Fitting allowance
- Grades
- Elevations
- Hypotenuse
- Side opposite

LEARNING TASKS	CONTENT
8. Calculate offsets using the applicable trigonometric function	<ul style="list-style-type: none"> • Side adjacent • Calculator methods • Table-based methods
9. Calculate the required measurements for a parallel piping offset	<ul style="list-style-type: none"> • Unequal spread • Equal spread • Rolling
10. Describe the properties of matter	<ul style="list-style-type: none"> • Substances <ul style="list-style-type: none"> ○ Elements ○ Compounds ○ Mixtures • Adhesion • Cohesion • Conductivity • Density • Heat properties
11. Use Pascal's theory of pressure and force	<ul style="list-style-type: none"> • Pressure <ul style="list-style-type: none"> ○ Pounds per square inch (psig) ○ Pascal (Pa) ○ KiloPascal (kPa) ○ Inches of water column (in WC) ○ Inches of mercury (in Hg) ○ Ounces per square inch (OSI) ○ Bar
12. Use Archimedes' principles of displacement and floatation	<ul style="list-style-type: none"> • Total Force <ul style="list-style-type: none"> ○ Pounds ○ Newtons
13. Define mechanical advantage as it relates to fluid power	<ul style="list-style-type: none"> • Specific weight/gravity • Buoyancy
14. Describe factors that affect fluid flow in a piping system	<ul style="list-style-type: none"> • Hydraulics • Hydrostatics • Viscosity • Laminar flow • Turbulent flow • Velocity • Piping material • Fittings
15. Describe factors that affect gas volumes and pressures	<ul style="list-style-type: none"> • Boyle's Law • Charles Law

LEARNING TASKS

CONTENT

	<ul style="list-style-type: none"> • Combined Gas Law (Gay-Lussac's Law) • Bernoulli's principle
16. Perform gas law calculations	<ul style="list-style-type: none"> • Boyle's Law • Charles Law • Combined Gas Law (Gay-Lussac's Law)
	<ul style="list-style-type: none"> • Temperature <ul style="list-style-type: none"> ○ Kelvin ○ Rankin • Pressures <ul style="list-style-type: none"> ○ Absolute ○ Gauge
17. Calculate the expansion and contraction of various piping materials due to heating and cooling	<ul style="list-style-type: none"> • Ferrous • Non-ferrous • Thermoplastic
18. Define methods of heat transfer	<ul style="list-style-type: none"> • Conduction • Convection • Radiation
19. Perform heat load calculations	<ul style="list-style-type: none"> • Sensible • Latent • Specific heat
20. Describe characteristics of hydrocarbon gases	<ul style="list-style-type: none"> • Chemistry • Heat value • Specific gravity • Flow characteristics • Ignition and flame temperature • Flame speeds • Odourant • Limits of flammability

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**
Competency: **C2 Interpret Drawings and Specifications**

Objectives

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

- Interpret information found on a set of drawings.
- Use drafting symbols, lettering and line conventions.
- Convert between orthographic and isometric projections.
- Create an isometric drawing of a basic orthographic piping arrangement.

LEARNING TASKS

CONTENT

- | | |
|---|---|
| 1. Describe drafting tools and materials | <ul style="list-style-type: none"> • Tools <ul style="list-style-type: none"> ○ Compasses ○ Dividers ○ Drawing boards ○ French curves ○ Protractors ○ Scale rulers ○ Spline ○ Triangles ○ T-squares • Erasers and shields • Pencils • Templates |
| 2. Use scale rulers | <ul style="list-style-type: none"> • Dimensions <ul style="list-style-type: none"> ○ Imperial ○ Metric |
| 3. Describe piping symbols | <ul style="list-style-type: none"> • Fittings <ul style="list-style-type: none"> ○ Elbows ○ Flanges ○ Tees ○ Valves ○ Wyes ○ Anchors ○ Brackets |
| 4. Describe characteristics of drafting lines and lettering | <ul style="list-style-type: none"> • Lines <ul style="list-style-type: none"> ○ Border ○ Center ○ Dimension ○ Extension ○ Hidden ○ Object |

LEARNING TASKS

CONTENT

5. Describe the types of drawings

- Phantom
- Lettering
 - Hierarchy
- Architectural drawings
- Structural drawings
- Mechanical drawings
- Isometric drawings
- Shop drawings
- Specification sheets
- Spool sheets
- General arrangement (GA)
- P&ID
- Parts
 - Details
 - Title block
 - Schedules
 - Legends

6. Describe drawing projections

- Views
 - Elevation
 - Section
 - Plan
 - Isometric
 - Orthographic
 - Oblique

7. Use drawing projections

- Isometric
- Orthographic

8. Create an isometric drawing of a basic piping arrangement

- Lettering
- Line type
- Relevant information
 - Detail required
- Dimensioning

Achievement Criteria

Performance The learner will be able to create an isometric drawing of a basic piping arrangement.

Conditions To be assessed during technical training.
The learner will be given:

- Drafting supplies
- Orthographic drawing

Criteria The learner will be evaluated on:

- Accuracy
- Neatness

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**
Competency: **C3 Use Codes, Regulations and Standards**

Objectives

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

- Identify codes, standards and organizations.

LEARNING TASKS

1. Identify codes, standards and organizations

CONTENT

- American National Standards Institute (ANSI)
- American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- American Society of Testing and Materials (ASTM)
- American Standard of Mechanical Engineers (ASME)
- American Water Works Association (AWWA)
- Authority having jurisdiction (AHJ)
- Canadian Commission on Building and Fire Codes (CCBFC)
- Canadian Gas Association (CGA)
- Canadian General Standards Board (CGSB)
- Canadian Standards Association (CSA)
- Leadership in Energy and Environmental Design (LEED)
- National Building Code of Canada (NBC)
- National Fire Protection Association (NFPA)
- National Standard of Canada (CAN)
 - Permits
- Safety Standards Act
- Technical Safety BC (formerly BC Safety Authority [BCSA])
- Underwriters' Laboratories of Canada (ULC)

Line (GAC): **D PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS**

Competency: **D1 Install Valves**

Objectives

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

- Describe the installation of valves.

LEARNING TASKS

1. Describe valve types

CONTENT

- Codes, standards and regulations
- Manufacturers' specifications
- Seating design
- Types
 - Butterfly
 - Check
 - Plug
 - Ball
 - Gate
 - Globe
- Needle
 - Pressure Reducing (PRV)
 - Mechanical Safety Devices
- Pressure Relief
- Temperature and Pressure Relief
- Pop Safety Valve (PSV)
- Safety Relief Valve (SRV)
- Relief Valve (RV)
- Vacuum relief
- Rupture disks
- Ratings
- Application
- Materials
- Limitations
 - Temperature
 - Pressure
- Manufacturers' specifications
- Selection
 - Applications
 - Pressure limitations
- Orientation
- Relative placement

2. Describe the installation of valves

Line (GAC): D PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS

Competency: D2 Install Fittings

Objectives

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

- Select fittings.
- Install fittings.

LEARNING TASKS

1. Describe fittings
2. Describe fitting connection methods
3. Install fittings

CONTENT

- Codes, standards and regulations
- Manufacturers' specifications
- Types
- Applications
- Limitations
- Threaded
- Compression
- Flared
- Flanged
- Crimped
- Soldered/brazed
- Mechanical
- Solvent welded
- Welded
- Polyfusion
- Sealants
 - Thread compound
 - Teflon tape
 - Gaskets
 - O-rings
- Codes and regulations
- Manufacturers' specifications
- Tools and equipment
- Assembly

Line (GAC): D PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS

Competency: D3 Penetrate Structures

Objectives

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

- Describe structure penetration.

LEARNING TASKS

1. Describe factors affecting penetrations in structures

CONTENT

- Describe factors affecting penetrations in structures
 - Codes and regulations
 - Manufacturers' specifications
 - Structural integrity
 - Fire separation
 - Interference with other building components and systems
 - Hidden components behind the surface
 - Electrical wiring
 - Reinforcing bars
 - Piping
 - Post tension cables
 - Sleeve installation
 - Fabrication
 - Timing (canning)
 - Location
 - Sizing
 - Fastening
 - Sealing
 - Fire stopping
 - Water-proofing
 - Isolating groundwater
 - Protecting pipe
 - Preventing oxidation
 - Protection during concrete pour
- Describe methods of structure penetration
 - Codes and regulations
 - Manufacturers' specifications
 - Fire stopping
 - Doughnut type
 - Gasket type
 - Caulking
 - Mineral wool
 - Fire rating requirements
 - Required gaps
 - Fastening or wrapping fire stopping to pipes
 - Sealing of vertical and horizontal penetrations
 - Selection of sealants according to specifications

Line (GAC):	D	PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS
Competency:	D4	Layout and Install Piping and Tubing

Objectives

To be competent in this area, the individual must be able to layout and install piping and tubing for:

- Carbon steel.
- Stainless steel.
- Copper.
- Plastic.

LEARNING TASKS

1. Describe piping and tubing

CONTENT

- Types
 - Carbon Steel
 - Stainless Steel
 - Copper
 - Plastic
- Grades
- Schedules/wall thickness
- Effects of heat and pressure
- Applications
- Codes and regulations
- Manufacturer's specifications

2. Describe methods of piping and tubing support

- Types
 - Hangers
 - Supports
 - Seismic
 - Anchors
 - Guides
 - Slide plates
- Compatibility with piping
- Size
- Spacing
- Fasteners
- Insulation thickness
- Attachment methods

3. Describe methods of protecting piping and tubing

- Frost protection
 - Heat tape
 - Frost boxes
- Ultraviolet protection
- Corrosion protection
 - Coatings

LEARNING TASKS

CONTENT

- | | |
|---|--|
| | <ul style="list-style-type: none"> ○ Tape • Physical damage <ul style="list-style-type: none"> ○ Protective plates ○ Sleeving • Protective measures <ul style="list-style-type: none"> ○ Metal stud grommets ○ End caps ○ Insulating ○ Dielectric protection • Potential defects <ul style="list-style-type: none"> ○ Pin holes ○ Cracked fittings ○ Bent ends ○ Damaged pipe and coatings • Environmental effects • Inspection techniques <ul style="list-style-type: none"> ○ Visual • Interpretation of markings • Checking against specifications • Types • Sizes • Uses • Hazards • Safety • Measuring procedures • Selection for application • Calculations • Cutting • Bending • Layout • Joining methods • Common fitting angles • Tools and equipment • Selection <ul style="list-style-type: none"> ○ Application • Manufacturers' specifications • Calculations • Tools and equipment • Hangers • Layout |
| 4. Describe the inspection of piping and tubing before installation | |
| 5. Describe the installation of piping and tubing | |
| 6. Install piping and tubing | |

Achievement Criteria

Performance	<p>The learner will be able to prepare, join and install piping:</p> <ul style="list-style-type: none"> • Carbon Steel • Stainless Steel • Copper • Plastic
Conditions	<p>To be assessed during technical training.</p> <p>The learner will be given:</p> <ul style="list-style-type: none"> • Drawings and specifications • Tools and equipment • Materials
Criteria	<p>The learner will be evaluated on:</p> <ul style="list-style-type: none"> • Safe work practices • Accuracy • Neatness

Line (GAC):	D	PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS
Competency:	D5	Perform Maintenance, Troubleshooting, Repairs and Testing on Valves

Objectives

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

- Describe servicing of valves.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| 1. Describe valve maintenance procedures | <ul style="list-style-type: none"> • Schedules • Lubrication • Cleaning • Inspection <ul style="list-style-type: none"> ○ Leaking packing ○ Seized/damaged components |
| 2. Describe valve troubleshooting procedures | <ul style="list-style-type: none"> • Functional checks • Visual inspections |
| 3. Describe valve repair procedures | <ul style="list-style-type: none"> • Replacement • Refurbish • Realign • Repack • Documentation <ul style="list-style-type: none"> ○ QA/QC verification ○ Repair signoff |
| 4. Describe valve testing procedures | <ul style="list-style-type: none"> • Hydrostatic |

Line (GAC):	E	PERFORM FABRICATION
Competency:	E1	Fabricate Brackets, Supports, Hangers, Guides and Anchors

Objectives

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

- Describe the installation of supports and hangers.
- Fabricate brackets, supports, hangers, guides and anchors.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Describe the forces that affect a piping system 2. Describe types of hangers, supports, guides and fasteners 3. Describe the installation of supports and anchors | <ul style="list-style-type: none"> • Weight of the system including components • Change in direction of flow • Friction loss and inertia • Thermal expansion and contraction • Electrolysis • Hangers <ul style="list-style-type: none"> ○ Clevis ○ Ring ○ Roller support ○ Continuous support • Support <ul style="list-style-type: none"> ○ Saddles and stanchions ○ U-bolt ○ Dummy legs ○ Trunnion ○ Thrust blocks ○ Uni-strut™ • Pipe clamps and guides • Fasteners and attachments <ul style="list-style-type: none"> ○ Hanger bolts ○ Beam clamps ○ Concrete fasteners ○ Metal fasteners ○ Anchors • Selection <ul style="list-style-type: none"> ○ Types ○ Application ○ Spacing • Fabrication <ul style="list-style-type: none"> ○ Brackets ○ Sway bracing ○ Anchors ○ Seismic |
|--|--|

LEARNING TASKS

CONTENT

4. Fabricate brackets, supports, hangers, guides and anchors

- Procedures
 - Epoxy
 - Expansion shields
 - Drop insert
 - Toggle bolts
- Drawings
- Codes
- Joining methods
- Tools and equipment
- Assembly
- Fit
- Position
- Post-weld procedures
- QA/QC

Achievement Criteria

- | | |
|-------------|---|
| Performance | The learner will be able to use welding and oxy-fuel equipment to fabricate a basic pipe support. |
| Conditions | To be assessed during technical training.
The learner will be given: <ul style="list-style-type: none">• Drawing and specifications• Oxy-fuel equipment• Welding equipment• Materials• PPE |
| Criteria | The learner will be evaluated on: <ul style="list-style-type: none">• Accuracy• Neatness• Design |

Line (GAC): **F USE COMMUNICATION TECHNIQUES**
Competency: **F1 Use Communication Techniques**

Objectives

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

- Describe effective communication practices.

LEARNING TASKS

1. Describe effective communication practices

CONTENT

- Verbal
- Non-verbal
 - Body language
 - Signals
- Active listening
 - Hearing
 - Interpreting
 - Reflecting
 - Responding
 - Paraphrasing
- Learning styles
 - See
 - Hear
 - Try
- Workplace responsibilities
 - Personal
 - Attitude
 - Harassment
 - Discrimination
 - Supervisor
 - Human Resources (HR)

Level 2

Steamfitter/Pipefitter

Line (GAC): **B USE TOOLS AND EQUIPMENT**
Competency: **B3 Use Rigging, Hoisting, Lifting and Positioning Equipment**

Objectives

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

- Use hoisting, lifting and rigging equipment.

LEARNING TASKS

1. Perform calculations

2. Use hoisting, lifting and rigging equipment

CONTENT

- Load weight
- Load dimensions
- Centre of gravity
- Load and rigging requirements

- Safety
- Working load limit (WLL)
- Lift plan
- Communication
 - Hand signals
 - Audible signals
- Securing of loads
 - Pre-lift
 - Post-lift
- Inspection
- Maintenance
- Storage
- Disposal

Achievement Criteria

- | | |
|-------------|--|
| Performance | The learner will be able to: <ul style="list-style-type: none"> • Perform multi-point hoisted lifts. |
| Conditions | To be assessed during technical training.
The learner will be given: <ul style="list-style-type: none"> • Tools and equipment • Specifications |
| Criteria | The learner will be evaluated on: <ul style="list-style-type: none"> • Lift plan • Communication with operator and others • Visual check of lifting equipment • Checking equipment capacity • Attaching the correct rigging configuration • Attaching load correctly to the lifting hook • Centering lifting hook above load before lifting |

- Hoisting load correctly
- Transferring load correctly
- Lowering load correctly
- Securing load prior to rigging removal
- Returning rigging to designated storage place
- Using all equipment in a safe manner
- Following all site safety rules

Line (GAC): **B USE TOOLS AND EQUIPMENT**
Competency: **B5 Use Welding Equipment**

Objectives

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

- Describe American Standard of Mechanical Engineers (ASME)
- procedures.
- Use arc welding equipment.

LEARNING TASKS

CONTENT

- | | |
|---|--|
| 1. Describe American Standard of Mechanical Engineers (ASME) procedures | <ul style="list-style-type: none"> • Codes, regulations and standards |
| 2. Describe properties of pipe and piping materials | <ul style="list-style-type: none"> • Metals <ul style="list-style-type: none"> ○ Carbon steel ○ Copper ○ Copper-nickel ○ Brass ○ Aluminum ○ Stainless • Plastic |
| 3. Use arc welding equipment | <ul style="list-style-type: none"> • Set-up • Amperage adjustment • Polarity selection • Weld faults • Distortion control • Shut down • Maintenance |

Achievement Criteria

Performance The learner will be able to fit and tack two pieces of pipe together.

Conditions The learner will be given:

- PPE
- Welding equipment
- Materials
- Tools

Criteria The learner will be evaluated on:

- Safety
- Set-up
- Technique
- Appearance

Line (GAC): **B** **USE TOOLS AND EQUIPMENT**
Competency: **B8** **Use Technical Instruments and Testers**

Objectives

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

- Describe pressure measuring tools.
- Interpret pressure readings.
- Use U-tube manometers.
- Use electrical testing meters to test voltage, amperage, resistance, and continuity.

LEARNING TASKS

CONTENT

- | | |
|---|--|
| 1. Describe pressure measuring tools | <ul style="list-style-type: none"> • Manometers <ul style="list-style-type: none"> ○ Types <ul style="list-style-type: none"> – Digital – Slack tubed – Incline ○ Filing ○ Fluids ○ Calibration ○ Differential • Mechanical gauges <ul style="list-style-type: none"> ○ Bourdon tube ○ Compound <ul style="list-style-type: none"> – Magnehelic gauge ○ Differential gauge |
| 2. Use manometers and mechanical gauges | <ul style="list-style-type: none"> • Gas pressures <ul style="list-style-type: none"> ○ Standing line pressures ○ Operating line pressures ○ Gauge pressures ○ Absolute pressures ○ Conversion between different pressures • Diagnostics <ul style="list-style-type: none"> ○ Pressure tests ○ Leak detection |
| 3. Interpret pressure readings | <ul style="list-style-type: none"> • Code B149.1 • Manufacturers' specifications • Diagnostics <ul style="list-style-type: none"> ○ Pressure tests ○ Leak detection • Tightness of closure |
| 4. Describe temperature measuring instruments | <ul style="list-style-type: none"> • Thermometer |

LEARNING TASKS

CONTENT

5. Use temperature measuring instruments

6. Describe electrical testing meters

7. Use electrical test meters

8. Use combustible gas indicator (CGI)

- Pyrometer
- Thermocouple
- Thermistor
- Scales
- Calibration
- Check readings
- Applications
- Types
 - Multi-meter
 - Ammeter
 - Ohm-meter
 - Volt-meter
 - Micro-ammeter
 - Milli-ammeter
 - Megaohm-meter
- Check voltage
- Check current
- Check resistance
- Check for continuity
- Types
 - Electronic
 - Laser
 - Draeger
 - Flame ionization
- Applications

Line (GAC):	C	PERFORM ROUTINE TRADE ACTIVITIES
Competency:	C1	Use Mathematics and Science

Objectives

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

- Describe methods of combustion air supply.
- Calculate air requirements and products of combustion.
- Describe draft.
- Describe the building as a system.

LEARNING TASKS

1. Describe the chemistry of combustion
2. Calculate air requirements and products of combustion
3. Describe draft

CONTENT

- Requirements for combustion
- Products of combustion
- Stoichiometric combustion
- Complete combustion
- Incomplete combustion
- Combustion yield formula
- Air requirements
 - Combustion
 - Primary
 - Secondary
 - Excess
 - Dilution
 - Total
- Products of combustion
 - CO
 - CHO
 - CO²
 - H²O
 - O²
 - N²
- Natural draft
 - Buoyancy
 - Temperature
 - Height
- Terms
 - Stack effect
 - Stack draft
 - Natural draft
 - Chimney effect
- Mechanical draft
 - Induced

LEARNING TASKS

CONTENT

4. Describe the building as a system

- Forced
- Balance
- Negative air pressure
- Exhaust equipment
- Air supply equipment
- Building envelope
- Building ventilation
 - Air exchange equipment
- Regional location
- Type of building
- Code requirements
 - B149.1
 - Building Code

Line (GAC): **C** **PERFORM ROUTINE TRADE ACTIVITIES**
Competency: **C2** **Interpret Drawings and Specifications**

Objectives

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

- Interpret drawings.

LEARNING TASKS

1. Interpret drawings

CONTENT

- Parts
 - Plot plan
 - Foundation plan
 - Floor plan
 - Elevation
 - Sections
 - Revisions
- Information contained
 - Building dimensions
 - Construction type
 - Room layout
 - Equipment locations
 - Finish details
- Symbols
- Conventions
- Spool sheets
 - Bill of material
 - Orientation
 - QA/QC
- Architectural drawings
- Structural drawings
- Mechanical drawings
- Isometric drawings
- Shop drawings
- Specification sheets
- Spool sheets
- General arrangement (GA)
- P&ID

2. Describe the types of drawings

Achievement Criteria

Performance	The learner will be able to create a spool sheet.
Conditions	To be assessed during technical training. The learner will be given: <ul style="list-style-type: none">• Drafting supplies
Criteria	The learner will be evaluated on: <ul style="list-style-type: none">• Accuracy• Neatness• Inclusion of all components

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**
Competency: **C3 Use Codes, Regulations and Standards**

Objectives

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

- Identify codes, standards and organizations.
- Interpret codes and standards for the B149.1 Gas Code series.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| 1. Describe the application of codes and standards | <ul style="list-style-type: none"> • Design • Planning • Installation • Maintenance • Decommissioning |
| 2. Describe the B149 Gas Code series | <ul style="list-style-type: none"> • B149.1, B149.2, B149.3 • Layout • Sections • Contents • Index • Annexes • Tables • Definitions • Scope • Revisions |
| 3. Interpret Sections of the B149.1 Gas Code | <ul style="list-style-type: none"> • Scope • Reference publications • Definitions • General • Piping and tubing systems, hose, and fittings • Annexes A & B |

Line (GAC):	C	PERFORM ROUTINE TRADE ACTIVITIES
Competency:	C4	Use Manufacturer and Supplier Documentation

Objectives

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

- Describe manufacturer and supplier documentation.
- Source manufacturer documentation.

LEARNING TASKS

CONTENT

1. Describe manufacturer and supplier documentation
 - Types
 - Tool and equipment documentation
 - Material Safety and Data Sheets (MSDS)
 - System component documentation
 - Proprietary product documentation
 - Certification agencies
 - Information
 - Installation instructions and requirements
 - Operation and maintenance manuals
 - Product specifications
 - Warranty information
2. Source manufacturer documentation
 - Manufacturer web-sites
 - Online search engines
 - Archival sources
 - On-site documentation
 - Contact manufacturer
 - Local agencies

Line (GAC):	D	PERFORM LAYOUT AND INSTALLATION OF PIPING AND COMPONENTS
Competency:	D4	Layout and Install Piping and Tubing

Objectives

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

- Describe the layout of specialty piping.
- Describe the installation of specialty piping.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| 1. Describe specialty piping and tubing | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Fibreglass ○ Chrome ○ Molybdenum ○ Titanium ○ Duplex ○ Lined pipe • Effects of heat and pressure • Cross contamination • Applications • Codes and regulations • Manufacturers' specifications |
| 2. Describe pipe support for specialty piping and tubing | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Hangers ○ Supports ○ Seismic ○ Anchors ○ Guides ○ Slide plates • Compatibility with piping • Size • Spacing • Fasteners • Insulation thickness • Attachment methods |
| 3. Describe protection for specialty piping and tubing | <ul style="list-style-type: none"> • Frost protection <ul style="list-style-type: none"> ○ Heat tape ○ Frost boxes • Ultraviolet protection • Corrosion protection <ul style="list-style-type: none"> ○ Coatings ○ Tape |

LEARNING TASKS

CONTENT

4. Describe the inspection of specialty piping and tubing before installation

5. Describe the installation of specialty piping and tubing

- Physical damage
 - Protective plates
 - Sleeving
- Protective measures
 - Metal stud grommets
 - Insulating
 - Dielectric protection
- Potential defects
 - Pin holes
 - Cracked fittings
 - Bent ends
 - Uneven casting
 - Damaged pipe and coatings
- Environmental effects
- Inspection techniques
 - Visual
- Interpretation of markings
- Checking against specifications
- Types
- Sizes
- Hazards
- Safety
 - Resins
 - Fibreglass
 - Acetones
- Selection
 - Application
- Calculations
- Cutting
- Bending
- Joining methods
- Layout

Line (GAC): **E PERFORM FABRICATION**
Competency: **E2 Fabricate Piping System Components**

Objectives

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

- Develop templates for piping system components.
- Use templates to fabricate components.
- Bend pipe using cold bending methods.

LEARNING TASKS

1. Use tools to sketch irregular shapes

2. Describe templates

3. Develop a template

CONTENT

- French curves
- Templates
- Compasses
- Splines
- Terminology
 - Advance
 - Cut-back
 - Offset
 - Ordinates
 - Quartering
 - Parallel line development
 - Radius
 - Set
 - Stretch-out
 - Travel
- Templates
 - Dummy leg
 - Mitres
 - Lateral
 - Reducer
 - Tee
 - True wye
 - Trunnion
- Methods
 - Parallel line
- Piping requirements
 - Specifications
 - Diameter
- Drafting equipment
- Calculations
- Layout
 - Direct pipe layout

LEARNING TASKS

CONTENT

4. Use templates to fabricate components

- Markings
- Tools and equipment
- Calculations
- Layout
- Markings

5. Describe welded pipe fitting

- Methods
 - Squaring
 - Quartering
 - Templates
 - Grinding
 - Beveling
 - Assembly
 - Tacking
 - Fittings
 - Heat treatment
 - QA/QC

6. Describe bolt-ups, gaskets and flanges

- Terminology
- Patterns
- Gaskets
 - Ring type (RTJ)
 - Garlock™
 - Red Rubber
 - Spiral wound
- Flanges
 - Raised face
 - Flat face
 - Types
 - Van stone
 - Slip on
 - Weld neck
 - Socket

7. Describe pipe bending methods

- Torque specifications
 - QA/QC
 - Manufacturers' specifications
- Terminology
- Types
 - Hot bending
 - Cold bending
- Calculations
- Equipment
 - Hot bending

LEARNING TASKS

CONTENT

	<ul style="list-style-type: none"> – Oxy-acetylene – Wooden plugs – Vises – Clamps – Slabs ○ Cold bending <ul style="list-style-type: none"> – Draw benders – Compression benders – Ram benders – Roll benders – Stretch benders • Filler materials <ul style="list-style-type: none"> ○ Sand ○ Salt ○ Rosins ○ Cerrobend ○ Cerrobaze ○ Lead
8. Bend pipe using cold bending methods	<ul style="list-style-type: none"> • Safe work practices • Tools and equipment • Drawings and specifications • Equipment set-up • Tolerances • QA/QC

Achievement Criteria 1

Performance	The learner will be able to cold bend pipe.
Conditions	To be assessed during technical training. The learner will be given: <ul style="list-style-type: none"> • Tools and equipment • Drawings and specifications • Materials
Criteria	The learner will be evaluated on: <ul style="list-style-type: none"> • Fit • Accuracy

Achievement Criteria 2

Performance	The learner will be able to: <ul style="list-style-type: none"> • Develop a template • Fabricate and assemble piping components
Conditions	To be assessed during technical training.

The learner will be given:

- Tools and equipment
- Drawings and specifications
- Materials
- PPE

Criteria

The learner will be evaluated on:

- Safe work practices
- Accuracy
- Neatness

Line (GAC): **G** **INSTALL HEAT TRACING SYSTEMS**
Competency: **G1** **Install Heat Tracing Systems (Liquid)**

Objectives

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

- Describe the installation of liquid-filled tracing systems.

LEARNING TASKS

CONTENT

- | | |
|---|--|
| 1. Describe liquid-filled tracing systems | <ul style="list-style-type: none"> • Safe work practices • Types <ul style="list-style-type: none"> ○ Hot water ○ Glycol • Components • Applications • Operation |
| 2. Describe the installation of liquid-filled tracing systems | <ul style="list-style-type: none"> • Engineered drawings • Codes and regulations • Tools and equipment • Materials • Components • Joining methods • Testing |

Line (GAC):	G	INSTALL HEAT TRACING SYSTEMS
Competency:	G2	Repair and Test Heat Tracing Systems (Liquid)

Objectives

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

- Describe repair procedures for liquid tracing systems.
- Describe testing procedures for liquid tracing systems.

LEARNING TASKS

1. Describe repair procedures for liquid tracing systems
2. Describe testing procedures for liquid tracing systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Medium disposal
 - WHMIS
 - Environmental regulations
- Repair/replace components
- Return to service
- Documentation
- Types
 - Hydrostatic
 - Pneumatic
 - In-service
- Safe work practices
- Leak checks
- Return to service
- Documentation
- Medium disposal
 - WHMIS
 - Environmental regulations

Line (GAC):	H	INSTALL HYDRONIC SYSTEMS
Competency:	H1	Interpret Heating and Cooling Systems

Objectives

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

- Describe the operation of forced air systems.
- Describe the operation of hydronic heating systems.
- Calculate volumetric thermal expansion.

LEARNING TASKS

1. Describe the operation of forced air systems

CONTENT

- Purpose
- Components
- Ducting configurations
 - Supply air
 - Return air
 - Zoning
- Controls
- Balancing
- Codes and regulations
- Purpose
- Volumetric thermal expansion
 - Expansion coefficients
 - Temperature
 - ΔT
 - Volume
- Fluid fundamentals
 - Volumetric coefficient differences
 - Linear and volumetric expansion
 - Viscosity
- Components
 - Valves
 - Mixing
 - Zone
 - Closed loops circulators
 - Gauges and thermometers
 - Heat transfer units
 - Fan coil units
 - Radiators
 - Radiant panels
 - Unit heaters
 - Termination heat pumps

LEARNING TASKS

CONTENT

- In-floor heating
 - Force flow units
 - Perimeter radiation
- Expansion tank
 - Air separator/eliminator
 - Zone headers
 - Air vents
 - Make up water
 - Water treatment
 - Backflow preventor
- Piping system configurations
 - Zoning
 - Supply water
 - Return water
 - Balancing
 - High-temperature
 - Low-temperature
 - Mixing
- Process Flow Diagrams (PFD)
- Controls
- Heat transfer units
- Safety considerations
- Design
 - Drawings and specifications
 - Zoning
 - Point of no pressure change
- Pipe sizing
- Heating generating equipment
 - Boilers
 - High mass
 - Low mass
 - Heat pumps
 - Heat exchangers
 - Solar panels
- Cooling generating equipment
 - Cooling towers
 - Heat pumps
 - Fluid coolers
 - Chillers
 - Dirt elimination devices
- Auxiliary equipment
 - Indirect fired hot water tanks

LEARNING TASKS

CONTENT

3. Calculate volumetric thermal expansion

- Heat exchangers
- Make-up tanks
- Controls
- Fluids
 - Water
 - Chemical
 - Brine solutions
- Additives
 - Treatment chemicals
 - Glycol
- Protection
 - Piping
 - Components
- Expansion coefficients
- Temperature
 - ΔT
- Volume

Line (GAC):	H	INSTALL HYDRONIC SYSTEMS
Competency:	H2	Install Equipment for Hydronic Systems

Objectives

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

- Describe the installation of equipment for hydronic systems.
- Describe hydronic systems.

LEARNING TASKS

1. Describe hydronic systems

CONTENT

- Safe work practices
- System components
 - Circulating pumps
 - Flanges
 - Unions
 - Y-strainer and side stream filters
 - Check valves
 - Isolation valves
 - Pressure and temperature relief valves
 - Pressure reducing valves
 - Air scoops
 - Automatic air vents
 - Flow switches
 - Gauges
 - Pot feeders
 - Chemical treatment and backflow prevention
 - Expansion tanks
 - Low-water cutoffs
 - Expansion joints
- Piping system configurations
- Series loop
- Primary / secondary
- Radiant
- Reverse return / direct return
- Boiler trim
- Codes and regulations
 - Manufacturers' specifications
- Tools and equipment
- Selection
 - Application
 - Size

- Describe the installation of equipment for hydronic systems

LEARNING TASKS

CONTENT

- Sizing
 - Calculations
 - Measurements
 - Manufacturers' specifications
- Location/placement
 - Drawings
 - Engineered
 - Mechanical
 - Electrical
 - High and low points
 - Valves
- Supports
- Fasteners
- Methods
 - Manual
 - Mechanical
- Set and secure
- Troubleshooting
- Maintenance

Line (GAC): **H INSTALL HYDRONIC SYSTEMS**
Competency: **H3 Install Piping for Hydronic Systems**

Objectives

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

- Describe the installation of piping for hydronic systems.

LEARNING TASKS

1. Describe the installation of piping for hydronic systems

CONTENT

- Pipe routing
- High and low points
- Tools and equipment
- Jointing methods
- Grade
- Supports
- Restraints
- Assembly

Line (GAC): **K APPLY ELECTRICAL CONCEPTS**
Competency: **K1 Use the Principles of Electricity**

Objectives

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

- Describe electrical concepts.
- Solve simple problems using Ohm's and Kirchhoff's Laws.
- Describe single phase and three phase power supplies.
- Identify transformers.

LEARNING TASKS

1. Describe the fundamentals of electricity

CONTENT

- Basic principles
 - Atomic theory
 - Electron flow
 - Conductors - insulators
 - Current types
 - AC current
 - DC current
 - Cathodic protection
- Properties of wire
 - Resistance
 - Calculating resistance
- Codes and regulations
 - Effect of temperature
 - Types of wires and cables
- Electrical sources
 - AC
 - Single phase
 - Three phase
 - DC
- Parts of a circuit
 - Source
 - Switch
 - Load
- DC circuits and measurements
 - Ohm's Law
 - Measurement of voltage and amperage
 - Resistors in parallel and series
 - Power and energy
 - Closing and opening DC circuits
- AC circuits and measurements

2. Describe electrical circuits

LEARNING TASKS

CONTENT

- | | |
|--|--|
| | <ul style="list-style-type: none"> ○ Inductance ○ AC amperage ○ Resistance ○ Impedance ○ Capacitance ○ Power factor |
| | <ul style="list-style-type: none"> • Fundamentals of magnetism <ul style="list-style-type: none"> ○ Natural and artificial magnets ○ Magnetic fields ○ Strength of field ○ Force on two wires |
| | <ul style="list-style-type: none"> • Permeability |
| 3. Use laws and formulas | <ul style="list-style-type: none"> • Ohm's Law • Kirchoff's Law • Solve simple problems |
| 4. Describe single phase power characteristics | <ul style="list-style-type: none"> • AC power distribution <ul style="list-style-type: none"> ○ Generation and transmission ○ Voltage drop ○ Step-down transformer • Power available • Single phase power supply <ul style="list-style-type: none"> ○ 3-wire, dual voltage • Circuit protection <ul style="list-style-type: none"> ○ Fuses ○ Circuit breakers |
| 5. Describe three phase power characteristics | <ul style="list-style-type: none"> • AC power distribution <ul style="list-style-type: none"> ○ Generation and transmission ○ Voltage drop ○ Step-down transformer • Power available • Three phase power supply <ul style="list-style-type: none"> ○ Delta ○ Wye |
| 6. Identify transformers | <ul style="list-style-type: none"> • Type of transformers <ul style="list-style-type: none"> ○ Step-up ○ Step-down ○ Isolation • Primary winding • Secondary winding • Tappings |

Line (GAC): **L** **PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**
Competency: **L3** **Select Gas-Fired Appliances**

Objectives

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

- Describe gas-fired appliances.

LEARNING TASKS

1. Describe gas-fired appliances

CONTENT

- Types
 - Boilers
 - Hot water
 - Steam
 - High mass
 - Low mass
 - Direct fired make-up air heaters
 - Direct vent appliances
 - Decorative appliances
 - Fireplace
 - Fire pit
 - Furnaces
 - Radiant heaters
 - Low intensity
 - High intensity
 - Ranges and/or Commercial cooking equipment
 - Rooftop units
 - Unit heaters
 - Water heaters
 - Tankless
 - Storage type
 - Gas fired refrigerators
- Characteristics
 - Appliance design
 - Direct-fired
 - Indirect-fired
- Applications
- Approval agencies

Line (GAC):	V	INSTALL MARINE SYSTEMS
Competency:	V1	Perform Penetration and Layout of Marine Structures and Piping

Objectives

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

- Describe piping systems in marine applications.
- Describe marine structure penetrations.
- Describe marine piping layout.

LEARNING TASKS

CONTENT

- Describe shipyard terminology and vessel types
 - Terminology
 - Hull
 - Port
 - Starboard
 - Inboard/outboard
 - Foreward/aft
 - Bulkhead
 - Deckhead
 - Bilge
 - Void space
 - Bridge
 - Compartment
 - Frames
 - Stiffeners
 - Vessels
 - Tug
 - Cruise liner
 - Hovercraft
 - Barges
 - Ferry
 - Submarine
 - Freighters
- Describe safe work practices for a marine environment
 - Codes and regulations
 - Hazards
 - Confined spaces
 - Access and exit routes
 - Fire safety
 - Personal Protective Equipment (PPE)
 - Fall arrest
 - Muster area
- Describe piping systems in marine applications
 - Fuel
 - Oil

LEARNING TASKS

CONTENT

- | | |
|--|---|
| <p>4. Describe factors affecting bulkhead and deck penetrations</p> <p>5. Describe marine structure penetrations</p> <p>6. Describe marine piping layout</p> | <ul style="list-style-type: none"> • Domestic water • Sewage • Desalination • Bilge • Balast • Vents • Sounding • Fire main • Hydraulics • Compressed air • Layout • Structural integrity • Water tight integrity • Fire protection • Material compatibility • Piping requirements <ul style="list-style-type: none"> ○ Schedule ○ Sleeving ○ Fittings • Safe work practices • Drawings and specifications • Equipment <ul style="list-style-type: none"> ○ Plasma cutting ○ Oxy-fuel cutting ○ Magnetic drilling • Drawings and specifications <ul style="list-style-type: none"> ○ Frames ○ Stiffeners |
|--|---|

Line (GAC): **V INSTALL MARINE SYSTEMS**
Competency: **V2 Install Piping for Marine Systems**

Objectives

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

- Describe the fabrication of a marine piping assembly.
- Describe the installation of a marine piping assembly.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| 1. Describe the fabrication of a marine piping assembly | <ul style="list-style-type: none"> • Jigs • Flanges • Steck™ • Bends • Fittings • Layout <ul style="list-style-type: none"> ○ Drawings and specifications • Templates |
| 2. Describe the installation of a marine piping assembly | <ul style="list-style-type: none"> • Codes, standards and regulations • Penetrations |

Achievement Criteria

- | | |
|-------------|--|
| Performance | The learner will be able to bend pipe for marine piping assembly. |
| Conditions | To be assessed during technical training.
The learner will be given: <ul style="list-style-type: none"> • Drawings and specifications • Tools and equipment • PPE • Materials |
| Criteria | The learner will be evaluated on: <ul style="list-style-type: none"> • Safe work practices • Accuracy • Neatness |

Line (GAC): **V** **INSTALL MARINE SYSTEMS**
Competency: **V3** **Repair Marine Piping Systems**

Objectives

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

- Describe repair procedures for marine systems.

LEARNING TASKS

1. Describe repair procedures for marine systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Level 3

Steamfitter/Pipefitter

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**
Competency: **C2 Interpret Drawings and Specifications**

Objectives

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

- Create a bill of material.
- Create a piping installation drawing.
- Describe 3D modeling.

LEARNING TASKS

1. Create a bill of material

2. Create a piping installation drawing

3. Describe 3D modeling

CONTENT

- Terminology
- Lists
- Calculations

- Components
 - Sizing
 - Valves
 - Supports
 - Drip legs
 - Expansion joint

- BIM
- Total station

Achievement Criteria

Performance	The learner will be able to: <ul style="list-style-type: none"> • Create a bill of material • Create a piping installation drawing
Conditions	To be assessed during technical training. The learner will be given: <ul style="list-style-type: none"> • Drawings and specifications • Drafting supplies
Criteria	The learner will be evaluated on: <ul style="list-style-type: none"> • Bill of material <ul style="list-style-type: none"> ○ Accuracy • Isometric drawing <ul style="list-style-type: none"> ○ Neatness ○ Accuracy • Inclusion of components <ul style="list-style-type: none"> ○ Sizing ○ Valves ○ Supports ○ Drip legs ○ Expansion joint • Pipe identification.

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**
Competency: **C3 Use Codes, Regulations and Standards**

Objectives

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

- Describe sections of American Standard of Mechanical Engineers (ASME) code.

LEARNING TASKS

CONTENT

1. Describe sections of American Standard of Mechanical Engineers (ASME) code

- B31.1
- B31.3

Line (GAC): **G** **INSTALL HEATING TRACING SYSTEMS**
Competency: **G1** **Install Heat Tracing Systems (Steam)**

Objectives

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

- Describe the installation of liquid-filled tracing systems.

LEARNING TASKS

1. Describe steam tracing systems

2. Describe the installation of steam tracing systems

CONTENT

- Safe work practices
- Types
 - Low to high pressure
 - Pre-insulated
- Components
- Applications
- Operation
- Engineered drawings
- Codes and regulations
- Tools and equipment
- Materials
- Components
- Joining methods
- Testing

Line (GAC):	G	INSTALL HEATING TRACING SYSTEMS
Competency:	G2	Repair and Test Heat Tracing Systems (Steam)

Objectives

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

- Describe repair procedures for steam tracing systems.
- Describe testing procedures for steam tracing systems.

LEARNING TASKS

1. Describe repair procedures for steam tracing systems
2. Describe testing procedures for steam tracing systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation
- Types
 - Hydrostatic
 - Pneumatic
 - In-service
- Safe work practices
- Leak checks
- Return to service
- Documentation

Line (GAC):	H	INSTALL HYDRONIC SYSTEMS
Competency:	H2	Install Equipment for Hydronic Systems

Objectives

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

- Describe switches.
- Install relays.
- Install controls for hydronic systems.

LEARNING TASKS

1. Describe switches

CONTENT

- ## 2. Describe relays

- Manual
- Temperature actuated
- Pressure actuated
- Liquid level actuated
- Flow
- Proximity/End
- Operation
- Ratings
- Contacts
 - Normally open
 - Normally closed

- ### 3. Select relays

- 120 volt coils
- 24 volt coils
- Ratings
- Wiring base connections
- Symbols
- Terminal identification on wiring diagram
- Enclosures

- #### 4. Install relays

- Circuit concepts
 - Source
 - Load
 - Switches
 - Conductors
- Circuit types
- Test equipment
- Circuit diagrams
- Symbols
- Electronic
- Electro-mechanical

5. Describe the principles of electrical controls

6. Describe control systems for hydronic systems

- Types

LEARNING TASKS

CONTENT

- Boilers
- Zoning
 - Location of controls and sensors
- Priority systems
- Reset
 - Heat curves
- Circulators
- Multi-temperature systems
 - Control valves
 - Mixing
 - Diverting
 - Injection
- Purpose/Operation

Achievement Criteria

Performance The learner will be able to install/wire a relay.

Conditions To be assessed during technical training.

The learner will be given:

- Ladder diagram
- Double pole, single throw relay
- Power supply
- Switch
- Light bulbs
- Transformer

Criteria The learner will be evaluated on:

- Safe work practices
- Accuracy to the diagram
- Wiring techniques
- Neatness

Line (GAC):	H	INSTALL HYDRONIC SYSTEMS
Competency:	H3	Install Piping for Hydronic Systems

Objectives

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

- Describe sizing of pipe and components for hydronic systems.
- Perform heat loss/gain calculations.
- Describe the installation of hydronic heating and cooling generating systems.

LEARNING TASKS

1. Describe sizing of pipe and components for hydronic systems
2. Describe the installation of hydronic heating and cooling generating systems

CONTENT

- Load requirements
- Heat loss/gain calculations
- Codes and regulations
- Manufacturers' specifications
- Engineered drawings
- Expansion devices
 - Bladder
 - Diaphragm
 - Conventional air cushion
 - Open tank
- Circuit balancing valves
- Heating and cooling compatibility
- Codes and regulations
 - Manufacturers' specifications
- Tools and equipment
- Cooling source
- Components
- Circulating pumps
- Venting
- Energy sources
- Layout
- Supports
- Restraints
 - Vibration
 - Seismic
- Trim
- Connections
 - Pipe
 - Condensate
 - Flue
 - Power
 - Drainage
 - Neutralizer

Achievement Criteria

Performance	The learner will be able to perform heat loss/gain calculations from a drawing.
Conditions	<p>To be assessed during technical training.</p> <p>The learner will be given:</p> <ul style="list-style-type: none">• Floor plan• Design criteria• Design materials
Criteria	<p>The learner will be evaluated on:</p> <ul style="list-style-type: none">• Accuracy

Line (GAC): **H INSTALL HYDRONIC SYSTEMS**
Competency: **H4 Test Hydronic Systems**

Objectives

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

- Describe the testing of hydronic systems.

LEARNING TASKS

1. Describe testing procedures for hydronic systems, components and controls

CONTENT

- Safe work practices
 - Lock-out
- Codes and regulations
 - Manufacturers' specifications
- Visual pre-check
- Sensory inspection
- Types
 - Visual pre-check
 - Sensory
 - Pressure
 - Thermal
- Tools and equipment
- Test medium
 - Fluid
 - Compressed air
- Components
- Procedures
 - Filling
 - Draining
 - Purging
- QA/QC
- Return to service
- Documentation

Line (GAC): **H INSTALL HYDRONIC SYSTEMS**
Competency: **H5 Repair Hydronic Systems**

Objectives

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

- Describe repair procedures for hydronic systems.

LEARNING TASKS

1. Describe repair procedures for hydronic systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC):	I	INSTALL STEAM SYSTEMS
Competency:	II	Install Equipment for Steam Systems (Low pressure)

Objectives

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

- Describe low pressure steam systems.
- Describe the installation of low pressure steam equipment.

LEARNING TASKS

1. Describe low pressure steam systems

CONTENT

- Codes and regulations
- Hazards/safe work practices
- Terminology
- Properties of steam
 - Heat transfer
- System types and configurations
- Symbols
- Fuels
 - Fuel oil
 - Gas
- Controls
 - Level
 - Pressure
- Applications
 - Commercial
 - Industrial
 - Institutional
- Troubleshooting
- Maintenance
- Types
 - Boiler
 - Expansion joints
 - Pumps
 - Steam traps
 - Tanks
 - Valves
 - Water treatment equipment
 - Heat transfer equipment
 - Convectors
 - Heat exchangers
 - Horizontal and vertical unit heaters
 - Pipe coils
 - Radiators
 - Components

2. Describe low pressure steam system equipment

LEARNING TASKS

CONTENT

	<ul style="list-style-type: none"> – Baseboard heaters – Blast coils – Blow down – Boiler return traps – Cast iron heaters – Check valves – Condensate pumps – Condensate tank – Drip legs – Equalizers – Feed water tank – Gauges – Hartford loops – Humidifiers – Lift fittings – Mechanical traps – Quick vents – Stop valves – Strainers – Radiators – Thermodynamic traps – Thermostatic traps – Unit heaters – Horizontal heaters – Vertical heaters – Valves
4. Describe sizing and selection of low pressure steam equipment	<ul style="list-style-type: none"> • Applications • Operation
5. Describe the installation of low pressure steam equipment	<ul style="list-style-type: none"> • Engineered drawings • Codes and regulations • Codes and regulations • Location • High point vent • Low point drain • Tools and equipment • Supports • Fasteners • Installation method <ul style="list-style-type: none"> ○ Manual ○ Mechanical <ul style="list-style-type: none"> – Cranes – Hoists – Hydraulic jacks • Clearances • Alignment and leveling • Anchoring

Line (GAC):	I	INSTALL STEAM SYSTEMS
Competency:	I2	Install Piping for Steam and Condensate Systems (Low pressure)

Objectives

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

- Interpret steam tables.
- Describe the installation of low pressure steam piping systems.

LEARNING TASKS

CONTENT

1. Interpret steam tables	<ul style="list-style-type: none"> • Pressures • Temperatures • Heat contents • Latent heat • Total heat • Specific volumes
2. Size components and pipe	<ul style="list-style-type: none"> • Engineered drawings • Codes and regulations
3. Describe the installation of low pressure steam piping systems	<ul style="list-style-type: none"> • Pipe routing/configurations • Tools and equipment • Assembly • Joining methods • Grade • Supports • Clearances • Protection <ul style="list-style-type: none"> ○ Mechanical damage ○ Seismic activity ○ Environmental conditions • Structure penetration

Line (GAC):	I	INSTALL STEAM SYSTEMS
Competency:	I3	Test Steam and Condensate Systems (Low pressure)

Objectives

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

- Describe hydrostatic testing for low pressure steam systems.

LEARNING TASKS

1. Describe hydrostatic testing for low pressure steam systems

CONTENT

- Safe work practices
- Codes and regulations
- Components
- Visual pre-check
- Filling
- Venting
- Draining
- Tools and equipment
- Medium
 - Water
 - Glycol
- Lock-out/isolation
- Return to service
- Inspection
 - QA/QC
 - Technical Safety BC
- Documentation
- Medium disposal
 - WHMIS
 - Environmental regulations

Line (GAC): **I** **INSTALL STEAM SYSTEMS**
Competency: **I4** **Repair Steam Systems (Low pressure)**

Objectives

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

- Describe repair procedures for low pressure steam systems.

LEARNING TASKS

1. Describe repair procedures for low pressure steam systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC):	J	INSTALL INDUSTRIAL WATER AND WASTE SYSTEMS
Competency:	J1	Install Equipment for Industrial Water and Waste Systems

Objectives

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

- Describe the installation of industrial water and waste equipment.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| 1. Describe industrial water and waste systems | <ul style="list-style-type: none"> • Safe work practices • Types • Codes and regulations • Hazards • Engineered drawings • Controls • Applications • Operation • Maintenance • Troubleshooting |
| 2. Describe industrial water and waste system equipment | <ul style="list-style-type: none"> • Pumps • Tanks • Valves • Filters • Strainers • Separators • Skimmers • Aerators • Water treatment |
| 3. Describe the installation of industrial water and waste equipment | <ul style="list-style-type: none"> • Safe work practices • Codes and regulations • Engineered drawings • High and low points • Tools and equipment • Installation method <ul style="list-style-type: none"> ○ Manual ○ Mechanical • Clearances • Alignment and leveling • Anchoring |

Line (GAC):	J	INSTALL INDUSTRIAL WATER AND WASTE SYSTEMS
Competency:	J2	Install Piping for Industrial Water and Waste Systems

Objectives

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

- Describe the installation of industrial water and waste system piping.

LEARNING TASKS

CONTENT

1. Describe industrial water and waste system piping
 - Types
 - Polyethylene
 - Fibreglass
 - Stainless steel
 - Carbon steel
 - Copper
 - Applications
 - Safe work practices
 - Codes and regulations
 - Engineered drawings
 - Tools and equipment
 - Joining methods
 - Grade
 - Clearances
 - Protection
 - Mechanical damage
 - Seismic activity
 - Site specific conditions
 - Structure penetration
2. Describe the installation of industrial water and waste system piping

Line (GAC):	J	INSTALL INDUSTRIAL WATER AND WASTE SYSTEMS
Competency:	J3	Test Industrial Water and Waste Systems

Objectives

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

- Describe testing for industrial water and waste systems.

LEARNING TASKS

1. Describe testing for industrial water and waste systems

CONTENT

- Safe work practices
- Types
- Visual pre-check
- Applications
- Lock-out
- Tools and equipment
- Test medium
 - Fluid
 - Air
 - Inert gas
- Procedures
 - Filling
 - Draining
 - Purging
- Return to service
- QA/QC
- Documentation
- Medium disposal
 - WHMIS

Line (GAC): J **INSTALL INDUSTRIAL WATER AND WASTE SYSTEMS**
Competency: J4 **Repair Industrial Water and Waste Systems**

Objectives

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

- Describe the repair of industrial water and waste systems.

LEARNING TASKS

1. Describe repair procedures for industrial water and waste systems

CONTENT

- Safe work practices
- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC):	K	APPLY ELECTRICAL CONCEPTS
Competency:	K2	Use Electrical Wiring Diagrams and Schematics

Objectives

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

- Identify electrical diagrams.
- Sketch a series and parallel circuit.
- Analyze simple circuits.
- Describe appliance circuits.
- Sketch a ladder diagram.

LEARNING TASKS

1. Identify electrical diagrams
2. Sketch a circuit
3. Analyze simple circuits

CONTENT

- Types of diagrams
 - Ladder
 - Schematic
 - Pictorial
 - Wiring
- Symbols used in schematic diagrams
- Read schematics
 - Identifying components
 - Determining function of circuit
 - Identifying control circuits
 - Parallel circuits
 - Series circuits
- Apply circuit diagrams
 - Troubleshooting techniques
- Parallel circuit
- Series circuit
- Safety
 - Lock-out and fuse removal
 - First aid for electrical shock
- Test circuits
 - Voltage test
 - Amperage test
 - Resistance test
 - Continuity test
- Analyze readings
 - Compare to manufacturer's data
 - Compare to previous readings
 - Compare to expected data

LEARNING TASKS

CONTENT

- | | |
|--------------------------------|--|
| | <ul style="list-style-type: none"> ○ Reasons for unexpected readings |
| 4. Describe appliance circuits | <ul style="list-style-type: none"> • Transformer • Limit/Safety • Pump/fan • Control |
| 5. Sketch a ladder diagram | <ul style="list-style-type: none"> • Sequence of operation • Components <ul style="list-style-type: none"> ○ Line voltage ○ Control voltage ○ Function <ul style="list-style-type: none"> – Source – Switch – Load – Conductors |

Achievement Criteria

- | | |
|-------------|---|
| Performance | <p>The learner will be able to sketch a:</p> <ul style="list-style-type: none"> • Series circuit • Parallel circuit • Ladder diagram |
| Conditions | <p>To be assessed during technical training.</p> <p>The learner will be given:</p> <ul style="list-style-type: none"> • Drawings and specifications • Sketching equipment |
| Criteria | <p>The learner will be evaluated on:</p> <ul style="list-style-type: none"> • Accuracy • Neatness |

Line (GAC):	K	APPLY ELECTRICAL CONCEPTS
Competency:	K5	Apply Wiring Practices

Objectives

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

- Describe wiring components.
- Describe conductor installation.
- Describe wire termination.

LEARNING TASKS

1. Describe wiring components

CONTENT

- Wire types
 - Solid
 - Stranded
- Connection types
 - Wire nuts
 - Crimp
 - Solder
 - Terminal strips/lug
 - Heat shrink sleeve
- Conduit types
 - Metal conduit
 - Rigid metal conduit
 - Galvanized conduit
 - Non-metallic conduit
 - Flexible conduit
- Fasteners
- Junction box
- Cutting of flexible conduit
- Wire insulation removal
- Wire nuts
- Wire nuts
- Junction box
- Terminal strips/lug
- Mechanically secure
- Heat shrink sleeve

2. Describe conductor installation
3. Describe wire termination

Line (GAC): **K Apply Electrical Concepts**
Competency: **K6 Interpret the Canadian Electrical Code (CEC)**

Objectives

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

- Interpret the Canadian Electrical Code Part 1.
- Interpret the Electrical Safety Regulations.

LEARNING TASKS

CONTENT

- | | |
|---|--|
| 1. Describe the Canadian Electrical Code Part 1 | <ul style="list-style-type: none"> • Section <ul style="list-style-type: none"> ○ 0,4,8,10,12 ○ Appendix B ○ Appendix D |
| 2. Interpret the Electrical Safety Regulations | <ul style="list-style-type: none"> • Technical Safety BC |
| 3. Size conductors | <ul style="list-style-type: none"> • Section 4 CEC |
| 4. Describe wiring installation | <ul style="list-style-type: none"> • Section 12 CEC |
| 5. Describe grounding and bonding techniques | <ul style="list-style-type: none"> • Section 10 CEC |

Line (GAC):	L	PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS
Competency:	L1	Size Piping and Tubing Systems

Objectives

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

- Describe piping, tubing and hoses.
- Size piping and tubing systems.

LEARNING TASKS

1. Describe factors that affect gas flow in a piping system
2. Describe natural gas fuel distribution systems

CONTENT

- Laminar flow
- Turbulent flow
- Specific gravity
- Pressure drop
- Velocity
- Size
- Piping material
- Fittings
- Utility provider
 - Gas well
 - Transmission line
 - Compressor station
 - City gate station
 - District regulator station
 - Distribution regulator
 - Gas main
 - Gas service
 - Service stop (valve)
 - Service regulator
 - Meter
- Consumer
 - Gas supply or building line
 - Branch line
 - Drop line
 - Riser
 - Drip or dirt pocket
 - Extension
- Gas pressures
 - High
 - Low
- Types
 - Black iron pipe
 - Copper tubing

LEARNING TASKS

CONTENT

4. Size piping and tubing systems

- PE piping
 - Tracer wire
- Corrugated stainless steel tubing (CSST)
- Hoses
- Flexible connectors
- Schedules and grades
- Pressure ratings
- Nominal sizes
- Protective coatings
- Cathodic protection
- Identification markings
- Types
 - Black iron pipe
 - Copper tubing
 - Corrugated stainless steel tubing (CSST)
- Pressures
 - Low pressure
 - 2 psig (14 kPa)
 - High pressure
- Sizing factors
 - Appliance rating
 - Distance
 - Allowable pressure drop
 - Piping or tubing type
 - Type of gas
 - Fittings
- Code requirements
- Procedures

Line (GAC):	L	PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS
Competency:	L2	Select Regulators, Valves and Valve Train Components

Objectives

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

- Select valves.
- Describe the operation of gas valve trains for appliances rated at 400 MBH or less.
- Describe the purpose and operation of gas pressure regulators.

LEARNING TASKS

CONTENT

- Describe manual valves
 - Types
 - Plug valves
 - Butterfly
 - Ball valves
 - Needle valves
 - Construction
 - Operation
 - Pressure markings and ratings
 - Maintenance
- Describe automatic gas valves
 - Electric
 - Solenoid
 - Diaphragm
 - Combination
 - Single stage
 - Two stage
 - Modulating
 - Pilot safety
 - Safety shut off
 - Non-electric
 - Rod and tube
 - Hydraulic
- Describe pressure regulators
 - Types
 - Appliances
 - Line pressure
 - Service
 - Direct operated
 - Operating elements
 - Loading
 - Measuring
 - Restricting
 - Pressure adjustment
 - Gas line

LEARNING TASKS

CONTENT

4. Describe gas valve train for appliances 400 MBH or less

- Manifold
- Parts
- Operating principles
- Applications
- Regulators
- Gas valves
- Manual valves
 - A-cock
 - B-cock
 - Test firing
- Flow control
- Electric valves
 - Solenoid
 - Diaphragm
 - Combination
- Non-electric valves
 - Rod and tube
 - Hydraulic
- Pilot safety valve
- Regulators

5. Describe the operation of a gas valve train

Line (GAC):	L	PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS
Competency:	L4	Select Flame Safeguards

Objectives

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

- Describe flame detectors.
- Describe the operation of standing pilot/thermocouple systems.

LEARNING TASKS

1. Describe flame detectors
2. Describe ignition systems
3. Describe standing pilot/thermocouple systems

CONTENT

- Thermocouple
- Thermopile
- Flame rectification (flame rod)
- Pilot types
 - Continuous
 - Intermittent
 - Interrupted
- Pilot
- Wiring circuit
- Sequence of operation
- Applications

Line (GAC):	L	PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS
Competency:	L5	Select Burners

Objectives

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

- Describe burners.
- Describe the operation of atmospheric burners.
- Describe burner orifices.

LEARNING TASKS

1. Describe burners

CONTENT

- Terminology
 - Turndown
 - High fire
 - Low fire
 - Modulation
 - Port loading
- Types
 - Forced draft
 - Fan assisted
 - Atmospheric
 - Insperating
 - Asperating
- Gas properties
- Flame characteristics
 - Aerated
 - Oxidizing
 - Carbonizing
 - Neutral
 - Non-aerated
 - Bunsen
 - Luminous
 - Impingment
 - Flame retention
- High installations
- Pilot
 - Continuous
 - Intermittent
- Interrupted
- Types
 - Main burners
 - Pilot burners
- Parts
 - Burner port

2. Describe atmospheric burners

LEARNING TASKS

CONTENT

3. Describe burner orifices

- Mixing tube
- Burner head
- Operation
 - Venturi effect (Bernoulli's principle)
 - Primary air control
 - Fuel control
- Application
- Types
 - Plug
 - Cap
 - Adjustable
- Sizing
 - Tables
 - Calculations
 - Orifice flow formula
 - Drilling
- Drill index

Line (GAC): **M INSTALL FUEL SYSTEMS**
Competency: **M1 Install Equipment for Fuel Systems**

Objectives

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

- Describe fuel delivery systems.
- Describe the installation of fuel system equipment.

LEARNING TASKS

1. Describe fuels

CONTENT

- Types
 - Natural gas
 - Diesel
 - Propane
 - Bio fuels
 - Bunker C
 - Liquid natural gas
 - Liquid propane
 - Black liquor
 - Light oils
 - Hydro-carbon derivatives
 - Recovered bio-gases
- Codes and regulations
- Characteristics
- Combustion
- Chemistry
- Heat values
- Specific gravity
- Flame speeds
- Odourant
- Limits of flamability
- Safe work practices
- Applications
- Operation
- Exhaust
 - Mufflers
 - Silencers
 - Terminations
 - Scrubbers
- Types
 - Blowers
 - Burners (excluding natural gas)

2. Describe fuel delivery systems

3. Describe fuel system equipment

LEARNING TASKS

CONTENT

4. Describe the installation of fuel system equipment

- Expansion joints
- Filters
- Flashback arrestors
- Heat exchangers
- Heat transfer units
- Pumps
- Regulators
- Safety release
- Tanks
- Vacuum breakers
- Valves
- Vapourizers
- Water separation equipment
- Primary safety controls
- Characteristics
- Operation
- Safe work practices
 - Underground tank safety
- Codes and regulations
- Engineered drawings
- Tools and equipment
- High and low points
- Grade
- Supports
- Fasteners
- Components
- Installation method
 - Manual
 - Mechanical
- Clearances
- Alignment and leveling
- Anchoring

Line (GAC):	M	INSTALL FUEL SYSTEMS
Competency:	M2	Install Piping and Tubing for Fuel Systems

Objectives

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

- Describe the installation of piping, tubing and hoses for natural gas applications.
- Describe the installation of fuel system piping.

LEARNING TASKS

1. Describe the installation of piping, tubing and hoses for natural gas applications

CONTENT

1. Describe the installation of piping, tubing and hoses for natural gas applications
 - Code and regulations
 - Manufacturers' specifications
 - Types
 - Methods
 - Identification
 - Procedures
 - Fittings
 - Valves
 - Prohibited practice
 - Location limitations
 - Structural penetrations
 - Fire stopping
 - Drip or dirt pockets
 - Between buildings
 - Concealment
 - Protection plates
 - In concrete
 - Protective coatings
 - Underground
 - Support
 - Tools
 - Connectors
2. Describe the installation of fuel system piping
 - Engineered drawings
 - Tools and equipment
 - Joining methods
 - Grade
 - Supports
 - Expansion
 - Clearances
 - Protection
 - Mechanical damage
 - Seismic activity
 - Site specific conditions
 - Structure penetration
 - Venting

Line (GAC): **M INSTALL FUEL SYSTEMS**
Competency: **M3 Install Regulators, Valves and Valve Train Components**

Objectives

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

- Describe manual shut-off valves installation.
- Describe gas pressure regulator installation.

LEARNING TASKS

1. Describe the installation of manual shut-off valves

2. Describe the installation of pressure regulators

CONTENT

- Code requirements
- Manufacturers' specifications
- Procedures
 - 2-piece ball valves

- Code requirements
- Manufacturers' specifications
- Procedures

Line (GAC): **M** **INSTALL FUEL SYSTEMS**
Competency: **M5** **Test Fuel Systems**

Objectives

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

- Describe testing for fuel systems (excludes natural gas).

LEARNING TASKS

1. Describe testing for fuel systems (excludes natural gas)

CONTENT

- Codes and regulations
- Visual pre-check
- Lock-out
- Types
- Applications
- Equipment
 - Multimeter
 - Manometer
 - Infrared thermometer
- Tools and equipment
- Test medium
- Components
- Procedures
 - Filling
 - Draining
 - Purging
- Return to service
- QA/QC
- Documentation
- Medium disposal
 - WHMIS

Line (GAC): **M INSTALL FUEL SYSTEMS**
Competency: **M6 Repair Fuel Systems**

Objectives

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

- Describe the repair of fuel systems (excludes natural gas).

LEARNING TASKS

1. Describe repair procedures for fuel systems (excludes natural gas)

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Flushing/purging
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC):	N	INSTALL MEDICAL GAS SYSTEMS
Competency:	N1	Install Equipment for Medical Gas Systems

Objectives

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

- Describe the installation of medical gas equipment.

LEARNING TASKS

1. Describe medical gas systems

CONTENT

- Gas/system types
- Safe work practices
- Applications
- Sources of medical gas
 - Bulk
 - Cylinders
 - Compressors
- Valve and accessory placement
- Safety features
- Advantages of pipe systems versus individual cylinders
- Air supply
- Relationships
 - Owner
 - Installer
 - Third party inspectors
- Maintenance
- Troubleshooting
- Types
 - Valve boxes
 - Terminal boxes
 - Compressors
 - Regulators
 - Pumps
 - Cryogenic tanks
 - Valves
 - Gauges
 - Alarms
- Applications
- Operation
- Supports
- Fasteners
- Connection systems

2. Describe medical gas equipment

LEARNING TASKS

3. Describe the installation of medical gas equipment

CONTENT

- Codes and regulations
- Jurisdictional requirements
- Diameter Index Safety System (DISS)
- Tools and equipment
- Joining methods
- Grade
- Pressure testing equipment
- Location of alarm points
- Installation method
 - Manual
 - Mechanical
 - Cranes
 - Hoists
 - Hydraulic jacks
- Clearances
- Alignment and leveling
- Anchoring

Line (GAC): **N** **INSTALL MEDICAL GAS SYSTEMS**
Competency: **N2** **Install Piping and Tubing for Medical Gas Systems**

Objectives

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

- Describe the installation of piping for medical gas systems.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Describe the installation of piping for medical gas systems | <ul style="list-style-type: none"> • Layout <ul style="list-style-type: none"> ○ Areas not permitted ○ Service requirements for different areas ○ Cross-connection ○ Location ○ Limitations • Safe work practices • Codes and regulations • Tools and equipment • Pipe types • Hangers and supports • Jointing • Cleaning and storing • Cutting, fitting, brazing • Degreasing • Capping • Certification requirements <ul style="list-style-type: none"> ○ CSA • Purging • Pressure testing |
|--|---|

Line (GAC): **N INSTALL MEDICAL GAS SYSTEMS**
Competency: **N3 Test Medical Gas Systems**

Objectives

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

- Describe testing for medical gas systems.

LEARNING TASKS

1. Describe testing for medical gas systems

CONTENT

- Types
- Applications
- Safe work practices
- Visual pre-check
- Lock-out
- Certification tests
- Equipment
 - Test trees
 - Pressure gauges
 - Compressors
- Test medium
 - Nitrogen
 - System gases
- Components
- Procedures
 - Filling
 - Purging
 - Cross-connection
 - Pressure test
 - Particulate test
- Return to service
- QA/QC
- Third party inspection
- Documentation

Line (GAC): **N INSTALL MEDICAL GAS SYSTEMS**
Competency: **N4 Repair Medical Gas Systems**

Objectives

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

- Describe repair procedures for medical gas systems.

LEARNING TASKS

1. Describe repair procedures for medical gas systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC): **W INSTALL BACKFLOW PREVENTION**
Competency: **W1 Install Cross Connection Assemblies and Devices**

Objectives

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

- Describe the installation of cross connection assemblies.

LEARNING TASKS

1. Describe cross connection control

CONTENT

- Hazards
- Assemblies
 - Reduced pressure backflow preventer assembly (RPBA)
 - Double check valve assembly (DCVA)
 - Pressure Vacuum Breaker Assembly (PVBA)
 - Air gap
- Devices
 - Dual check Valve
 - Dual check Valve Backflow Preventer with Atmospheric Port
 - Atmospheric Vacuum Breaker
 - Hose Connection Vacuum Breaker
 - Laboratory Faucet Type Vacuum Breaker
- Inspection
- Methods
- Maintenance
 - Calibration
 - Annual verification
- Codes, regulations and permits
 - NPC, Section 7, Non-Potable Water Systems
- Certification
- Hazard assessment
- Installation requirements
 - Height
 - Location
 - Accessibility
- Codes and regulations
 - BCWWA
 - National Plumbing Code (NPC)

2. Describe the installation of cross connection control devices and assemblies

LEARNING TASKS

CONTENT

- Health Act
- Tools and equipment
- Connections
- Pressures
- Inspection
- Testing

Line (GAC): **W INSTALL BACKFLOW PREVENTION**
Competency: **W2 Test Cross Connection Assemblies and Devices**

Objectives

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

- Describe testing of cross connection assemblies.

LEARNING TASKS

1. Describe testing of cross connection assemblies

CONTENT

- Safe work practices
- Types
 - Reduced Pressure Backflow Assembly (RPBA)
 - Double-check Valve Assembly (DCVA)
 - Pressure Vacuum Breaker Assembly (PVBA)
- Test procedures
- Purpose
- Minimum requirements
- Test frequency
- Documentation

Line (GAC): **W INSTALL BACKFLOW PREVENTION**
Competency: **W3 Troubleshoot and Repair Cross Connection Assemblies and Devices**

Objectives

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

- Describe the troubleshooting and repair of cross connection control assemblies.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| <p>1. Describe the troubleshooting and repair of cross connection control assemblies</p> | <ul style="list-style-type: none"> • Troubleshoot <ul style="list-style-type: none"> ○ Isolation ○ Assemblies <ul style="list-style-type: none"> – Reduced pressure backflow preventer assembly (RPBA) – Double check valve assembly (DCVA) – Pressure Vacuum Breaker Assembly (PVBA) ○ Visual Inspection ○ Verify component • Repair or replace <ul style="list-style-type: none"> ○ Safe work practices ○ Tools and equipment ○ Retest ○ Return to service ○ Documentation ○ Codes, regulations and permits <ul style="list-style-type: none"> – Inspection |
|--|---|

Level 4

Steamfitter/Pipefitter

Line (GAC):	B	USE TOOLS AND EQUIPMENT
Competency:	B3	Use Rigging, Hoisting, Lifting and Positioning Equipment

Objectives

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

- Use rigging, hoisting, lifting and positioning equipment.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| 1. Describe complex and critical lifts | <ul style="list-style-type: none"> • Multi-crane • Load transferring • Transferring • Unbalanced • Engineered |
| 2. Use hoisting, lifting and rigging equipment in a multi-point lift for piping installation | <ul style="list-style-type: none"> • Lift plan • Engineer recommendations • Certification requirements • Estimation of weights • Calculations • Equipment capacities • Equipment selection • Lifting location • Operating procedures • Communication <ul style="list-style-type: none"> ○ Hand signals ○ Audible signals • Securing of loads • Equipment inspection • Equipment maintenance • Equipment storage • Disposal procedures • Centre of gravity • Load orientation • Multi-point pick |

Achievement Criteria

- | | |
|-------------|--|
| Performance | <p>The learner will be able to:</p> <ul style="list-style-type: none"> • Perform a multi-point hoisted lift for an unbalanced load. |
| Conditions | <p>To be assessed during technical training.</p> <p>The learner will be given:</p> <ul style="list-style-type: none"> • Tools and equipment • Specifications |

Criteria

The learner will be evaluated on:

- Lift plan
- Communication with operator and others
- Visual check of lifting equipment
- Checking equipment capacity
- Attaching the correct rigging configuration
- Attaching load correctly to the lifting hook
- Centering lifting hook above load before lifting
- Hoisting load correctly
- Transferring load correctly
- Lowering load correctly
- Securing load prior to rigging removal
- Returning rigging to designated storage place
- Using all equipment in a safe manner
- Following all site safety rules

Line (GAC):	B	USE TOOLS AND EQUIPMENT
Competency:	B4	Rig Loads for Cranes

Objectives

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

- Prepare cranes for hoisting.
- Secure loads for rigging removal.

LEARNING TASKS

1. Prepare cranes for hoisting
2. Secure loads for rigging removal

CONTENT

- Set up
- Blocks and tackle
- Crane procedures
 - Load charts
 - Outriggers
 - Walk-around inspection
- Securing loads
 - Guy wires
 - Come-alongs
 - Lashing
 - Welding
- Potential dangers during rigging
- Cribbing
- Ensuring load stability
- Tying knots
- Determining requirements for securing load
- Selecting securing materials
- Suspending loads for subsequent placement

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**
Competency: **C2 Interpret Drawings and Specifications**

Objectives

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

- Interpret P&ID drawings and their components.

LEARNING TASKS

1. Interpret P&ID drawings and their components

CONTENT

- Pipe classes
- Line numbers
- Flow directions
- Interconnections
- Start-up
- Bypass line
- Valve identification
- Control
 - Inputs
 - Outputs
 - Interlocks
- Miscellaneous

Line (GAC): **F USE COMMUNICATION TECHNIQUES**
Competency: **F2 Use Mentoring Techniques**

Objectives

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

- Use mentoring techniques.

LEARNING TASKS

CONTENT

1. Describe effective mentoring techniques

- Verbal
- Non-verbal
 - Body language
 - Signals
- Active listening
 - Hearing
 - Interpreting
 - Reflecting
 - Responding
 - Paraphrasing
- Personal responsibilities
 - Attitude
 - Harassment
 - Discrimination

2. Describe learning strategies

- Coaching
- Practice
- Assessing
 - Feedback
 - Correcting
- Reinforcement

Line (GAC):	I	INSTALL STEAM SYSTEMS
Competency:	II	Install Equipment for Steam Systems (High pressure)

Objectives

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

- Install high pressure steam system equipment.
- Describe high pressure steam systems.
- Perform calculations for high pressure steam systems.

LEARNING TASKS

1. Describe high pressure steam systems

CONTENT

- Hazards/safe work practices
- Codes and regulations
- Terminology
- Types
 - Condensing/non-condensing
- Fuels
 - Hydrocarbons
 - Biomass
 - Nuclear
- Controls
 - Level
 - Pressure
- Cooling sources
 - Towers
 - Condensers
 - Flash tanks
 - Blowdown tanks
 - Blowdown separators
 - Converters
- Applications
 - Power generation
 - Process
 - Central heating
- Troubleshooting
- Maintenance
- Terminology
- Boiler components
 - Accumulators
 - Blow down
 - Burners
 - Condensate pumps
 - Condensate tank

2. Describe high pressure steam system equipment

LEARNING TASKS

CONTENT

- | | |
|---|---|
| | <ul style="list-style-type: none"> ○ Condensers ○ De-aerators ○ Desuperheaters ○ Drip legs ○ Expansion joints ○ Feed water tank ○ Flash tanks ○ Gauges ○ Heat transfer equipment <ul style="list-style-type: none"> – Converters – Heat exchangers – Horizontal and vertical unit heaters – Pipe coils – Radiators – Turbines ○ Pumps ○ Quick vents ○ Re-heaters ○ Sight glasses ○ Solid fuel feeders ○ Soot blowers ○ Stop and check valves ○ Strainers ○ Superheaters ○ Temperator ○ Traps <ul style="list-style-type: none"> – Mechanical – Thermodynamic – Thermostatic ○ Unit heaters <ul style="list-style-type: none"> – Horizontal heaters – Vertical heaters ○ Water treatment equipment |
| 3. Describe sizing and selection of high pressure steam equipment | <ul style="list-style-type: none"> • Applications • Operation |
| 4. Describe the installation of high pressure steam equipment | <ul style="list-style-type: none"> • Engineered drawings • Codes and regulations • Engineered drawings • Tools and equipment • Installation method <ul style="list-style-type: none"> ○ Manual ○ Mechanical |

LEARNING TASKS

CONTENT

5. Describe the installation of high pressure steam piping system components and their functions

- Cranes
- Hoists
- Hydraulic jacks
- Alignment and leveling
- Anchoring
- Troubleshooting
- Maintenance
- Pop safety valves (PSV)
 - Open spring type
 - Enclosed spring type
 - Torsion bar type
 - Electromatic type
- Piping of pop safety valves
 - Drip pan elbow
 - Drains from elbow and valve
 - Exhaust head
- Blow down valves
 - Quick opening valves
 - Slow opening valves
 - Seatless valves
 - Hard seated valves
 - Surface blow down valve
 - Continuous blow down valve
 - Blow down piping to the blow down tank
- Piping of a heat exchanger
 - Isolating devices, valves, spectacle-flanges, etc.
- Dump valves or drain valves
- Boiler trim
 - Syphons
- Forced draft fan
- Induced draft fan
- Balanced draft fan
- De-aerator
- Feed water heater
- Condenser water treatment
 - Evaporator
 - Barometric condenser
 - Surface condenser
- Double block and bleed valve systems
- Pressure reducing station

LEARNING TASKS

6. Describe the installation and the purpose of water columns, including pipe sizing

CONTENT

- Economizer
- Inspectors crosses
- Gauge glasses, round and flat
- Simpli port bi-colour
- Tri-cocks
- Gauge glass cocks
- Blow down connection
- Feed water pump controllers

Line (GAC):	I	INSTALL STEAM SYSTEMS
Competency:	I2	Install Piping for Steam and Condensate Systems (High pressure)

Objectives

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

- Describe sizing of pipe.
- Describe the installation of high pressure steam piping systems.

LEARNING TASKS

1. Describe sizing of pipe

2. Describe the installation of high pressure steam piping

CONTENT

- Codes and regulations
- Engineered drawings
- Manufacturers' specifications

- Pipe routing
- Tools and equipment
- Assembly
- Joining methods
- Grade
- Supports
- Clearance
- Protection
 - Mechanical damage
 - Seismic activity
 - Environmental conditions
- Structure penetration
- Flow diagrams

Line (GAC):	I	INSTALL STEAM SYSTEMS
Competency:	I3	Test Steam and Condensate Systems (High pressure)

Objectives

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

- Describe hydrostatic testing for high pressure steam systems.

LEARNING TASKS

1. Describe hydrostatic testing for high pressure steam systems

CONTENT

- Codes and regulations
- Safe work practices
- Components
- Visual pre-check
- Filling
- Venting
- Draining
- Tools and equipment
- Medium
 - Water
 - Glycol
- Lock-out/isolation
- Return to service
- Inspection
 - QA/QC
 - Technical Safety BC
- Documentation
- Medium disposal
 - WHMIS
 - Enviromental regulations

Line (GAC): **I** **INSTALL STEAM SYSTEMS**
Competency: **I4** **Repair Steam Systems (High pressure)**

Objectives

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

- Describe the repair of high pressure steam systems.

LEARNING TASKS

1. Describe repair procedures for high pressure steam systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC): **K APPLY ELECTRICAL CONCEPTS**
Competency: **K3 Apply Single Phase Motor Theory**

Objectives

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

- Describe single phase motors.

LEARNING TASKS

1. Identify motor components
2. Describe characteristics and operation of single phase motors

CONTENT

- Types of components
- AC theory
 - Electromagnetic theory
 - Induction motors

Line (GAC): **K APPLY ELECTRICAL CONCEPTS**
Competency: **K4 Apply Three Phase Motor Theory**

Objectives

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

- Describe three phase motors.

LEARNING TASKS

1. Describe three phase motors

CONTENT

- Three phase supplies
 - Delta supply
 - Wye (Y) supply
- Characteristics
- Components
- Operation

Line (GAC): L **PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**
Competency: L6 **Plan a Project**

Objectives

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

- Plan a gas piping installation.

LEARNING TASKS

1. Determine load
2. Layout the system
3. Size the system
4. Determine material take-off

CONTENT

- Appliance rating plates
- Manufacturers' specifications
- Pressure
- System Regulators
- Regulator locations
- Hangers and supports
- Valve placement
- Drip legs
- Routing
- Piping material
- Pressure
 - 7-14 in WC
 - 2 psig
- Lengths
- Type of gas
- Pressure drop
- Fittings
- Valves
- Hangers and supports
- Regulators
- Pipe and tubing
- Consumables

Achievement Criteria:

- Performance** The learner will be able to:
- Plan a layout of a gas piping installation
 - Sketch an isometric piping drawing
 - Size the piping system
 - Generate a tools and material list

- Conditions** To be assessed during technical training.
 The learner will be given:
- Floor plan with meter and appliance location

	<ul style="list-style-type: none"> • Appliance model number • Piping material • Sketching equipment • Delivery pressure
Criteria	<p>The learner will be evaluated on:</p> <ul style="list-style-type: none"> • Material take-off <ul style="list-style-type: none"> ○ Accuracy • Isometric drawing <ul style="list-style-type: none"> ○ Neatness ○ Accuracy • Code compliance <ul style="list-style-type: none"> ○ Sizing ○ Hanger spacing ○ Valves ○ Drip legs ○ Swing joints ○ Pipe identification

Line (GAC): **M** **INSTALL FUEL SYSTEMS**
Competency: **M4** **Install Air Supply Systems**

Objectives

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

- Describe installation of passive air supply systems.

LEARNING TASKS

1. Describe installation of passive air supply

CONTENT

- Code requirements
- Structural penetrations
- Sealing
- Sheet Metal assembly
 - Drive cleats
 - Esses
 - Tools
- Opening and ducts
 - Terminations
- Traps
- Weather
- Equivalent length of air supply

Line (GAC): **M INSTALL FUEL SYSTEMS**
Competency: **M7 Commission Fuel/Air Delivery Systems**

Objectives

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

- Describe testing and purging procedures for pipe under 4 inch diameter.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| 1. Describe piping and tubing testing requirements | <ul style="list-style-type: none"> • B149.1 • Pressure • Duration • Equipment |
| 2. Describe piping and tubing pressure testing procedures | <ul style="list-style-type: none"> • Air <ul style="list-style-type: none"> ○ Tools ○ Equipment ○ Spools ○ System isolation <ul style="list-style-type: none"> – Lock-out • Inert gases <ul style="list-style-type: none"> ○ Tools ○ Equipment ○ Spools ○ System isolation <ul style="list-style-type: none"> – Lock-out ○ Calculations • Leak (integrity) testing <ul style="list-style-type: none"> ○ Soap test ○ After appliance connection • Valve tightness of closure testing |
| 3. Describe purging procedures for piping and tubing under 4 inch diameter | <ul style="list-style-type: none"> • Code requirements <ul style="list-style-type: none"> ○ Locations ○ Equipment ○ Duration |

Line (GAC):	O	INSTALL PROCESS PIPING SYSTEMS
Competency:	O1	Install Equipment for Process Piping Systems

Objectives

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

- Describe process piping systems.
- Describe the installation of process piping equipment.

LEARNING TASKS

CONTENT

1. Describe process piping systems
 - Types
 - Gas/oil refining
 - Pulp production
 - Mining
 - Food processing
 - Chemical production
 - Ship building
 - Sawmills
 - Manufacturing
 - Codes and regulations
 - Engineered drawings
 - Safe work practices
 - Applications
 - Operation
 - Maintenance
 - Troubleshooting
2. Describe process piping equipment
 - Types
 - Circulating pumps
 - Tanks
 - Pressure vessels
 - Heat exchangers
 - Transfer pumps
 - Holding tanks
 - Relief valves
 - Isolation valves
 - Control valves
 - Strainers
 - Filters
 - Flare stack
 - Characteristics
 - Operation
 - Supports
 - Fasteners

LEARNING TASKS

CONTENT

3. Describe the installation of process piping equipment

- Safe work practices
- Codes and regulations
- Engineered drawings
- Location
- High and low points
- Supports
- Fasteners
- Installation method
 - Manual
 - Mechanical
- Clearances
- Alignment and leveling
- Anchoring

Line (GAC): **O** **INSTALL PROCESS PIPING SYSTEMS**
Competency: **O2** **Install Piping for Process Piping Systems**

Objectives

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

- Describe the installation of process pipe.

LEARNING TASKS

1. Describe process pipe

CONTENT

- Types
 - Metal
 - Plastic
- Applications
- Service requirements
 - Heat
 - Pressure
 - Compatability
 - Erosion
 - Corrosion
 - Scaling
 - Thermal fatigue
 - Mechanical fatigue
 - Creep
 - Metallurgical instability
- Safe work practices
- Codes and regulations
- Engineered drawings
- Tools and equipment
- Assembly
- Joining methods
- Grade
- Supports
- Clearances
- Protection
 - Personnel
 - Mechanical damage
 - Seismic activity
 - Environmental conditions
- Structure penetration

2. Describe the installation of process pipe

Line (GAC): **O INSTALL PROCESS PIPING SYSTEMS**
Competency: **O3 Test Process Piping Systems**

Objectives

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

- Describe testing for process piping systems.

LEARNING TASKS

1. Describe testing for process piping systems

CONTENT

- Safe work practices
- Codes and regulations
- Types
- Visual pre-check
- Lock-out
- Applications
- Tools and equipment
- Test medium
- Components
- Procedures
 - Filling
 - Draining
 - Purging
- Return to service
- QA/QC
- Documentation
- Medium disposal
 - WHMIS

Line (GAC): **O INSTALL PROCESS PIPING SYSTEMS**
Competency: **O4 Repair Process Piping Systems**

Objectives

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

- Describe the repair of process piping systems.

LEARNING TASKS

1. Describe repair procedures for process piping systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC):	P	INSTALL HYDRAULIC SYSTEMS
Competency:	P1	Install Equipment for Hydraulic Systems

Objectives

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

- Describe the principles of hydraulic and fluid power.
- Describe the installation of hydraulic system equipment.

LEARNING TASKS

1. Describe the principles of hydraulic and fluid power

2. Describe hydraulic systems

3. Describe hydraulic system equipment

CONTENT

- Terminology
- Laws and formulas
- Types of fluids
- Characteristics

- Safe work practices
- Codes and regulations
- Types
- Applications
- Operation
- Maintenance
- Troubleshooting

- Types
 - Reservoir tanks
 - Pumps
 - Motors
 - Fittings
 - Valves
 - Cylinders
 - Pistons
 - Actuators
 - Accumulators
 - Fluid coolers
 - Fluid heaters
 - Strainers
 - Filters

- Materials
 - Gaskets
 - Lubricants and seals
 - Brackets
 - Tubing/piping
 - Hoses

- Applications
- Operation

LEARNING TASKS

4. Describe the installation of hydraulic system equipment

CONTENT

- Codes and regulations
- Engineered drawings
- Location
- Tools and equipment
- Supports
- Fasteners
- Installation method
 - Manual
 - Mechanical
- Clearances
- Alignment and leveling
- Controls

Line (GAC):	P	INSTALL HYDRAULIC SYSTEMS
Competency:	P2	Install Piping, Tubing and Hoses for Hydraulic Systems

Objectives

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

- Describe the installation of hydraulic piping.
- Assemble a hydraulic piping system.

LEARNING TASKS

1. Describe hydraulic piping
2. Describe the installation of hydraulic piping

CONTENT

- Types
 - Tubing
 - Hoses
 - Carbon steel
 - Stainless steel
- Applications
- Operation
- Codes and regulations
- Engineered drawings
- Tools and equipment
- Joining methods
- Grade
- Supports
- Clearances
- Protection
 - Mechanical damage
 - Seismic activity
 - Vibration
 - Environmental conditions
- Structure penetration

¹Achievement Criteria

Performance The learner will be able to assemble a hydraulic piping system.

Conditions	To be assessed during technical training. The learner will be given:
------------	---

- Drawings and specifications
- Tools and equipment
- Fittings and materials
- Pump
- Valves
- Actuator

Criteria	The learner will be evaluated on: <ul style="list-style-type: none"> • System operation
----------	--

¹This practical exercise can be replaced with the practical exercise outlined in the Achievement Criteria in Q2 - Install Piping and Tubing for Compressed Air and Pneumatic Systems. Please base your grading sheets on one or the other. The weighting as noted in the Level 4 Assessment Guidelines is 25% of the overall practical mark and is accounted for in Line Q.

Line (GAC): **P** **INSTALL HYDRAULIC SYSTEMS**
Competency: **P3** **Test Hydraulic Systems**

Objectives

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

- Describe testing for hydraulic systems.

LEARNING TASKS

1. Describe testing for hydraulic systems

CONTENT

- Safe work practices
- Types
- Visual pre-check
- Applications
- Lock-out
- Tools and equipment
- Test medium
 - Fluid
- Procedures
 - Filling
 - Draining
 - Purging
- Return to service
- QA/QC
- Documentation
- Medium disposal
 - WHMIS

Line (GAC): **P** **INSTALL HYDRAULIC SYSTEMS**
Competency: **P4** **Repair Hydraulic Systems**

Objectives

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

- Describe the repair hydraulic of systems.

LEARNING TASKS

CONTENT

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Describe repair procedures for hydraulic systems | <ul style="list-style-type: none"> • Codes, standards and regulations • Tools and equipment • Lock-out • Isolate components • Disassemble system • Repair/replace components • Return to service • Documentation |
|---|--|

Line (GAC):	Q	INSTALL COMPRESSED AIR AND PNEUMATIC SYSTEMS
Competency:	Q1	Install Equipment for Compressed Air and Pneumatic Systems

Objectives

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

- Describe compressed air and pneumatic systems.
- Describe the installation of compressed air and pneumatic system equipment.

LEARNING TASKS

CONTENT

- | | |
|---|--|
| 1. Describe compressed air and pneumatic systems | <ul style="list-style-type: none"> • Pneumatic principles and laws • Types • Standards/symbols • Codes and regulations • Hazards/sae work practices • Piping configurations • Contaminants • Components • Controls • Applications • Operation • Maintenance • Troubleshooting |
| 2. Describe compressed air and pneumatic system equipment | <ul style="list-style-type: none"> • Compressors • Receiver tanks • Valves • Dryers • Separators • Filters • Regulators • Lubricators • Compressed gas cylinders • Tanks • Liquid drainers • Applications • Operation |

LEARNING TASKS

3. Describe the installation of compressed air and pneumatic system equipment

CONTENT

- Codes and regulations
- Location
- High and low points
- Tools and equipment
- Supports
- Fasteners
- Installation method
 - Manual
 - Mechanical
- Clearances
- Alignment and leveling
- Anchoring

Line (GAC):	Q	INSTALL COMPRESSED AIR AND PNEUMATIC SYSTEMS
Competency:	Q2	Install Piping and Tubing for Compressed Air and Pneumatic Systems

Objectives

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

- Describe the installation of compressed air and pneumatic piping and tubing.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| 1. Describe compressed air and pneumatic piping and tubing | <ul style="list-style-type: none"> Types <ul style="list-style-type: none"> Carbon steel Stainless steel Copper Plastic |
| 2. Describe the installation of compressed air and pneumatic piping and tubing | <ul style="list-style-type: none"> Applications Engineered drawings Codes and regulations Tools and equipment Joining methods Grade Supports Clearances Protection <ul style="list-style-type: none"> Mechanical damage Seismic activity Site specific conditions Structure penetration |

¹Achievement Criteria

Performance	The learner will be able to assemble a pneumatic piping system.
Conditions	To be assessed during technical training. The learner will be given: <ul style="list-style-type: none"> Drawings and specifications Tools and equipment Fittings and materials
Criteria	The learner will be evaluated on: <ul style="list-style-type: none"> Accuracy

¹This practical exercise can be replaced with the practical exercise outlined in the Achievement Criteria P2 – Install Piping, Tubing and Hoses for Hydraulic Systems. Please base your grading sheets on one or the other. The weighting as noted in the Level 4 Assessment Guidelines is 25% of the overall practical mark and is accounted for in Line Q

Line (GAC): **Q INSTALL COMPRESSED AIR AND PNEUMATIC SYSTEMS**
Competency: **Q3 Test Compressed Air and Pneumatic Systems**

Objectives

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

- Describe testing for compressed air and pneumatic systems.

LEARNING TASKS

1. Describe testing for compressed air and pneumatic systems

CONTENT

- Safe work practices
- Types
- Visual pre-check
- Applications
- Lock-out
- Tools and equipment
- Test medium
 - Air
 - Inert gas
- Procedures
 - Purging
- Return to service
- QA/QC
- Documentation

Line (GAC): **Q INSTALL COMPRESSED AIR AND PNEUMATIC SYSTEMS**
Competency: **Q4 Repair Compressed Air and Pneumatic Systems**

Objectives

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

- Describe the repair of compressed air and pneumatic systems.

LEARNING TASKS

1. Describe repair procedures for compressed air and pneumatic systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC): **R INSTALL HEAT RECOVERY SYSTEMS**
Competency: **R1 Install Equipment for Heat Recovery Systems**

Objectives

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

- Describe heat recovery systems.
- Describe the installation of heat recovery system equipment.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| 1. Describe heat recovery systems | <ul style="list-style-type: none"> • Types • Codes and regulations • Engineered drawings • Safe work practices • Controls • Applications • Operation • Maintenance • Troubleshooting |
| 2. Describe heat recovery equipment | <ul style="list-style-type: none"> • Expansion joints • Pumps • Heat transfer equipment • Heat exchangers • Tanks • Valves • Water treatment equipment |
| 3. Describe the installation of heat recovery system equipment | <ul style="list-style-type: none"> • Codes and regulations • Engineered drawings • High and low points • Tools and equipment • Installation method <ul style="list-style-type: none"> ○ Manual ○ Mechanical • Clearances • Alignment and leveling • Anchoring |

Line (GAC): **R** **INSTALL HEAT RECOVERY SYSTEMS**
Competency: **R2** **Install Piping for Heat Recovery Systems**

Objectives

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

- Describe the installation of heat recovery piping.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| 1. Describe heat recovery piping | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Carbon steel ○ Copper ○ Polyethylene ○ Stainless steel |
| 2. Describe the installation of heat recovery piping | <ul style="list-style-type: none"> • Applications • Codes and regulations • Engineered drawings • Tools and equipment • Joining methods • Grade • Clearances • Protection <ul style="list-style-type: none"> ○ Mechanical damage ○ Seismic activity ○ Site specific conditions • Structure penetration |

Line (GAC): **R INSTALL HEAT RECOVERY SYSTEMS**
Competency: **R3 Test Heat Recovery Systems**

Objectives

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

- Describe testing for heat recovery systems.

LEARNING TASKS

1. Describe testing for heat recovery systems

CONTENT

- Safe work practices
- Types
- Visual pre-check
- Applications
- Lock-out
- Tools and equipment
- Test medium
 - Fluid
 - Air
 - Inert gas
- Procedures
 - Filling
 - Draining
 - Purging
- Return to service
- QA/QC
- Documentation
- Medium disposal
 - WHMIS

Line (GAC): **R** **INSTALL HEAT RECOVERY SYSTEMS**
Competency: **R4** **Repair Heat Recovery Systems**

Objectives

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

- Describe the repair of heat recovery systems.

LEARNING TASKS

1. Describe repair procedures for heat recovery systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC):	S	INSTALL HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION SYSTEMS (HVACR)
Competency:	S1	Install Equipment for HVACR Systems

Objectives

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

- Describe HVACR systems.
- Describe the installation of HVACR equipment.

LEARNING TASKS

1. Describe HVACR systems

2. Describe HVACR equipment

3. Describe the installation of HVACR equipment

CONTENT

- Types
- Codes and regulations
- Hazards/safe work practices
- Controls
- Applications
- Operation
- Refrigeration cycle
- Psychometric chart
- Maintenance
- Troubleshooting
- Compressors
- Condensors
- Heat pumps
- Chillers
- Evaporators
- Cooling towers
- Fin fans
- Co-gen devices
- Liquid receivers
- Accumulators
- Humidifiers
- Plate exchangers
- Safe work practices
- Codes and regulations
- Engineered drawings
- High and low points
- Tools and equipment
- Installation method
 - Manual
 - Mechanical
- Clearances
- Alignment and leveling
- Anchoring

Line (GAC):	S	INSTALL HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION SYSTEMS (HVACR)
Competency:	S2	Install Piping for HVACR Systems

Objectives

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

- Describe the installation of HVACR piping.

LEARNING TASKS

1. Describe HVACR piping

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 2. Describe the installation of HVACR piping | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Carbon steel ○ Copper ○ Alloys • Applications • Safe work practices • Engineered drawings • Codes and regulations • Tools and equipment • Joining methods • Grade • Clearances • Insulation methods • Protection <ul style="list-style-type: none"> ○ Mechanical damage ○ Seismic activity ○ Site specific conditions • Structure penetration |
|--|---|

Line (GAC):	S	INSTALL HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION SYSTEMS (HVACR)
Competency:	S3	Test HVACR Systems

Objectives

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

- Describe testing for HVACR systems.

LEARNING TASKS

1. Describe testing for HVACR systems

CONTENT

- Safe work practices
- Types
- Visual pre-check
- Applications
- Lock-out
- Tools and equipment
- Test medium
 - Fluid
 - Air
 - Inert gas
- Procedures
 - Filling
 - Draining
 - Purging
- Return to service
- QA/QC
- Documentation
- Medium disposal
 - WHMIS

Line (GAC):	S	INSTALL HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION SYSTEMS (HVACR)
Competency:	S4	Repair HVACR Systems

Objectives

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

- Describe the repair of HVACR systems.

LEARNING TASKS

1. Describe repair procedures for HVACR systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC):	T	INSTALL SPECIALITY SYSTEMS
Competency:	T1	Install Equipment for Specialty Systems

Objectives

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

- Geo-thermal heating equipment.
- Solar heating equipment.
- Fire protection equipment.

LEARNING TASKS

1. Describe geo-thermal heating, solar heating and fire protection systems
2. Describe geo-thermal heating and solar heating system equipment
3. Describe fire protection equipment

CONTENT

- Safe work practices
- Types
- Codes and regulations
- Hazards
- Engineered drawings
- Controls
- Applications
- Operation
- Maintenance
- Troubleshooting
- Types
 - Vertical
 - Horizontal
- Components
 - Collectors
 - Heat exchangers
 - Heat dissipation units
 - Valves
 - Pumps
 - Expansion tank
- Applications
- Operation
- Types
 - Wet
 - Dry
- Components
 - Saddles
 - Sprinkler heads
 - Valve stations
 - Air compressor
 - Fire alarm panel
- Applications

LEARNING TASKS

4. Describe the installation of geo-thermal heating, solar heating systems and fire protection equipment

CONTENT

- Operation
- Codes and regulations
- Engineered drawings
- High and low points
- Tools and equipment
- Installation method
 - Manual
 - Mechanical
- Clearances
- Alignment and leveling
- Anchoring

Line (GAC):	T	INSTALL SPECIALITY SYSTEMS
Competency:	T2	Install Piping for Specialty Systems

Objectives

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

- Geo-thermal heating piping.
- Solar heating piping.
- Fire protection piping.

LEARNING TASKS

CONTENT

1. Describe geo-thermal heating, solar heating and fire protection piping
 - Types
 - Carbon steel
 - Copper
 - Polyethylene
 - PEX
 - PEX-AL-PEX
 - Stainless steel
 - Applications
 - Safe work practices
 - Codes and regulations
 - Engineered drawings
 - Tools and equipment
 - Joining methods
 - Grade
 - Clearances
 - Protection
 - Mechanical damage
 - Seismic activity
 - Site specific conditions
 - Structure penetration
2. Describe the installation of geo-thermal heating, solar heating and fire protection piping

Line (GAC):	T	INSTALL SPECIALITY SYSTEMS
Competency:	T3	Test Specialty Systems

Objectives

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

- Geo-thermal heating systems.
- Solar heating systems.
- Fire protection systems.

LEARNING TASKS

1. Describe testing for geothermal heating, solar heating and fire protection systems

CONTENT

- Safe work practices
- Types
- Visual pre-check
- Applications
- Lock-out
- Tools and equipment
- Test medium
 - Fluid
 - Air
 - Inert gas
- Procedures
 - Filling
 - Draining
 - Purging
- Return to service
- QA/QC
- Documentation
- Medium disposal
 - WHMIS

Line (GAC): **T** **INSTALL SPECIALITY SYSTEMS**
Competency: **T4** **Repair Speciality Systems**

Objectives

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

- Geo-thermal heating systems.
- Solar heating systems.
- Fire protection systems.

LEARNING TASKS

1. Describe repair procedures for geo-thermal heating, solar heating and fire protection systems

CONTENT

- Codes, standards and regulations
- Tools and equipment
- Lock-out
- Isolate components
- Disassemble system
- Repair/replace components
- Return to service
- Documentation

Line (GAC):	U	PERFORM COMMISSIONING
Competency:	U1	Prepare Systems for Commissioning, Start-up and Turnover

Objectives

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

- Describe the preparation of a system for commissioning and start-up.

LEARNING TASKS

1. Describe the preparation of a system for commissioning
2. Describe preparation of a system for start-up

CONTENT

- Pre-check
- Labelling and identification
- Hazards/safe work practices
- Purging
- Flushing
 - Chemical
 - Water
 - Steam
- Commissioning equipment
- Permits
- Electrical supply and connections
- Water supply
- Load
- Venting
- Codes
- Manufacturers' specifications
- Remove shipping materials
- Valves test
- Leak test
- Hydrostatic test

Line (GAC): **U PERFORM COMMISSIONING**
Competency: **U2 Balance and Commission Systems**

Objectives

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

- Describe commissioning requirements for piping assemblies.
- Describe commissioning documentation.

LEARNING TASKS

CONTENT

- | | |
|---|--|
| <p>1. Describe commissioning requirements for piping assemblies</p> | <ul style="list-style-type: none"> • Hazards/safe work practices <ul style="list-style-type: none"> ○ Secure area ○ Lock-out ○ Isolation • Engineered drawings <ul style="list-style-type: none"> ○ Manufacturers' specifications ○ Codes and regulations • Tools and equipment • System inspection • Corrective measures • Repairs |
| <p>2. Describe commissioning documentation</p> | <ul style="list-style-type: none"> • Commissioning report • Statement of completion • Regulatory responsibilities |

Section 4

ASSESSMENT GUIDELINES

Assessment Guidelines – Level 1

Level 1 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:		STEAMFITTER/PIPEFITTER LEVEL 1	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	Perform Safety Related Functions	20%	10%
B	Use Tools and Equipment	17%	25%
C	Perform Routine Trade Activities	22%	10%
D	Perform Layout and Installation of Piping and Components	24%	20%
E	Perform Fabrication	15%	35%
F	Use Communication Techniques	2%	0%
	Total	100%	100%
In-school theory / practical subject competency weighting		70%	30%
Final in-school mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Steamfitter/Pipefitter Standardized Level exam		IN-SCHOOL %	

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

Assessment Guidelines – Level 2

Level 2 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:		STEAMFITTER/PIPEFITTER LEVEL 2	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
B	Use Tools and Equipment	17%	25%
C	Perform Routine Trade Activities	12%	15%
D	Perform Layout and Installation of Piping and Components	6%	0%
E	Perform Fabrication	22%	35%
G	Install Heat Tracing Systems (liquid)	4%	0%
H	Install Hydronic Systems	22%	0%
K	Apply Electrical Concepts	1%	0%
L	Plan Gas-Fired System Installations	6%	0%
V	Install Marine Systems	10%	25%
	Total	100%	100%
In-school theory / practical subject competency weighting		60%	40%
Final in-school mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Steamfitter/Pipefitter Standardized Level exam		IN-SCHOOL %	

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

Assessment Guidelines – Level 3

Level 3 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:		STEAMFITTER/PIPEFITTER LEVEL 3	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
C	Perform Routine Trade Activities	6%	30%
G	Install Heat Tracing Systems (steam)	2%	0%
H	Install Hydronic Systems	20%	40%
I	Install Steam Systems (low pressure)	20%	0%
J	Install Industrial Water and Waste Systems	8%	0%
K	Apply Electrical Concepts	12%	30%
L	Plan Gas-Fired Systems Installations	14%	0%
M	Install Fuel Systems	14%	0%
N	Install Medical Gas Systems	2%	0%
W	Install Backflow Prevention	2%	0%
	Total	100%	100%
In-school theory / practical subject competency weighting		90%	10%
Final in-school mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Steamfitter/Pipefitter Standardized Level exam		IN-SCHOOL %	

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

Assessment Guidelines – Level 4

Level 4 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:		STEAMFITTER/PIPEFITTER LEVEL 4	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
B	Use Tools and Equipment	13%	65%
C	Perform Routine Trade Activities	2%	0%
F	Use Communication Techniques	1%	0%
I	Install Steam Systems (high pressure)	22%	0%
K	Apply Electrical Concepts	2%	0%
L	Plan Gas-Fired Systems Installations	2%	10%
M	Install Fuel Systems	10%	0%
O	Install Process Piping Systems	11%	0%
¹ P	Install Hydraulic Systems	11%	0%
¹ Q	Install Compressed Air and Pneumatic Systems	11%	25%
R	Install Heat Recovery Systems	1%	0%
S	Install Heating, Ventilation, Air Conditioning and Refrigeration Systems (HVACR)	11%	0%
T	Install Specialty Systems	2%	0%
U	Perform Commissioning	1%	0%
	Total	100%	100%
In-school theory / practical subject competency weighting		90%	10%
Final in-school mark 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 %	

¹The practical exercises in P2 – Install Piping, Tubing and Hoses for Hydraulic Systems and Q2 – Install Piping and Tubing for Compressed Air and Pneumatic Systems are not intended to both be done for a practical mark. Please choose one based on the type of equipment available at your training institution. Your grading sheets should reflect one practical or the other. The weighting as noted in the Level 4 Assessment Guidelines is 25% of the overall practical mark and is accounted for in Line Q

All apprentices who complete Level 4 of the Steamfitter/Pipefitter 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' Steamfitter/Pipefitter Interprovincial Red Seal examination percentage score into SkilledTradesBC Portal.

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

Section 5

TRAINING PROVIDER STANDARDS

Facility Requirements

Classroom Area

- Minimum 22 square feet per student
- Compliance with the local and national fire code and occupational safety requirements
- Meets applicable municipal zoning bylaws for technical instruction and education facilities
- Comfortable seating and tables suitable for learning
- Overhead and multimedia projectors and screen
- Whiteboard with marking pens and erasers
- Heating/air conditioning
- Lighting controls (windows and fixtures) for screen viewing
- Acoustics that allow audibility of the instructor

Shop Area

- Compliance with the local and national fire code and occupational safety requirements
- Meets applicable municipal zoning bylaws for technical instruction and education facilities
- Minimum 3,000 square feet of shop area including a tool crib and work stations
- Minimum 10 foot ceiling height for shop and lab areas
- Minimum 20 foot ceiling for rigging practical as outlined in this program outline
- Adequate heating, lighting and ventilation
- Refuse and recycling bins
- First-aid equipment
- Shops will be equipped to support the practical lab exercises as outlined in this program outline

Lab Requirements

- See shop and classroom area requirements

Student Facilities

- Adequate eating area as per WorkSafeBC requirements (4.84 OHS Regulation and Guidelines)
- Adequate washroom facilities as per WorkSafeBC requirements (4.85 OHS Regulation and Guidelines)

Instructor's Office Space

- Adequate space for student consultation
- Desk and filing space
- Computer
- Internet access
- Printer
- Stationary supplies
- Adequate storage facilities for material and training aids
- Access to photocopier
- Telephone

Tools and Equipment

Shop (Facility) Tools and Equipment

Hand Tools

Alignment clamps (external and internal)	Pinch bars
Angle finder	Pipe cutters (single-wheel, multi-wheel)
Bench, power vise (power driver pliers)	Pipe reamer (spiral, fluted)
Bending tools (hand and hydraulic)	Pipe tap
Bolt cutter	Pipe threader
Bolt die	Pipe vises (chain and jokes, tri-stand and bench, power vise (power drive))
Bolt tap	Pipe stands
Centering head	Pliers
C-clamp	Prying tool
Centre punch	Ratchet
Cold chisels	Screwdrivers
Contour markers	Shear
Drafting accessories	Pipe stands
Files	Spacing tool
Flange alignment pins	Swaging tool
Flange spreader (jacks)	Tip cleaner
Flaring tool	Tube cleaner
Gasket cutter	Tube benders
Hacksaws (hand, portable band, large band)	Vise-grip™ pliers
Hammers (ball peen, chipping, sledge, soft-face, dead-blow)	Wrap-around™
Hand beveller	Wrenches (adjustable/crescent, chain, combination (open/closed end), hammer, hex-key, non-spark, pin, pipe, socket, torque)
Hole punch	
Levels (laser, standard, builder's, digital (smart))	
Marking tool	

Power Tools

Air compressor	Grooving machine
Beveling tools (hand, electric drive, oxy-fuel)	Hydraulic jacks
Bending machine	Hydrostatic pump
Drills (electric, pneumatic, hammer, bench or stand press, mag)	Impact driver
Facing tool	Portable end-prep milling (pneumatic, electric)
Grinders (electric or pneumatic) angle, bench, die pedestal	Powder-actuated tools
	Saws (circular, cut-off, jig, sabre)
	Threading machine

Welding and Cutting Equipment

Arc welders	Regulator
Compressed gas cylinders (purge, shield cutting)	Torches (oxy-fuel cutting, heating and welding)
Flashback arrestor	Welding machines (SMAW, GMAW, GTAW)

Testing and Measuring Tools

Ampere probe	Measuring tape
Calipers	Manometer
Feeler gauge	Micrometer
Gauges (temperature, pressure, liquid, vacuum, specialty)	Multimeter
Draft gauge	Plumb bob
Leak detector	Squares (24 in. combination, flange straightedge)
Infrared temperature sensor	Thermometer

Rigging and Hoisting Equipment

Beam clamps
Cable clips
Chain block
Chain falls
Come-along
Eye bolts
Grip hoist (Tirfor™)

Jacks (hydraulic, ram and piston)
Rope
Shackles
Slings (nylon, wire rope, wire mesh)
Snatch block
Softeners

Ladders and Platforms

Combination ladder
Extension ladder

Scaffolding (staging)

Personal Protective and Safety Equipment

Eye wash kit
Face shield
Fire extinguisher
First aid kit
Hearing protection

Lock-out devices
Safety glasses/goggles
Safety harness, lanyard, and life line
Welding gloves
Welding helmet

Student Tools (supplied by student)

Required

- Hard hat (CSA approved)
- Calculator (SkilledTradesBC approved)
- Safety boots (CSA approved)

Recommended

- Dust mask/respirator

Reference Materials

Required Reference Materials

- IPT's Pipe Trades Handbook
- WorkSafeBC Regulations (online)
- Student Materials Package
- CAN/ CSA B149.1 current
- CAN/ CSA C22.1 (current)
- Technical Safety BC (formerly BCSA) Safety Standards General Regulation
- Technical Safety BC (formerly BCSA) Gas Safety Regulation
- Technical Safety BC (formerly BCSA) Safety Standards Act

Recommended Resources

- CSA Gas Trade Training Modules, ISBN 978-1-4883-0127-8
- Low Pressure Boilers, Frederick M. Steingrass, Daryl R. Walker, American Technical Publishers, ISBN 978-0-8269-4365-1
- High Pressure Boilers, Frederick M. Steingrass, Harold J. Frost, Daryl R. Walker, American Technical Publishers, ISBN 978-0-8269-4315-6
- IPT's Guide to Blueprint Interpretation
- CAN/ CSA B.214 Installation of Hydronic Heating Systems
- Modern Heating – Seigenthaler
- Fundamentals of Gas Utilization – Dutton
- Design of Fluid Systems – Spirex Sarco

Suggested Texts/Websites

- Technical Safety BC (formerly BC Safety Authority), www.technicalsaftybc.ca
- TECA, Thermal Environmental Comfort Association, www.teca.ca
- SkilledTradesBC www.skilledtradesbc.ca
- CSA, www.csagroup.org
- Red Seal, www.red-seal.ca
- WorkSafeBC, www.worksafebc.com

NOTE:

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

Instructor Requirements

Occupation Qualification

The instructor must possess:

- Steamfitter/Pipefitter – Certificate of Qualification with Red Seal endorsement.

Additionally, all Steamfitter/Pipefitter instructors delivering Red Seal Gasfitter - Class B content must possess one of the following:

- SkilledTradesBC Gasfitter - Class B Certificate of Qualification (C of Q) with Interprovincial Red Seal endorsement
- OR**
- SkilledTradesBC Gasfitter – Class A Certificate of Qualification (C of Q) with Interprovincial Red Seal endorsement

Work Experience

- A minimum of 5 years' experience working in the industry as a Steamfitter/Pipefitter journey person after Red Seal certification; and
- A minimum of 5 years' experience working in the industry as a Gasfitter - Class B after Certificate of Qualification.

Instructional Experience and Education

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

- Provincial (BC) Instructor Diploma or equivalent
- Bachelor's Degree in Education
- Master's Degree in Education
- AND**
- 2 years supervisory or administrative experience
- Experienced user of relevant software
 - Word processing
 - Spreadsheets
 - Presentations

Appendices

Appendix A Acronyms

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASOPE	American Society of Power Engineers
AST	Aboveground storage tank
ASTM	American Society of Testing and Materials
BHP	Boiler horse power
Btuh	British thermal units per hour
CAPS	Combustion Air Proving Switch
CEC	Canadian Electrical Code
CEMS	Continuous emissions monitoring system
CPVC	Chlorinated polyvinyl chloride
CSA	Canadian Standards Association
CSST	Corrugated Stainless Steel Tubing
DFMA	Direct-Fired Make-up Air
ECM	Electronically commutated motors
ESP	External static pressure
EXV	Electronic expansion valve
FGR	Flue gas recirculation
HGPS	High gas pressure switch
HMI	Human-machine interface
HRT	Horizontal return tubular (boiler)
ICI	Industrial, commercial and institutional
IR	Infrared
ISO	International Organization for Standardization
kW	kilowatts
LAER	Lowest achievable emission rate
LEED	Leadership in Energy and Environmental Design
LGPS	Low gas pressure switch
LON	Local operation network
LP Gas	Liquified Petroleum Gas
mA	milliamps
MAWP	Maximum allowable working pressure
MCC	Motor control centre
MTFI	Mainflame Trial For Ignition
mV	millivolts
MSDS	Material Safety Data Sheet
MSW	Municipal solid waste
NAAQS	National Ambient Air Quality Standards
NAPE	National Association of Power Engineers
NBC	National Building Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NSPS	New Source Performance Standards

NRR	Noise reduction rating number
OH&S	Occupational Health and Safety
OS&Y	Outside stem and yoke (valve)
PLC	Programmable logic controller
PPE	Personal protective equipment
PRV	Pressure reducing valve
PTFI	Pilot trial for ignition
PVC	Programmable logic controller
RPM	Revolutions per minute
RTD	Resistance temperature detector
SCR	Selective catalytic reduction
TDG	Transportation of dangerous goods
TXV	Thermostatic expansion valve
UL	Underwriters Laboratories
ULC	Underwriters Laboratories of Canada
UST	Underground storage tank
VFD	Variable frequency drive
VSD	Variable speed drive
WHMIS	Workplace Hazardous Materials Information System

Appendix B Previous Contributors

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Resource Training Organization (RTO). Members included:

- Steve Anderson Department of National Defense
- Danny Bradford BC Federation of Labour
- Larry Doskoch Teck
- Dana Goedbloed Kwantlen Polytechnic University
- Wayne Muzykowski West Fraser (Eurocan Pulp and Paper)
- James Piwek Teck
- Brad Smith Catalyst Paper
- Cindy Soderstrom CADODC (Rig Tech Trade)
- Gene Von Matt Elk Valley Coal
- Wayne Wetmore Enform Training
- Trevor Williams BC Institute of Technology (BCIT)

Industry Subject Matter Experts retained to assist in the development of the Program Outline (2012):

- Bill Johnston (Instructor) BC Institute of Technology
- Dave Sales (Instructor) Piping Industry Apprenticeship Board School
- Rick Vanier (Instructor) Pacific Vocational College
- Charlie Bowne Canadian Forces
- Glen Sanders Teck
- Rob English Canadian Maritime Engineering

Appendix C Technical Safety BC Requirements

(in support of Gasfitter – Class B training)

Gasfitter – Class B Exam administered by Technical Safety BC:

- Successful completion of Steamfitter/Pipefitter Technical Training Levels 1 – 4
- SkilledTradesBC transcript demonstrating a minimum 1,500 work based training hours in the Gasfitter – Class B program (3,000 total); **AND**
- Be registered on an official class list provided by an approved training institution for **Gasfitter – Class B Level 2** technical training

Tools and Equipment

(to be used in coordination with the program Tools and Equipment list beginning on page 206)

Level One (Class B) Apprenticeship

- 1 threading machine (power drive with threading attachment) for every 4 students
- 1 oxy/acetylene cutting outfit for every 8 students
- 1 fuel/air brazing unit for every 4 students
- 1 flaring tool for every 8 students
- 1 tubing bender for every 8 students