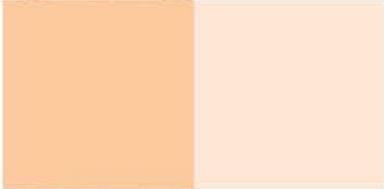


**ita**  
**YOUR TICKET.**



## PROGRAM OUTLINE

### Steamfitter/Pipefitter





The latest version of this document is available in PDF format on the ITA website  
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# **STEAMFITTER/PIPEFITTER PROGRAM OUTLINE**

**APPROVED BY INDUSTRY  
NOVEMBER 2011**

**BASED ON  
NOA 2010**

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



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# **Section 1**

## **INTRODUCTION**

### **Steamfitter/Pipefitter**



## Foreword

The Program Standards for Steamfitter/Pipefitter 2011 were updated through a Standards Review project funded by the Industry Training Authority. These revised standards incorporate changes made to the National Occupational Analysis (Steamfitter / Pipefitter) released in 2010.

### **SAFETY ADVISORY**

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



## Acknowledgements

The Program Outline was prepared with the advice and direction of key stakeholders from industry sectors including employers, associations, training providers, and trades workers.

### Project Review Committee

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

Industry Subject Matter Experts retained to assist in the development of Program Outline content 2008-09:

Name	Organization	Position	Sector
Bill Johnston	BCIT	Instructor	Education
Dave Sales	Piping Industry Apprenticeship Board School	Instructor	Education / Organized Labour
Rick Vanier	Pacific Vocational College	Instructor	Education
Charlie Bowne	Canadian Forces	Steamfitter / Pipefitter	Shipbuilding
Glen Sanders	Teck	Steamfitter / Pipefitter	Mining
Rob English	Canadian Maritime Engineering	Steamfitter / Pipefitter	Marine Repair

Minor modifications were made to the Program Outline in 2011 to address changes made to the NOA in 2010. These modifications were reviewed and validated with a small group of Industry Subject Matter Experts.

The Industry Training Authority would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the 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
<b>Program Credentialing Model</b>	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
<b>OAC</b>	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
<b>Training Topics and Suggested Time Allocation</b>	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	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
<b>Program Content</b>	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	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



Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
<b>Training Provider Standards</b>	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

**Appendix A – Glossary of Acronyms** – Defines program specific acronyms

## Achievement Standards

The Achievement Standards for each Competency in the Program Outline will define and help guide assessment of competent performance. They define what competence looks like and give guidance to assess whether a person has achieved each of the standards described in this program outline.

<b>Achievement Criteria</b>	Define what performance is expected in the technical training environment (theory tests and lab based theory assessments and practical exercises).
<b>Workplace Achievement Criteria</b>	References the application of theory learning to performance in the workplace. It guides the employer and apprentice to understand their roles in training and is intended as an example of a criterion to reference performance. Employers determine the level of competence and accuracy with which tasks are performed.

The Achievement Standards guide assessment of competent performance but are not intended to be exclusive or exhaustive.

For example: one criterion referenced is “*the learner must achieve a minimum of 70% on a multiple choice exam...*” This is intended as an example of a criterion to reference performance against but it is possible to use other theory assessment methods.

Technical training programs are able to use learning and assessment materials that fit their own curriculum, so long as the program of instruction incorporates theory assessment referenced against each standard, either in a stand-alone form, or as part of a summative assessment.

Similarly in the **Workplace Achievement Criteria**, the specifics of what performance is used to judge competence in the workplace will vary with the type of work each industry sector requires. The Criteria are intended to be used as a guide to evaluating an equivalent level of performance across different workplace situations as well as across different industry sectors.



# **Section 2**

## **PROGRAM OVERVIEW**

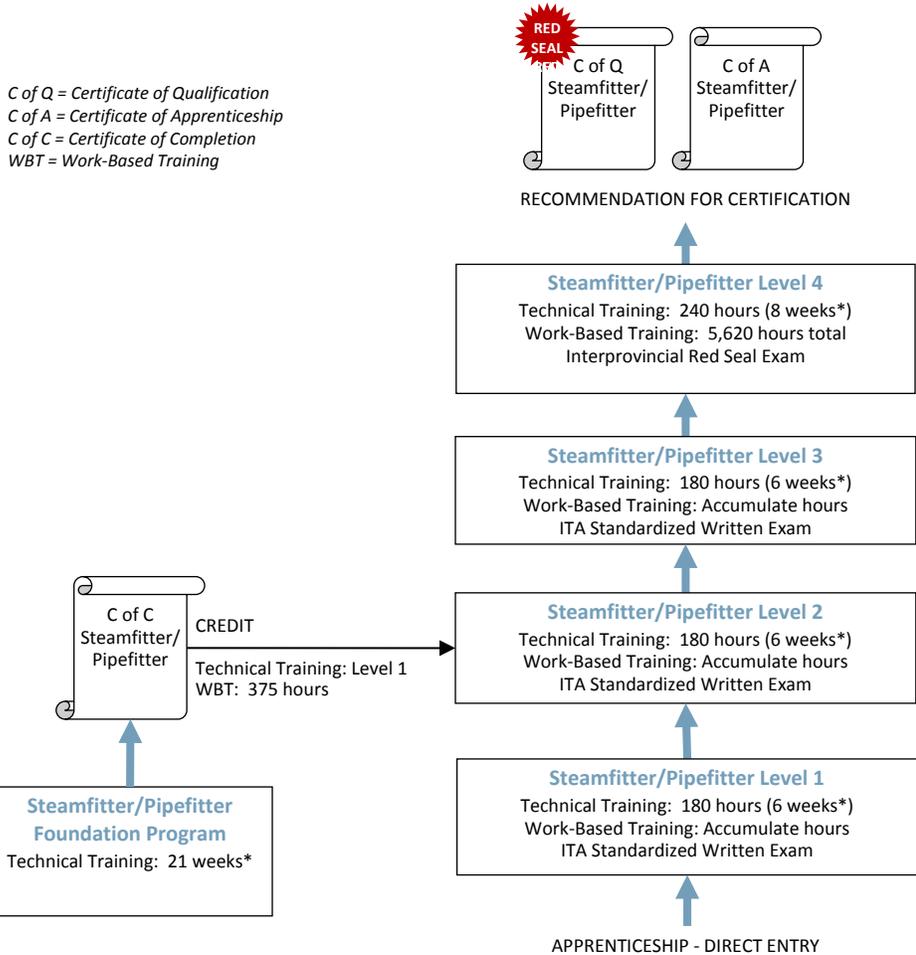
### **Steamfitter/Pipefitter**



# Program Credentialing Model

## Apprenticeship Pathway

This graphic provides an overview of the Steamfitter/Pipefitter apprenticeship pathway.



\*Suggested duration based on 30-hour week

### CROSS-PROGRAM CREDITS

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

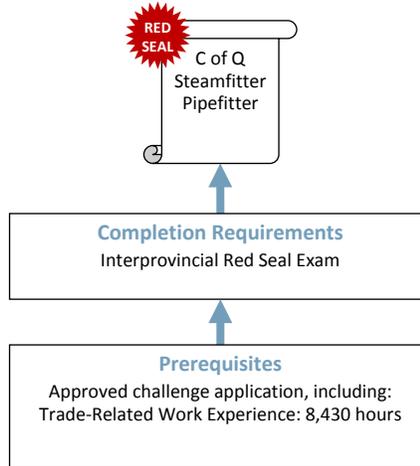




## Challenge Pathway

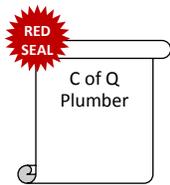
This graphic provides an overview of the Steamfitter/Pipefitter challenge pathway.

*C of Q = Certificate of Qualification*



### CREDIT FOR PRIOR LEARNING

*Individuals who hold the credentials listed below are considered to have met or partially met the prerequisites for challenging this program*



Workplace hours: 5,620 hours



Workplace hours: 5,620 hours



## Occupational Analysis Chart

### STEAMFITTER/PIPEFITTER

**Occupation Description:** “Steamfitter/Pipefitter” means a person who installs, alters or repairs steam and hot water boilers and system for the generation and conveyance of steam and hot water and process piping systems in industrial project or manufacturing plants.

<b>Safe Work Practices</b> A	Control workplace hazards A1	Describe occupational health and safety regulations A2	Describe WHMIS and hazardous materials safety A3	Use personal protective equipment A4	Practice fire prevention A5	
	1	1	1	1	1	
<b>Use Tools and Equipment</b> B	Use hand tools B1	Use ladders and platforms B2	Use cutting, brazing and soldering equipment B3	Use measuring and leveling tools B4	Use rigging and hoisting equipment B5	Use portable power tools B6
	1	1	1	1   2	1   2	1
	Use stationary power tools B7					
	1					
<b>Organize Work</b> C	Use mathematics and science (including electricity) C1	Read drawings and specifications C2	Use codes, regulations and standards C3	Use manufacturer and supplier documentation C4	Plan a project C5	
	1   2	1   2   3   4	1	1	2   3   4	
<b>Prepare and Assemble Piping Components</b> D	Join pipe D1	Select and install valves D2	Select and install fittings D3	Describe methods of penetrating structures D4	Describe pumps D5	
	1   2	1	1	1	2	



<b>Install Hydronic Heating and Cooling</b> <span style="float: right;">E</span>	Describe the operation of hydronic heating and cooling piping systems <span style="float: right;">E1</span>	Describe controls for hydronic heating and cooling systems <span style="float: right;">E2</span>	Install, test and commission hydronic heating and cooling systems <span style="float: right;">E3</span>	Maintain and repair hydronic heating and cooling systems <span style="float: right;">E4</span>			
	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
<b>Perform Layout, Fabrication and Installation</b> <span style="float: right;">F</span>	Prepare pipe and fittings <span style="float: right;">F1</span>	Develop and use templates <span style="float: right;">F2</span>	Develop a simple spool sheet <span style="float: right;">F3</span>	Fabricate from spool sheets <span style="float: right;">F4</span>	Use welding equipment <span style="float: right;">F5</span>	Bend pipe <span style="float: right;">F6</span>	
	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
	Install supports, hangers, guides and anchors <span style="float: right;">F7</span>	Erect a piping assembly <span style="float: right;">F8</span>	Test and commission a piping assembly <span style="float: right;">F9</span>				
	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>				
	<b>Special Application Systems</b> <span style="float: right;">G</span>	Install marine systems piping <span style="float: right;">G1</span>	Install fuel oil piping systems <span style="float: right;">G2</span>	Install low pressure steam piping systems <span style="float: right;">G3</span>	Install high pressure steam piping systems <span style="float: right;">G4</span>	Describe feedwater treatment systems <span style="float: right;">G5</span>	Install fire protection piping systems <span style="float: right;">G6</span>
		<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> 3 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
		Install hydraulic piping systems <span style="float: right;">G7</span>	Install pneumatic and compressed air piping systems <span style="float: right;">G8</span>	Install process piping systems <span style="float: right;">G9</span>	Install air conditioning piping systems <span style="float: right;">G10</span>	Install refrigeration piping systems <span style="float: right;">G11</span>	Install medical gas piping systems <span style="float: right;">G12</span>
		<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 4 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 4 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 4 <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 4 <input type="checkbox"/> <input type="checkbox"/>
		Install instrumentation piping systems <span style="float: right;">G13</span>	Describe renewable energy systems <span style="float: right;">G14</span>				
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 4 <input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 4 <input type="checkbox"/> <input type="checkbox"/>					



<b>Water Supply</b> <span style="float: right;">H</span>	Describe potable water distribution systems  <span style="float: right;">H1</span>	Describe the installation of cross connection assemblies  <span style="float: right;">H2</span>	Test and commission cross connection assemblies  <span style="float: right;">H3</span>		
	3	3	3		
<b>Install Natural Gas and Propane Systems</b> <span style="float: right;">I</span>	Install and service fuel gas systems  <span style="float: right;">I1</span>	Install and service fuel gas controls and safeguards  <span style="float: right;">I2</span>	Install and service fuel gas equipment  <span style="float: right;">I3</span>	Install venting and air supply  <span style="float: right;">I4</span>	Apply gas codes, regulations and standards  <span style="float: right;">I5</span>
	3 4	4	4	4	4



## Training Topics and Suggested Time Allocation

### Steamfitter/Pipefitter – Level 1

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line A</b>	<b>Safe Work Practices</b>	<b>20%</b>	<b>55%</b>	<b>45%</b>	<b>100%</b>
A1	Control workplace hazards		✓	✓	
A2	Describe occupational health and safety regulations		✓	✓	
A3	Describe WHMIS and hazardous materials safety		✓	✓	
A4	Use personal protective equipment		✓	✓	
A5	Practice fire prevention		✓		
<b>Line B</b>	<b>Use Tools and Equipment</b>	<b>30%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
B1	Use hand tools		✓	✓	
B2	Use ladders and platforms		✓	✓	
B3	Use cutting, brazing and soldering equipment		✓	✓	
B4	Use measuring and leveling tools		✓	✓	
B5	Use rigging and hoisting equipment		✓	✓	
B6	Use portable power tools		✓	✓	
B7	Use stationary power tools		✓	✓	
<b>Line C</b>	<b>Organize Work</b>	<b>30%</b>	<b>45%</b>	<b>55%</b>	<b>100%</b>
C1	Use mathematics and science (including electricity)		✓	✓	
C2	Read drawings and specifications		✓	✓	
C3	Use codes, regulations and standards		✓	✓	
C4	Use manufacturer and supplier documentation			✓	
<b>Line D</b>	<b>Prepare and Assemble Piping Components</b>	<b>20%</b>	<b>55%</b>	<b>45%</b>	<b>100%</b>
D1	Join pipe		✓	✓	
D2	Select and install valves		✓	✓	
D3	Select and install fittings		✓	✓	
D4	Describe methods of penetrating structures		✓	✓	
<b>Total Percentage for Steamfitter/Pipefitter Level 1</b>		<b>100%</b>			



## Training Topics and Suggested Time Allocation

### Steamfitter/Pipefitter – Level 2

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line B</b>	<b>Use Tools and Equipment</b>	<b>8%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
B4	Use measuring and leveling tools		✓	✓	
B5	Use rigging and hoisting equipment		✓	✓	
<b>Line C</b>	<b>Organize Work</b>	<b>9%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
C1	Use mathematics and science (including electricity)		✓	✓	
C2	Read drawings and specifications		✓	✓	
C5	Plan a project		✓	✓	
<b>Line D</b>	<b>Prepare and Assemble Piping Components</b>	<b>8%</b>	<b>75%</b>	<b>25%</b>	<b>100%</b>
D1	Join pipe		✓	✓	
D5	Describe pumps		✓		
<b>Line E</b>	<b>Install Hydronic Heating and Cooling</b>	<b>27%</b>	<b>55%</b>	<b>45%</b>	<b>100%</b>
E1	Describe the operation of hydronic heating and cooling piping systems		✓		
E2	Describe controls for hydronic heating and cooling systems		✓	✓	
E3	Install, test and commission hydronic heating and cooling systems		✓	✓	
E4	Maintain and repair hydronic heating and cooling systems		✓	✓	
<b>Line F</b>	<b>Perform Layout, Fabrication and Installation</b>	<b>30%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
F1	Prepare pipe and fittings		✓	✓	
F2	Develop and use templates		✓	✓	
F3	Develop a simple spool sheet			✓	
F4	Fabricate from spool sheets		✓	✓	
F5	Use welding equipment		✓	✓	
F6	Bend pipe		✓	✓	
F7	Install supports, hangers, guides and anchors		✓	✓	
F8	Erect a piping assembly		✓	✓	
F9	Test and commission a piping assembly				✓
<b>Line G</b>	<b>Special Application Systems</b>	<b>18%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
G1	Install marine systems piping		✓	✓	
G7	Install hydraulic piping systems		✓	✓	
G8	Install pneumatic and compressed air piping systems		✓	✓	
<b>Total Percentage for Steamfitter/Pipefitter Level 2</b>		<b>100%</b>			



## Training Topics and Suggested Time Allocation

### Steamfitter/Pipefitter – Level 3

% of Time Allocated to:

		% of Time	Theory	Practical	Total
<b>Line C</b>	<b>Organize Work</b>	<b>10%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
C2	Read drawings and specifications		✓	✓	
C5	Plan a project		✓	✓	
<b>Line G</b>	<b>Special Application Systems</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>100%</b>
G2	Install fuel oil piping systems		✓	✓	
G3	Install low pressure steam piping systems		✓	✓	
G4	Install high pressure steam piping systems		✓	✓	
G5	Describe feedwater treatment systems		✓	✓	
G6	Install fire protection piping systems		✓	✓	
<b>Line H</b>	<b>Water Supply</b>	<b>15%</b>	<b>75%</b>	<b>25%</b>	<b>100%</b>
H1	Describe potable water distribution systems		✓		
H2	Describe the installation of cross connection assemblies		✓		
H3	Test and commission cross connection assemblies		✓	✓	
<b>Line I</b>	<b>Install Natural Gas and Propane Systems</b>	<b>15%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
I1	Install and service fuel gas systems		✓	✓	
<b>Total Percentage for Steamfitter/Pipefitter Level 3</b>		<b>100%</b>			



## Training Topics and Suggested Time Allocation

### Steamfitter/Pipefitter – Level 4

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line C</b>	<b>Organize Work</b>	<b>10%</b>	<b>75%</b>	<b>25%</b>	<b>100%</b>
C2	Read drawings and specifications		✓	✓	
C5	Plan a project		✓		
<b>Line G</b>	<b>Special Application Systems</b>	<b>40%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
G9	Install process piping systems		✓	✓	
G10	Install air conditioning piping systems		✓	✓	
G11	Install refrigeration piping systems		✓	✓	
G12	Install medical gas piping systems		✓	✓	
G13	Install instrumentation piping systems		✓	✓	
G14	Describe renewable energy systems	✓			
<b>Line I</b>	<b>Install Natural Gas and Propane Systems</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
I1	Install and service fuel gas systems		✓	✓	
I2	Install and service fuel gas controls and safeguards		✓	✓	
I3	Install and service fuel gas equipment		✓	✓	
I4	Install venting and air supply		✓	✓	
I5	Apply gas codes, regulations and standards	✓	✓		
<b>Total Percentage for Steamfitter/Pipefitter Level 4</b>		<b>100%</b>			



# **Section 3**

## **PROGRAM CONTENT**

### **Steamfitter/Pipefitter**



# Level 1

## Steamfitter/Pipefitter





**Achievement Criteria**

Given information on short-term and long-term hazards, safety precautions when working at elevations, non-emergency injury reporting procedures, workplace safety policies and lock out and tag procedures, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks that include taking safety precautions at elevations, lock out and tag procedures. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on short-term and long-term hazards, safety precautions when working at elevations, non-emergency injury reporting procedures, workplace safety policies and lock out and tag procedures, the learner must correctly follow procedures, policies and be aware of safety precautions at all times. Procedures and policies relating to potential long and short-term hazards, safety precautions, safety policies and lock out and tag procedures are imperative. Employer assessed accuracy is required for each task.



**Line (GAC):**        **A    Safe Work Practices**  
**Competency:**       **A2   Describe occupational health and safety regulations**

**Objectives**

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

- Locate the parts of the Occupational Health and Safety Regulation as it applies to the steamfitter/pipefitter workplace.
- Identify hazards that are found in the steamfitter/pipefitter workplace.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Define key terms used in the Workers Compensation Act</li> <li>2. Describe the conditions under which compensation is paid</li> <li>3. Describe the general duties of employers, employees and others</li> <li>4. Describe the WorkSafeBC requirements for the reporting of accidents</li> <li>5. Describe the “Core Requirements” of the Occupational Health and Safety Regulation</li> </ol> | <ul style="list-style-type: none"> <li>• Applicable terms</li> <li>• Applicable regulations</li> <li>• Applicable regulations</li> <li>• Applicable requirements and procedures</li> <li>• Definitions</li> <li>• Application</li> <li>• Rights and Responsibilities <ul style="list-style-type: none"> <li>○ Health and safety programs</li> <li>○ Young worker orientation</li> <li>○ Contractor's safety policy manuals</li> <li>○ Investigations and reports</li> <li>○ Workplace inspections</li> <li>○ Right to refuse work</li> </ul> </li> <li>• General Conditions <ul style="list-style-type: none"> <li>○ Building and equipment safety</li> <li>○ Emergency preparedness</li> <li>○ Preventing violence</li> <li>○ Working alone</li> <li>○ Ergonomics</li> <li>○ Illumination</li> <li>○ Indoor air quality</li> <li>○ Smoking and lunchrooms</li> </ul> </li> </ul> |
| <ol style="list-style-type: none"> <li>6. Identify the hazards and safety procedures in the steamfitter/pipefitter workplace</li> </ol>  | <ul style="list-style-type: none"> <li>• Chemical and biological substances</li> <li>• Substance specific requirements</li> <li>• Noise, vibration, radiation and temperature</li> <li>• Personal protective clothing and equipment</li> <li>• Confined spaces</li> <li>• De-energization and lockout</li> <li>• Fall protection</li> <li>• Tools, machinery and equipment</li> </ul>   |

**LEARNING TASKS****CONTENT**

- Ladders, scaffolds and temporary work platforms
- Cranes and hoists
- Rigging
- Mobile equipment
- Transportation of workers
- Traffic control
- Electrical safety

**Achievement Criteria**

Given information on the Workers Compensation Act, WorkSafeBC requirements for accident reporting, core requirements of the Occupational Health and Safety Regulation as well as potential hazards and safety procedures, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to include occupational health and safety regulations, potential hazards and safety procedures. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on the Workers Compensation Act, WorkSafeBC requirements for accident reporting, core requirements of the Occupational Health and Safety Regulation as well as potential hazards and safety procedures, the learner must correctly follow procedures and policies at all times. Procedures and policies relating to occupational health and safety are highly important. Employer assessed accuracy is required for each task.



**Line (GAC):           A    Safe Work Practices**  
**Competency:         A3   Describe WHMIS and hazardous materials safety**

**Objectives**

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

- Describe the purpose of the Workplace Hazardous Materials Information System (WHMIS) Regulations.
- Explain the contents of material safety data sheets (MSDS).
- Explain the contents of a WHMIS label and apply WHMIS regulations.

**LEARNING TASKS**

1. Describe the regulations that require suppliers of hazardous materials to provide material safety data sheets (MSDSs) and label products as a condition of sale and importation
2. State the purpose of the Workplace Hazardous Materials Information System (WHMIS)
3. Describe the key elements of WHMIS
4. Describe the responsibilities of suppliers under WHMIS
5. Describe the responsibilities of employers under WHMIS
6. Describe information to be disclosed on a MSDS

**CONTENT**

- Hazardous Product Act
- Controlled Products Regulations
- Ingredient Disclosure List
- Hazardous Materials Information Review Act
- Protection of Canadian workers from the adverse effects of hazardous materials through the provision of relevant information while minimizing the economic impact on industry and the disruption of trade
- Recognition of rights
  - Workers
  - Employers
  - Suppliers
  - Regulators
- Material safety data sheets (MSDSs)
- Labeling of containers of hazardous materials
- Worker education programs
- MSDSs
- Labels
- MSDSs
- Labels
- Work education programs in the workplace
- Hazardous ingredients
- Preparation information
- Product information
- Physical data
- Fire or explosion
- Reactivity data
- Toxicological properties

**LEARNING TASKS**

7. Identify symbols found on WHMIS labels and their meaning
  
8. Apply WHMIS regulations as they apply to hazardous materials used in the shop

**CONTENT**

- Preventive measures
- First-aid measures
  
- Compressed gases
- Flammable and combustible materials
- Oxidizing materials
- Poisonous and infectious materials
  - Materials causing immediate and serious toxic effects
  - Materials causing other toxic effects
  - Biohazardous infectious materials
- Corrosive materials
- Dangerously reactive materials
  
- Use, storage and disposal of shop materials

**Achievement Criteria**

Given information on WHMIS regulations and requirements for an MSDS, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to include WHMIS regulations and MSDS requirements. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on WHMIS regulations and requirements for an MSDS, the learner must correctly follow procedures and policies at all times. Procedures and policies relating to workplace hazardous materials are regulated and are highly important. Employer assessed accuracy is required for each task.





**Line (GAC):           A    Safe Work Practices**  
**Competency:         A5   Practice fire prevention**

**Objectives**

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

- Prevent and identify various classes of fires.
- Select appropriate fire extinguishers for the class of fire and environmental condition.

**LEARNING TASKS**

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

**CONTENT**

- Air
- Fuel
- Heat
  
- Class A
- Class B
- Class C
- Class D
- Symbols and colours
  
- Hot work permit (site specific)
- Handling and storage of flammable materials
- Symbols
- Fuels
  - Diesel
  - Gasoline
  - Propane
  - Natural Gas
- Ventilation, including purging
- Lubricants
- Oily rags
- Combustible metals
- Aerosols
  
- Warning others and fire department
- Evacuation of others
- Fire contained and not spreading
- Personal method of egress
- Training
  
- Extinguisher selection
- P.A.S.S.
  - Pull
  - Aim
  - Squeeze
  - Sweep



**Line (GAC):**        **B**    **Use Tools and Equipment**

**Competency:**     **B1**   **Use hand tools**

### Objectives

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

- Select and use hand tools appropriate to steamfitter/pipefitter trade.
- Inspect and maintain hand tools.

### LEARNING TASKS

1. Describe hand tools used in the trade

2. Use all hand tools (as listed above)

### CONTENT

- Cutting tools
- Measuring and marking tools
- Bracing and securing tools
- Hammering tools
- Leveling tools
  - Pitch levels
- Wrenches and pliers
- Screwdrivers
- Chiseling tools
- Squaring tools
- Threading tools
- Dies
- Flaring and swaging tools
  - Tubing benders
  - Expanding and crimping tools
- Types
- Parts
- Purpose/uses
- Procedures/operations
- Safety
- Adjustment
- Inspection
- Maintenance
- Storage

### Achievement Criteria

Given information on hand tools and their appropriate use, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to include the selection and use of appropriate hand tools as well as follow the inspection and maintenance procedure. Tasks must be performed with 100% accuracy.



**Workplace Achievement Criteria**

Given information on hand tools and their appropriate use, the learner must correctly inspect, maintain and use tools at all times. Employer assessed accuracy is required for each task.





**Line (GAC):**        **B    Use Tools and Equipment**  
**Competency:**     **B3   Use cutting, brazing and soldering equipment**

**Objectives**

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

- Select cutting, brazing and soldering equipment appropriate to the steamfitter/pipefitter processes.
- Use cutting, brazing and soldering equipment.
- Inspect and maintain cutting, brazing and soldering equipment.

**LEARNING TASKS**

1. Describe oxy-acetylene and air/fuel equipment
  
2. Describe cutting, brazing and soldering techniques
  
3. Use oxy-acetylene equipment to cut, braze and solder

**CONTENT**

- Parts
  - Oxygen cylinders
  - Acetylene cylinders
  - Regulators
  - Gauges
  - Spark arrestors
  - Torches (oxy / fuel, air / fuel)
- Safety devices
- Transportation of Dangerous Goods Legislation
- Ventilation
- Selection
- Procedure
- Limitations
- Inspection
- Safety
- Flammable material recognition
- Types
- Parts
- Purpose/uses
- Procedures/operations
  - Setup
  - Take down
  - Tip selection
  - Alloy selection
  - Flux selection
- Adjustment
- Inspection
- Minor maintenance
- Storage

**Achievement Criteria**

Given information on oxy-acetylene and air/fuel equipment, and cutting brazing and soldering techniques, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to include selection of the appropriate cutting, soldering and brazing technique and use of oxy-acetylene equipment. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on oxy-acetylene equipment and cutting, brazing and soldering techniques, the learner must correctly use oxy-acetylene equipment to cut, braze and solder. The use of oxy-acetylene equipment is highly important part of the job Employer assessed accuracy is required for each task.













**Line (GAC):** C **Organize Work**  
**Competency:** C1 **Use mathematics and science (including electricity)**

**Objectives**

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

- Use mathematics and science to solve problems in the steamfitter/pipefitter trade.

**LEARNING TASKS**

1. Add, subtract, multiply and divide numbers
  
2. Use formulas to calculate area
3. Use formulas to calculate volumes
  
4. Use formulas to calculate capacity
  
5. Transpose formulas
6. Perform conversions

**CONTENT**

- Whole numbers
- Fractions
- Decimals
- Percentages
  
- Cross-sectional area of pipe
- Cylinders
- Rectangular tanks
  
- Imperial gallons
- US gallons
- Litres
  
- Processes
  
- Length
- Volume
- Capacity
- Area
- Mass
- Weight
- Heat energy
  - Kilowatts
  - BTUs
  - Gigajoules
  - Calories
- Temperature
  - Fahrenheit
  - Centigrade
  - Kelvin
  - Rankin
- Pressure
  - Absolute
  - Gauge



**LEARNING TASKS**

7. Calculate piping measurements
  
8. Use the Pythagorean theorem of right angles
  
9. Calculate offsets using the applicable trigonometric function
  
10. Calculate the required measurements for a parallel piping offset
  
11. Define the properties of matter
  
12. Use Pascal's theory of pressure and force
  
13. Use Archimedes' principles of displacement and floatation
  
14. Define mechanical advantage as it relates to fluid power

**CONTENT**

- Terms
  - Thread allowance
  - Fitting allowance
  - End to end
  - End to centre
  - Centre to centre
  - Face to face
  - End to back
  - Back to back
  - Socket depth
- Calculations
- Grades
- Elevations
- Benchmarks
- Hypotenuse
- Side opposite
- Side adjacent
- Calculator methods
- Table-based methods
- Equal spread
- Rolling
- Jumper
- Density
- Cohesion
- Adhesion
- Tensile strength
- Ductility
- Malleability
- Elasticity
- Conductivity
- Heat properties
  - BTUs
  - Calories
  - Gigajoules
  - Specific Heat
- Pounds
- Newtons
- Specific weight
- Specific gravity
- Hydraulics
- Hydrostatics



**LEARNING TASKS**

15. Describe factors that affect fluid flow in a piping system
  
16. Describe factors that affect gas volumes and pressures
  
17. Calculate the expansion and contraction of various piping materials due to heating and cooling
  
18. Define methods of heat transfer
  
19. Perform heat load calculations

**CONTENT**

- Viscosity
- Laminar flow
- Turbulent flow
- Velocity
- Piping material
- Fittings
  
- Boyle's Law
- Charles Law
- Combined Gas Law
  
- Ferrous
- Non-ferrous
- Thermoplastic
  
- Conduction
- Convection
- Radiation
  
- Sensible
- Latent
- Specific heat as it applies to change of state
- Steam tables

**Achievement Criteria**

Given information on basic mathematics, formulas, conversions, calculations, Pythagorean theorem, trigonometrics properties of matter, Pascal's theory, Archimedes' principles, fluid flow, gas volume, expansion and contractions and methods of heat transfer, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to include correct use of basic mathematics, formulas, conversions and calculations at all times. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on basic mathematics, formulas, conversions, calculations, Pythagorean theorem, trigonometrics properties of matter, Pascal's theory, Archimedes' principles, fluid flow, gas volume, expansion and contractions and methods of heat transfer, the learner must correctly use mathematics and science to solve problems. Using science and mathematics to solve problems is an integral part of the job. Employer assessed accuracy is required for each task.



**Line (GAC):**        **C    Organize Work**  
**Competency:**     **C2   Read drawings and specifications**

**Objectives**

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

- Use drafting tools.
- Use drafting symbols, lettering and line conventions.
- Convert between isometric and orthographic projections.
- Interpret information found on a set of drawings.
- Create both plan view and isometric drawings of a piping system.

**LEARNING TASKS**

1. Describe drafting tools and materials
  
2. Use scale rulers to determine actual dimensions from a piping diagram
  
3. Describe piping and fixture symbols currently used in the steamfitter/pipefitter trade
  
4. Describe lettering and dimensioning of piping diagrams

**CONTENT**

- Drawing boards
- T-squares
- Triangles
- Protractors
- French curves
- Pencils
- Erasers and shields
- Scale rulers
- Compasses
- Dividers
- Templates
  
- Scale rulers
  
- Tees
- Wyes
- Flanges
- Elbows
- Valves
  
- Hidden lines
- Object lines
- Border lines
- Center lines
- Dimension lines
- Extension lines
- Phantom lines



**LEARNING TASKS**

5. Describe drawing projections
  
6. Use drawing projections
  
7. Use tools to sketch irregular shapes
  
8. Create isometric drawings of piping systems

**CONTENT**

- Isometric
- Orthographic
- Oblique
- Views
  
- Isometric
- Orthographic
- Conversion from one to the other
  
- French curves
- Templates
- Compasses
- Splines
  
- Lettering
- Line type
- Information to be contained
- Detail required
- Dimensioning
- Pipe sizing

**Achievement Criteria**

Given information on drafting tools, symbols, lettering and line conventions, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to include correct use of drafting tools at all times. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on drafting tools, symbols, lettering and line conventions, the learner must correctly use drafting tools to create plan view and isometric drawings of a piping system. Using drafting tools to create drawings and plans is a highly important part of the job. Employer assessed accuracy is required for each task.





**Achievement Criteria**

Given information on code, standards and organizations that affect the steamfitter/pipefitter trade, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on code, standards and organizations that affect the steamfitter/pipefitter trade, the learner must correctly use codes and standards and be aware of the various environmental agencies that affect the trade. Employer assessed accuracy is required for each task.



**Line (GAC):**        **C    Organize Work**  
**Competency:**     **C4   Use manufacturer and supplier documentation**

**Objectives**

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

- Describe documentation encountered in the steamfitter/pipefitter trade.
- Describe information contained in manufacturer and supplier documentation.
- Describe how to use the internet to source manufacturer’s documentation.

**LEARNING TASKS**

1. Describe documentation encountered in the steamfitter/pipefitter trade
  
2. Describe information contained in manufacturer and supplier documentation
  
3. Source and use manufacturer’s documentation

**CONTENT**

- Tool and equipment documentation
- Material Safety and Data Sheets (MSDS)
- System component documentation
- Proprietary product documentation
- Certification agencies
  
- Installation instructions and requirements
- Operation and maintenance manuals
- Product specifications
- Warranty information
  
- Manufacturer’s web-sites
- Search engines
- Archival sources
- On-site documentation

**Achievement Criteria**

The learner must perform lab practical tasks to include correct interpretation of manufacturer and supplier documentation at all times. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on manufacturer and supplier documentation, the learner must correctly use supplied documentation and information and use the internet to source manufacturer’s documentation. Use of available documentation and information is an important part of the job. Employer assessed accuracy is required for each task.





## LEARNING TASKS

5. Describe the inspection of pipe before installation

6. Describe the installation of tubing and pipe

7. Install tubing and pipe

## CONTENT

- Physical damage
  - Protective plates
  - Sleeving
  - Metal stud grommets
- Protective measures
  - Insulating
  - Water treatment
  - Dielectric protection
- Potential defects
  - Pin holes
  - Cracked fittings
  - Bent ends
  - Uneven casting
  - Damaged pipe and coatings
- Environmental effects
- Inspection techniques
  - Visual
  - Sounding of cast iron pipe and fittings
- Interpretation of markings
- Checking against specifications
- Types
- Sizes
- Uses
- Hazards
- Safety
- Measuring procedures
- Selection for application
- Calculations
  - Length
  - Fitting allowances
  - Offsets
  - Gain or loss
- Cutting
- Bending
- Joining methods
- Common fitting angles
- Tools and equipment
- Install tubing and pipe in a practical shop exercise



**Achievement Criteria**

Given information on piping and tubing material, methods of manufacture, types of pipe support and methods of support, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to include correct selection of appropriate pipe, pipe support, methods of protecting the pipe, pre-installation inspection and installation of pipe at all times. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on piping and tubing material, methods of manufacture, types of pipe support and methods of support, the learner must join piping and tubing. Joining piping and tubing is an integral part of the job. Employer assessed accuracy is required for each task.



**Line (GAC):**        **D    Prepare and Assemble Piping Components**  
**Competency:**     **D2    Select and install valves**

**Objectives**

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

- Describe valves used in the steamfitter/pipefitter trade.
- Select and install valves.

**LEARNING TASKS**

1. Describe basic valve types

**CONTENT**

- Types
- Purpose
- Materials
- Seating design
- Orientation
- Temperature limitations
- Pressure limitations
- Applications
- Specifications
- Special purpose
  - Pressure relief
  - Temperature relief
  - Pressure reducing/Regulator
- Selection
  - Applications
  - Specifications
  - Pressure limitations
- Orientation
- Installation requirements
- Select and install valves in a practical shop exercise

2. Describe the methods of installing valves

3. Select and install valves

**Achievement Criteria**

Given information on valves, and valve installation methods, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks for correct selection and installation of various valves. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on valves, and valve installation methods, the learner must select and install valves. Selecting and installing valves is an important part of the job. Employer assessed accuracy is required for each task.



**Line (GAC):**        **D    Prepare and Assemble Piping Components**  
**Competency:**     **D3   Select and install fittings**

**Objectives**

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

- Describe fittings and connection methods used in the steamfitter/pipefitter trade.
- Select and install fittings.

**LEARNING TASKS**

1. Describe fittings used in the steamfitter/pipefitter trade
  
2. Describe connection methods of fittings
  
3. Describe considerations in selecting fittings
  
4. Select and install fittings

**CONTENT**

- Purpose
- Types
- Applications
- Limitations
  
- Welded
- Threaded
- Compression
- Flared
- Soldered/brazed
- Mechanical
- Solvent welded
  
- Applications
- Specifications
  
- Select and install fittings in a practical shop exercise

**Achievement Criteria**

Given information on fittings and how to select and connect them, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to select and install fittings. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information fittings and how to select and connect them, the learner must correctly select and connect various types of fittings. Selecting and installing valves is an important part of the job. Employer assessed accuracy is required for each task.



**Line (GAC):** D Prepare and Assemble Piping Components

**Competency:** D4 Describe methods of penetrating structures

### Objectives

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

- Describe acceptable methods of structure penetration.

### LEARNING TASKS

1. Describe considerations when making penetrations in structures
2. Describe acceptable methods of structure penetration

### CONTENT

- 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
  - Sealing around
    - Fire stopping
    - Water-proofing
    - Isolating groundwater
    - Protecting pipe
    - Preventing oxidation
  - Sizing
  - Positioning
  - Fastening
  - Protection during concrete pour
- BC Building Code
- Manufacturer's literature
- Fire stopping
  - Doughnut type
  - Gasket type
  - Caulking
  - Mineral wool
- Fire rating requirements
- Required gaps
- Codes, specifications and requirements
- Fastening or wrapping fire stopping to pipes
- Sealing of vertical and horizontal penetrations
- Selection of sealants according to specifications



**Achievement Criteria**

Given information on considerations when making penetrations in structures and acceptable methods of structure penetration, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on considerations when making penetrations in structures and acceptable methods of structure penetration, the learner must correctly describe structure penetration according to BC Building Code. Employer assessed accuracy is required for each task.



# Level 2

## Steamfitter/Pipefitter



**Line (GAC):**        **B    Use Tools and Equipment**  
**Competency:**     **B4   Use measuring and leveling tools**

**Objectives**

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

- Use measuring and leveling equipment.

**LEARNING TASKS**

1. Describe leveling equipment used in the steamfitter/pipefitter trade to establish elevations
  
2. Use measuring and leveling equipment to establish elevations

**CONTENT**

- Builder's level
- Laser levels
- Laser measuring tools
- Level rods and scales
- Plumb bob
- Rules and squares
  
- Grade and pitch calculations
- Procedures
- Manufacturers documentation
- Inspection
- Adjustment
- Maintenance
- Storage

**Achievement Criteria**

Given information on leveling equipment and the use of leveling equipment to establish elevations, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to use measuring and leveling equipment. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on leveling equipment and the use of leveling equipment to establish elevations, the learner must correctly establish elevations taking into consideration grade and pitch calculations and appropriate procedures. Use of leveling and measuring equipment is an important part of the job. Employer assessed accuracy is required for each task.



**Line (GAC):**        **B**    **Use Tools and Equipment**  
**Competency:**     **B5**   **Use rigging and hoisting equipment**

**Objectives**

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

- Select and use hoisting, lifting and rigging equipment.

**LEARNING TASKS**

1. Identify and interpret WorkSafeBC regulations
  
2. Describe equipment used to work from height when performing hoisting and rigging in the steamfitter/pipefitter trade
  
3. Use hoisting, lifting and rigging equipment in a multi-point lift for piping installation

**CONTENT**

- Scaffolding
- Shoring
- Rigging
- Confined spaces
- Combustibles
- Ladders
- Safety harnesses, lines etc.
- Slings
- Working loads of ropes
  
- Ladders
- Scaffolding
- Shoring
- Pneumatic, hydraulic and electric lifts
- Elevated work platforms
  
- Certification requirements
- Estimation of weights
- Equipment capacities
- Equipment selection
- Lifting location
- Operating procedures
- Communication/hand signals
- Securing of loads
- Equipment inspection
- Equipment maintenance
- Equipment storage
- Disposal procedures
- Centre of gravity
- Load orientation
- Multi-point pick

**Achievement Criteria**

Given information on WorkSafeBC regulations for rigging and hoisting equipment, equipment used when working from a height, and use of rigging and hoisting equipment to install pipe, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to interpret regulations and use rigging and hoisting equipment. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on WorkSafeBC regulations for rigging and hoisting equipment, equipment used when working from a height, and use of rigging and hoisting equipment to install pipe, the learner must correctly apply WorkSafeBC regulations and select and use hoisting, rigging and lifting equipment. Use of hoisting, rigging and lifting equipment is an important part of the job. Employer assessed accuracy is required for each task







**Line (GAC):** C **Organize Work**  
**Competency:** C2 **Read drawings and specifications**

**Objectives**

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

- Read and interpret blueprints.

**LEARNING TASKS**

1. Identify and explain pipefitting symbols
2. Identify the types of drawings
3. Identify and describe the three types of view
4. Describe the uses of different views

**CONTENT**

- Tees
- Wyes
- Flanges
- Elbows
- Valves
- Anchors
- Brackets
- Architectural drawings
- Structural drawings
- Mechanical drawings
- Isometric drawings
- Shop drawings
- Specification sheets
- Spool sheets
- Plan view
- Side view
- Elevation view
- Sectional views
- Isometric views (projections)
- Orthographic views (projections)
- Detailed views
- Additions and revisions

**Achievement Criteria**

Given information on pipefitting symbols, types of drawings, types of views and their uses, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on pipefitting symbols, types of drawings, types of views and their uses, the learner must correctly read and interpret blueprints. Interpreting drawings and specifications is a highly important part of the job. Employer assessed accuracy is required for each task.



**Line (GAC):** C Organize Work  
**Competency:** C5 Plan a project

### Objectives

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

- Plan a commercial heating project.

### LEARNING TASKS

1. Describe the organization of a commercial heating project

### CONTENT

- Project specifications
- Safety
- Installation permits
- Quality assurance (moaning)
- Sequence of operation
- Prioritization
- Coordination with other trades
- Estimate material
- Tools and equipment
- Rigging
- Work platforms
- Inventory requirements
  - Secure storage
  - Time delivery
  - Labeling materials
  - Stock maintenance
  - Consumables
- Checklist utilization
- Cost efficiency
- Post job efficiency analysis

### Achievement Criteria

Given information on how to organize a commercial heating project, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

### Workplace Achievement Criteria

Given information on how to organize a commercial heating project, the learner must correctly plan a commercial heating project. Employer assessed accuracy is required for each task.



**Line (GAC):**        **D    Prepare and Assemble Piping Components**  
**Competency:**     **D1   Join pipe**

**Objectives**

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

- Describe piping and tubing materials used in the steamfitter/pipefitter trade.
- Join piping.

**LEARNING TASKS**

1. Describe piping and tubing materials including effects of heat and pressure
  
2. Describe the method of manufacture
  
3. Install tubing and pipe

**CONTENT**

- Carbon and stainless steel pipe and tubing
- Thermoplastic pipe and tubing
- Thermoset plastic pipe
- Glass pipe
- Specialty piping and tubing
- Potential defects
  
- Carbon and stainless steel
- Thermoplastic pipe and tubing
- Specialty piping and tubing
  
- Types
- Sizes
- Uses
- Selection for application
- Cutting
- Bending
- Joining methods
- Hot air plastic welding
- Tools and equipment

**Achievement Criteria**

Given information on piping and tubing materials including the effects of heat and pressure, methods of manufacture and criteria for installing tubing and pipe, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform lab practical tasks to correctly select and install tubing and pipe. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on piping and tubing materials including the effects of heat and pressure, methods of manufacture and criteria for installing tubing and pipe, the learner must correctly join pipe. Employer assessed accuracy is required for each task



**Line (GAC): D Prepare and Assemble Piping Components**

**Competency: D5 Describe pumps**

### Objectives

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

- Describe theory and operation of pumps in piping systems.

### LEARNING TASKS

1. Describe the meaning of pump related terms and concepts
2. Describe non-positive displacement pumps
3. Describe positive displacement pumps

### CONTENT

- Piping practices
- Static suction lift
- Static suction head
- Static discharge head
- Total discharge head
- Atmospheric pressure affects pump suction
- Maximum theoretical suction lift of a pump
- Maximum practical lift of a pump
- Calculations for pressure to head conversions
- Lifts between 22 and 25 feet (6.5 and 7.5 metres) reasons for recommendations
- Pump orientation
- Priming
- Pump curves and sizing
- Closed faced impeller
- Open faced impeller
- Single suction
- Double suction
- Diffuser body
- Single stage
- Multi-stage
- Turbine
- Injector
- Gear
- Lobe
- Crescent (internal gear)
- Vane (balanced, unbalanced)
- Piston
- Screw



**LEARNING TASKS**

Describe pump applications

5. Describe pump components and their functions

6. Describe pump troubleshooting procedures and solutions

**CONTENT**

- Boiler feed
- Hydraulics
- Centrifugal circulation pump
- Centrifugal fire pumps
- Booster pumps for process water
- Suction and discharge pump connections
- Priming lines
- Foot valve
- Relief valves
- Double duty valves
- Triple duty valves
- Suction strainers
- Suction guides
- Air vents
- Discharge strainers
- Isolating valves
- Filters (full flow, percentage flow)
- Piping materials
- Isolation and vibration control
- Loss of prime
- Air in water
- Couplers
- Sediment in pump
- Motor failures
- Seal leaks
- Misalignment
- Pump rotation
- Pump orientation

**Achievement Criteria**

Given information on pump related terms and concepts, non-positive and positive displacement pumps, pump applications, components and troubleshooting methods, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy



**LEARNING TASKS****CONTENT**

- Heating and cooling generating equipment
  - Boilers
  - Heat pumps
  - Heat exchangers
  - Solar panels
  - Radiant panels
  - Unit heaters
  - Coils
  - Green technology

**Achievement Criteria**

Given information on the principles of design and operation of hydronic heating and cooling systems, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on piping and tubing materials including the effects of heat and pressure, methods of manufacture and criteria for installing tubing and pipe, the learner must correctly install hydronic heating and cooling systems. Employer assessed accuracy is required for each task.







**Line (GAC):** E **Install Hydronic Heating and Cooling**  
**Competency:** E4 **Maintain and repair hydronic heating and cooling systems**

**Objectives**

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

- Maintain and repair hydronic heating and cooling systems.

**LEARNING TASKS**

1. Describe maintenance and repair of hydronic heating and cooling systems
  
2. Maintain and repair hydronic heating and cooling systems

**CONTENT**

- Testing
- Replacement
- Adjustment
- Components
- Leak checks
- Temperature checks
- Pressure checks
- Safety limits
- Operating limits
- Inspection
- Cross-connection controls
- Fluid analysis
- Install, test and commission a hydronic heating and cooling system in a practical shop exercise

**Achievement Criteria**

Given information on the maintenance and repair of hydronic heating and cooling systems, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on the maintenance and repair of hydronic heating and cooling systems, the learner must correctly maintain and repair hydronic heating and cooling systems. Employer assessed accuracy is required for each task.



**Line (GAC):**        **F**    **Perform Layout, Fabrication and Installation**  
**Competency:**     **F1**   **Prepare pipe and fittings**

**Objectives**

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

- Describe the preparation of pipe and fitting.

**LEARNING TASKS**

1. Describe the appropriate fabrication practice for ferrous and non-ferrous material
  
2. Identify the materials that will require preheating and/or post heating of metals
  
3. Select practices and procedures for piping fabrication or erection

**CONTENT**

- Squaring up
- Backer rings
- Quartering a pipe using a carpenter's square, a wrap-around, or a centering head
- Use of a template development or contour maker
- Use of a disk grinder and/or an oxy-acetylene torch
- Bevel a joint as per ASME codes
  - Transition
  - High-Low
- Assemble the pieces to produce a fitting
- Tack weld the joints together
- Pre-manufactured fittings
- Pipeline assembly
  
- Identify materials
- List of materials
  
- ASME
- A.N.S.L.

**Achievement Criteria**

Given information on how to perform layout, fabrication and installation of pipes and fittings, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to prepare pipes and fittings according to ASME or ANSL codes. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on how to perform layout, fabrication and installation of pipes and fittings, the learner must correctly prepare pipes and fittings. Preparing pipes and fittings is an important part of the job. Employer assessed accuracy is required for each task.



**Line (GAC):**        **F**    **Perform Layout, Fabrication and Installation**  
**Competency:**     **F2**    **Develop and use templates**

**Objectives**

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

- Develop templates for the pipe fabrication and assembly process.
- Use templates to fabricate fittings.

**LEARNING TASKS**

1. Use tools to sketch irregular shapes
  
2. Explain terms used with piping and piping templates
  
3. Develop a template
  
4. Use templates to fabricate fittings

**CONTENT**

- French curves
- Templates
- Compasses
- Splines
- Offset
- Advance
- Travel
- Cut-back
- Set
- Stretch-out
- Ordinates
- Mitres
- Bends
- Line development
- Quartering a pipe
- True wye
- Lateral
- Reducer
- Orange peel
- Tee
  
- Develop a template using the parallel line method
  
- Fabricate fittings from templates in practical shop exercises

**Achievement Criteria**

Given information on how to perform layout, fabrication and installation of pipes and fittings using templates, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to use templates to fabricate fittings. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on how to perform layout, fabrication and installation of pipes and fittings using templates, the learner must correctly design templates and use them to fabricate fittings. Employer assessed accuracy is required for each task.



**Line (GAC):** F **Perform Layout, Fabrication and Installation**  
**Competency:** F3 **Develop a simple spool sheet**

### Objectives

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

- Develop a spool sheet for a simple piping project.

### LEARNING TASKS

1. Develop a spool sheet from a supplied drawing

### CONTENT

- Prepare a materials list
  - Gaskets
  - Bolts
  - Hangars
  - Valves
  - Pipe
  - Flanges
  - Fittings
- Identify fittings that will require fabrication
- Determine sizes of pipe and fittings
- Weld mapping
- Dimensioning of materials
- Designations of materials
- End-to-end measurements of piping

### Workplace Achievement Criteria

Given information on how to develop a spool sheet from a supplied drawing, the learner must develop a simple spool sheet for a piping project. Employer assessed accuracy is required for each task.



**Line (GAC): F Perform Layout, Fabrication and Installation**

**Competency: F4 Fabricate from spool sheets**

### Objectives

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

- Fabricate piping systems from spool sheets.

### LEARNING TASKS

1. Demonstrate operations and procedures for spool sheets
2. Demonstrate calculations and formulas
3. Identify and interpret codes
4. Select and/or describe tools used for fabrication
5. Fabricate piping assemblies

### CONTENT

- List fittings from a spool sheet
- Select measurements from a spool sheet
- Identify fittings that will require fabrication
- Determine sizes of pipe and fittings from the spool sheet
- Layout a pipe run
- Lengths of pipe runs
- Angles of cuts and bends
- Establishing the number of pieces, cuts and welds in a pipe run
- Fabrication of joints from:
  - ASME Power piping
  - ASTM Petro-chemical piping
- Spool sheet material list
  - ASME codes
  - ANSI codes
- Tape measure
- Carpenter's square
- Wrap-around
- Contour markers
- Centering head
- Angle finder
- Centre punch
- Flange and pipe aligner
- Spirit level
- Chalkline
- Cut-off saw
- Disk grinders
- Straight edge
- Oxy-acetylene cutting torch
- Fabricate piping assemblies from spool sheets in practical shop exercises



**Achievement Criteria**

Given information on how to fabricate from spool sheets, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to fabricate piping systems from spool sheets. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on how to fabricate from spool sheets, the learner must correctly fabricate piping systems from spool sheets. Employer assessed accuracy is required for each task.





**LEARNING TASKS**

7. Demonstrate proper welding techniques using oxy-acetylene welding equipment
  
8. Demonstrate proper welding techniques using arc welding equipment

**CONTENT**

- Cutting or burning pipe using a wrap-around and an oxy-acetylene outfit
- Tack welding a joint
- Perform a bead weld
  
- Tack welding a joint
- Perform a bead weld

**Achievement Criteria**

Given information on safety devices on oxygen and acetylene tanks, personal protective equipment, acetylene and arc welding equipment and proper welding techniques, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks and wear personal protective equipment while demonstrating proper welding techniques. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on safety devices on oxygen and acetylene tanks, personal protective equipment, acetylene and arc welding equipment and proper welding techniques, the learner must correctly use oxy-acetylene and arc welding equipment. Correct use of welding equipment is integral to the job function. Employer assessed accuracy is required for each task.



**Line (GAC): F Perform Layout, Fabrication and Installation**

**Competency: F6 Bend pipe**

**Objectives**

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

- Prepare and bend pipe.

**LEARNING TASKS**

1. Demonstrate pipe bending calculations to determine pipe lengths
  
2. Explain pipe-bending terms
  
3. Identify equipment used for hot bending
  
4. Identify equipment used for cold bending
  
5. Explain purpose of materials
  
6. Describe bending qualities of materials

**CONTENT**

- Calculate
  - Radius
  - Tangents
  - Length of bend
  - Gain
  
- Throat
- Heel
- Tangents
- Centre lines
- Pipe gain
- Radius to diameter
  
- Wooden plugs
- Vibrators
- Oxy-acetylene outfit
- Oil torches
- Vises
- Clamps
- Slab
  
- Draw benders
- Compression benders
- Ram benders
- Roll benders
- Stretch benders
  
- Sand fillers
- Salt fillers
- Rosins
- Cerrobend
- Cerrobase
- Lead
  
- Carbon steel pipe
- Copper pipe
- Copper-nickel pipe
- Brass pipe



**LEARNING TASKS**

- 7. Describe hot bending procedures
- 8. Demonstrate cold bending procedures

**CONTENT**

- Aluminum pipe
- Stainless pipe
- Plastic pipe
- Steel pipe
- Copper pipe
- Aluminum pipe
- Steel pipe
- Copper pipe
- Aluminum pipe

**Achievement Criteria**

Given information on the procedures to hot or cold bend pipe using pipe bending calculations, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to calculate radius, tangents, length of bend and gain and use a variety of equipment for hot and cold bending. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on the procedures to hot or cold bend pipe using pipe bending calculations, the learner must correctly prepare and bend pipe. Correct use of procedures to bend pipe is integral to the job function. Employer assessed accuracy is required for each task.



**Line (GAC):** F **Perform Layout, Fabrication and Installation**  
**Competency:** F7 **Install supports, hangers, guides and anchors**

### Objectives

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

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

### LEARNING TASKS

1. Describe the forces that act on a piping system
2. Describe types of hangers, supports, guides and fasteners
3. Describe the installation of supports and anchors

### CONTENT

- Weight of the system including components
- Change in direction of flow
- Friction loss and inertia
- Thermal expansion and contraction
- Electrolysis
- Pipe hangers
- Clevis hangers
- Ring hangers
- Roller hanger
- Saddles and stanchions
- Roller support
- Thrust blocks
- Pipe clamps and guides
- Fasteners and attachments
  - Hanger bolts
  - Beam clamps
  - Concrete fasteners
  - Metal fasteners
  - Anchors
- Location, spacing and selection considerations
- Selection of appropriate anchor brackets
- Selection of appropriate spacing for brackets and anchors
- Fabrication by cutting and welding
  - Brackets
  - Sway bracing
  - Anchors
- Installation of brackets or anchors using:
  - Expansion shields
  - Star steel anchors
  - Toggle bolts

**Achievement Criteria**

Given information on types of supports, hangers, guides and anchors, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to install supports and anchors. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on types of supports, hangers, guides and anchors, the learner must correctly install supports, hangers, guides and anchors. Correct use of procedures to bend pipe is highly important to the job function. Employer assessed accuracy is required for each task.



**Line (GAC):**        **F**    **Perform Layout, Fabrication and Installation**  
**Competency:**     **F8**    **Erect a piping assembly**

**Objectives**

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

- Erect a piping assembly.

**LEARNING TASKS**

1. Identify equipment and its function used in erecting piping assemblies

**CONTENT**

- Shackles
- Snatch blocks
- Block and tackles
- Beam clamps
- Chain falls
- Come-a-longs
- Luggers
- Rope knots
- Mobile cranes
- Spreader bars when lifting a load
- Equalizers
- Pinch bars and rollers
- Shackles
- Flange aligners
- Pry bars
- Combination wrenches
- Speed type wrenches
- Nuts and bolts
- Ladders
- Scaffolding
- Shoring
- Lifts
  - Pneumatic
  - Hydraulic
  - Electric
  - Elevated work platforms
- Erect a piping assembly in a practical shop exercise, observing all applicable health and safety regulations
- Use appropriate lifting systems and methods

2. Erect a piping assembly



**Achievement Criteria**

Given information on the equipment used to erect a piping assembly and how to erect the piping assembly, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to erect a piping assembly while observing all applicable health and safety regulations. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on the equipment used to erect a piping assembly and how to erect the piping assembly, the learner must correctly erect a piping assembly. Employer assessed accuracy is required for each task.



**Line (GAC):**        **F**    **Perform Layout, Fabrication and Installation**  
**Competency:**     **F9**   **Test and commission a piping assembly**

**Objectives**

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

- Test and commission a piping assembly.

**LEARNING TASKS**

1. Describe commissioning requirements for piping assemblies
  
2. Describe the cleaning of a piping assembly
  
3. Describe testing procedures for piping assemblies

**CONTENT**

- Quality control requirements
- Bolt selection
- Gasket selection
- Torquing
- Tensioning
- Bracketing
  
- Pickling solution
- Caustic solution
- Water flushing
- Air flushing
  
- Equipment needing isolation
  - Controls
  - Gauges
  - Valves
  - Equipment
- Test Media
  - Water
  - Air
  - Oil
  - Other prescribed media
- Hydrostatic testing
- Pneumatic testing
- Non-destructive testing

**Workplace Achievement Criteria**

Given information on commissioning requirements for piping assemblies and the cleaning and testing procedures for piping assemblies, the learner must correctly commission and test a piping assembly. Employer assessed accuracy is required for each task.





## LEARNING TASKS

3. Describe different types of marine vessels
  
4. Identify marine systems and their functions

## CONTENT

- Collision bulkhead
- Black water
- Grey water
- Air and sounding systems
- King post
- Wing tanks
- Midships
- Plimsoll mark
- Superstructure
- Scupper
- Afterpeak tank
- Deck
- Deck head
- Bridge deck
- Chain locker
- Trimming tanks
- Water tight bulkhead
- Island
  
- Tankers
- Ore carriers
- L.P.G. carriers
- Coastal vessels
- Passenger vessels
- Ferries
- Freighters
- Naval vessels
  - Frigates
  - Coastal patrol boat
  - Coast guard
  
- Fuel oil systems
- Fire main systems
- Fresh water systems
- Salt water systems
- Bilge and ballast systems
- Pumping and flooding systems
- Scupper and drain systems
- Hydraulic systems
- Pneumatic systems
- Cargo pumping systems
- Lubricating oil systems



### LEARNING TASKS

5. Describe water tight integrity considerations
  
6. Describe marine piping arrangements
  
7. Fabricate a marine piping assembly

### CONTENT

- High pressure air systems
- Low pressure air systems
- Interpret blueprint and drawing symbols
  
- Vessel
  - Compartment
- Procedures
  - Pipe removal
  - Blanking component
  
- Bulkhead fittings
- Deckhead fittings
- Expansion and contraction fittings
- Screw-down, non-return valves
- Mechanical sleeves
- Vibration and isolation factors
  
- Fabricate a piping assembly for a marine application in a practical shop exercise
  - Flanges
  - Bends
  - Fittings
  - Use a jig type set-up

### Achievement Criteria

Given information on the hazards codes and terms used in marine systems piping, vessels, water integrity considerations and marine piping arrangements, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to fabricate a piping assembly for a marine application including flanges, bends, fittings and use a jig type set up. Tasks must be performed with 90% accuracy.

### Workplace Achievement Criteria

Given information on the hazards codes and terms used in marine systems piping, vessels, water integrity considerations and marine piping arrangements, the learner must correctly fabricate and install piping for a marine application. Employer assessed accuracy is required for each task.







## LEARNING TASKS

5. Assemble a hydraulic piping system

## CONTENT

- Isolating equipment before testing the system
  - Gauges
  - Controls
  - Relief valves
  - Flow control valves
  - Reducing valves
- System faults
  - Flow
  - Pressure
  - Force
  - Speed
- Partially closed valves
- Plugged strainers or filters
- Leaks at fittings, tubes, or hoses
- Air in the system
- Breathers plugged on reservoir
- Given appropriate drawings, assemble a hydraulic piping system in a practical shop exercise
- Interpret drawings
  - Symbols
  - Specifications
  - Standards
- Tubing and fittings
- Pipe and fittings
- Hose and fittings

### Achievement Criteria

Given information on the components, materials, troubleshooting procedures and assembly instructions for a hydraulic piping system, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to interpret drawings and assemble a hydraulic piping system. Tasks must be performed with 100% accuracy.

### Workplace Achievement Criteria

Given information on the components, materials, troubleshooting procedures and assembly instructions for a hydraulic piping system, the learner must correctly install a hydraulic piping system. Employer assessed accuracy is required for each task.



**Line (GAC):**        **G**    **Special Application Systems**  
**Competency:**     **G8**   **Install pneumatic and compressed air piping systems**

**Objectives**

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

- Describe and install pneumatic and compressed air piping systems.

**LEARNING TASKS**

1. Describe the laws and terms that apply to fluid power, pneumatics
  
2. Identify and interpret standards and symbols that apply to pneumatics
  
3. Describe compressed air systems

**CONTENT**

- Boyle's Law
- Charles' Law
- Avogadro's laws
- Air flow formulas
- Isothermal
- Adiabatic
- Force and speed
  
- ANSI
- ASME
- ASTM
  
- Hazards
- Pipe types
- Codes and regulations regarding vessels
- Piping arrangements
  - Straight line
  - Loop
- Tools and equipment
- Joining methods
- Draining of moisture
- Compressors
  - Types
  - Operation
- Safety devices
- Codes and regulations
- Lubricators (FRLs)
- Vibration isolation
- Connection of equipment to piping
- Components
  - Air driers
  - Flex-connectors
  - Auto drains
  - Pressure regulators
  - Filters



### LEARNING TASKS

4. Describe the effects of contaminants in a compressed air system
  
5. Describe components used in a pneumatic piping system
  
6. Describe the operation of pneumatic tools
  
7. Describe controls used in air conditioning piping systems

### CONTENT

- Liquids
- Droplets
- Dust
- Dirt
- Vapours
  
- Water separators
- Storage tanks
  - Relief valves
  - Pressure gauges
  - Fusible plugs
  - Automatic drains
- Mainline dryers and filters
  - Regenerative dryers
  - Desiccant dryers
  - Micron filters
  - Refrigerated air dryers
- Automatic drains
  
- Grinders
- Drills
- Hammers
- Flaring tools (rolling tools)
- Vibrators
  
- Pressure regulators
- Direct and reverse acting thermostats
- Direct and reverse acting humidistats
- Pressure to electric switches
- Electric to pressure switches
- Switching relays
- Reversing relays
- Proportional controllers
- Booster relays
- Sequencing relays
- Normally open and normally closed valves
- Mixing valves
- Diverting valves
- Balance valves
- Stop valves
- Master-submaster controls
- Restrictor
- Receiver controller



**LEARNING TASKS**

8. Describe controls used in industrial pneumatic piping systems
  
9. Describe the function and material limitations of pneumatic piping system components
  
10. Describe installation of pneumatic piping systems

**CONTENT**

- Spool valves
- Check valves
- Relief valves
- Pressure regulating valves
- Quick release valves
- Pilot air valves
- Relay air valves
- Accumulators
- Volumes
- Cylinders
- Rotary motors
  
- Steel pipe and/or tube
- Copper pipe and/or tube
- Plastic pipe
- Stainless pipe and/or tube
- Screwed fittings
- Welded fittings
- Brazed fittings
- Flared fittings
- Flareless fittings
- Sizing pipe
  - Flow
  - Pressure
  - Temperature
- Installation practices
  - Through pipe chases
  - Through walls
  - Through raceways or troughs
  - Through heated spaces
  - Through refrigerated spaces
  - In bundles
- Flex connections
  - Reinforced hoses
  - Metal flex pieces
  - Pipe bending
- Pipe and pipe fittings
- Tube and tube fittings
- Hose and hose fittings
- Sealants
- Lubricants
- Gasket materials
- Pipe grading



## LEARNING TASKS

11. Describe testing and maintenance consideration for pneumatic piping systems
12. Describe troubleshooting procedures for pneumatic piping systems
13. Assemble a pneumatic piping system

## CONTENT

- Pipe drips
- Branch take-offs
- Run identifications
- Running and nesting of control piping
- Installing raceways
- Brackets
- Flushing and blowing out of a system
- Cleaning out the drips and filters after flushing
- Identify minimum test requirements
- Isolating
- Gauges
- Relief valves
- Equipment
- Soap testing joints
- Draining down and activating the system
- Partially closed valves
- Filters plugged
- Pressure reducing valve failure
- Leaks at fitted joints
- Given appropriate drawings, assemble a pneumatic piping system in a practical shop exercise
- Interpret drawings
  - Symbols
  - Specifications
  - Standards
- Tubing and fittings
- Pipe and fittings
- Hose and fittings

### Achievement Criteria

Given information on pneumatic and compressed air laws, terms, standards and symbols, tools, controls and maintenance, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to interpret drawings and assemble a pneumatic piping system. Tasks must be performed with 100% accuracy.

### Workplace Achievement Criteria

Given information on pneumatic and compressed air laws, terms, standards and symbols, tools, controls and maintenance, the learner must correctly install a pneumatic and compressed air piping system. Employer assessed accuracy is required for each task



# Level 3

## Steamfitter/Pipefitter



**Line (GAC):** C **Organize Work**  
**Competency:** C2 **Read drawings and specifications**

### Objectives

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

- Read contract documents and specifications.
- Plan take-offs to establish material and labour components.

### LEARNING TASKS

1. Describe contract documents used in the construction industry

### CONTENT

- Types
  - Agreements
  - General conditions
  - Drawings
  - Specifications
  - Divisions
- General requirements
- Responsibilities and obligations
  - Guarantees
  - Workmanship
  - Tests and inspections
- Purpose
- Master format
- Change orders
- Permits and requirements





**Line (GAC):** C Organize Work  
**Competency:** C5 Plan a Project

### Objectives

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

- Plan an industrial piping project.

### LEARNING TASKS

1. Describe organization of an industrial piping project
2. Plan an industrial piping project

### CONTENT

- Project specifications
- Safety
- Installation permits
- Sequence of operation
- Prioritization
- Coordination with other trades
- Estimate material
- Tools and equipment
- Inventory requirements
  - Secure storage
  - Time delivery
  - Labeling materials
  - Stock maintenance
  - Consumables
- Checklist utilization
- Cost efficiency
- Post job efficiency analysis
- Plan an industrial piping project based on supplied documentation

### Achievement Criteria

Given information on the organization of an industrial piping project including safety, permits, sequence, coordination with other trades, tools and inventory, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks using calculations and formulas to plan a take-off and develop a materials list. Tasks must be performed with 100% accuracy.

### Workplace Achievement Criteria

Given information on the organization of an industrial piping project including safety, permits, sequence, coordination with other trades, tools and inventory, the learner must correctly plan an industrial piping project. The industrial piping project plan is a highly important part of the job function. Employer assessed accuracy is required for each task.



**Line (GAC):**        **G    Special Application Systems**  
**Competency:**     **G2   Install fuel oil piping systems**

**Objectives**

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

- Install fuel oil systems.

**LEARNING TASKS**

1. Identify applicable hazards and regulations for fuel oil systems piping
  
2. Describe underground tank piping safety practices
  
3. Describe fuel oil terms
  
4. Describe tank considerations

**CONTENT**

- National Fire Protection Association (N.F.P.A.) standards for
  - Buried tanks
  - Above ground tanks
  - Vent piping
  - System piping
- Building codes
- Tank filling before piping begins
- Tank testing after filling
- "Seney" valve installation before piping is commenced (check valve)
- Tank never left open or empty
- Cathodic protection is installation
- Residual oils
- Crude petroleum
- Distillate oils
- Blended oils
- #1 light domestic
- #2 medium domestic
- #3 heavy domestic
- #4 light industrial
- #5 medium industrial
- #6 heavy industrial
- Heating
  - Steam coils
  - Hot water coils
  - Shell and tube type of heaters
- Underground piping
  - Fuel filling lines
  - Fuel sounding lines
  - Dirty oil suction lines
  - Fuel oil return lines
  - Fuel oil suction lines
  - Fuel oil vents
  - Steam heating lines
  - Welded construction





**LEARNING TASKS**

8. Describe the fuel oil firing sequence
  
9. Describe combustion requirements
  
10. Describe combustion analysis for oil or gas fired equipment
  
11. Set-up and fire an oil-fired appliance

**CONTENT**

- Purge periods
- Fuel supply periods
- Ignition periods
- Flame proving period
- Automatic shut-down
  
- Primary air
- Secondary air
- Fuel
- Fuel preparation
- Analysis equipment
- Chemical absorption
  - Electronic analysers
  - Flue products readings
  
- CO
- CO<sup>2</sup>
- Stack temperature
- Draft
- Smoke
  
- Set-up and fire an oil-fired appliance in a practical shop exercise

**Achievement Criteria**

Given information on fuel oil system hazards and regulations, underground tank safety regulations, components, pumps, burners and combustion information, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to set up and fire an oil-fired appliance following all safety regulations. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on fuel oil system hazards and regulations, underground tank safety regulations, components, pumps, burners and combustion information, the learner must correctly install a fuel oil system. Installing a fuel oil system while following complete safety regulations is a highly important part of the job function. Employer assessed accuracy is required for each task.



**Line (GAC):**        **G    Special Application Systems**  
**Competency:**     **G3   Install low pressure steam piping systems**

**Objectives**

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

- Install low pressure steam piping systems.

**LEARNING TASKS**

1. Identify applicable hazards, codes and regulations related to low pressure steam piping
  
2. Describe low pressure steam terms
  
3. Interpret steam tables
  
4. Describe low pressure steam piping systems

**CONTENT**

- B.C. Boiler Code
- ASME
- ANSI
  
- BTUs
- Kilowatts
- Sensible heat
- Equivalent direct radiation (EDR)
  - Calculations for surface areas and the steam emissions from those surface areas
- Measurement
- Boiler horsepower (BHP)
- Latent heat
- Specific heat
- Specific weight
- Specific gravity
- Vacuum
  - Measurement
  - Pumps
  - Piping up a vacuum pump
  
- Pressures
- Temperatures
- Heat contents
- Latent heat
- Total heat
- Specific volumes
  
- Counter flow systems
- One-pipe systems
- Two-pipe systems
- Two-pipe gravity return systems
- Sub-atmospheric systems
- Steam heating systems symbols



**LEARNING TASKS**

5. Describe low pressure steam piping system components

6. Identify and size equipment and components

**CONTENT**

- Pop safety valves
- Pressure gauges
- Equalizers
- Boiler
- Boiler trim
- Hartford loops
- Boiler return traps
- Condensate pumps
- Stop valves
- Check valves
- Float vents
- Quick vents
- Lift fittings
- Drip legs
- Strainers
- Mechanical traps
- Thermostatic traps
- Thermodynamic traps
- Unit heaters
  - Horizontal heaters
  - Vertical heaters
- Blast coils
- Radiators
- Baseboard heaters
- Cast iron heaters
- Blow down
- Water tube
- Unit heaters
- Radiators
- Heat exchangers
- Blast coils
- Heating boilers
  - Cast iron sectional
  - Package type
  - Fire tube
- Steam traps
  - Mechanical
  - Thermostatic
  - Thermodynamic



## LEARNING TASKS

7. Describe piping practices
  
8. Describe control components for a low pressure boiler
  
9. Install low pressure steam piping system

## CONTENT

- Pipe
  - Supply mains
  - Return mains
  - Riser mains
  - Runouts
  - Spring pieces
  - Stubs
  
- Compensate for expansion and contraction
- Expansion joints
  - Mechanical
  - Bending
  - Cold-springing
  
- Condensate pump and tank system
- Water level tank control
- Boiler low water cut-off
- Boiler water feeder combination
- Pressure reducing valves
- Automatic boiler controls
- Electric water feeders
- High water limits
- Operating pressure switch
  - Siphon
- High limit pressure switch
  - Siphon
  
- In a practical exercise, install a low pressure steam piping system, including:
  - Piping around obstacles
  - Supporting pipe runs and equipment
  - Eccentric reducers
  - Bracketing
    - Guides
    - Rollers
    - Anchors

**Achievement Criteria**

Given information on low pressure steam hazards, codes, regulations, steam tables, steam systems, components and control components, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to install a low pressure steam piping system including piping around obstacles, supporting pipe runs and equipment, eccentric reducers and bracketing. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on low pressure steam hazards, codes, regulations, steam tables, steam systems, components and control components, the learner must correctly install a low pressure steam piping system while following all safety guidelines. Installing a low pressure steam piping system is a highly important part of the job function. Employer assessed accuracy is required for each task.



**Line (GAC):**        **G**    **Special Application Systems**  
**Competency:**     **G4**   **Install high pressure steam piping systems**

**Objectives**

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

- Describe the installation of high pressure steam piping systems.

**LEARNING TASKS**

1. Identify applicable hazards, codes and regulations related to high pressure steam piping
  
2. Describe high pressure steam piping terms
  
3. Describe calculations for high pressure steam piping systems
  
4. Describe the installation of high pressure steam piping system components and their functions

**CONTENT**

- B.C. Boiler Code
- ASME
- ANSI
- Power plant piping codes
- Petrochemical piping codes
- ASTM A120
- ASTM A53(A,B)
- ASTM A106(A,B,C)
- ASTM A335(P1 &P11)
  
- Wet saturated steam
- Dry saturated steam
- Pounds per hour
- Condensing and non-condensing systems
- Flash steam
- Cubic feet per minute
- De-superheated system
  
- Thomas formula
  - Pipe diameter
  - Steam flow in pounds per minute (lbs/min.)
  - Pressure drop/100 ft.
- Expansion and contraction of steam and condensate lines
  
- "Pop safety valves" including
  - 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 pipe
  - Sleeve, rain, cap, pipe chamfer
  - Anchors and brackets



## LEARNING TASKS

## CONTENT

- Blow down valves
  - Quick opening valves
  - Slow opening valves
  - Seatless valves
  - Hard seated valves
  - Surface 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
- Fusible plugs
- Boilers
- Water tube
- Fire tube
- Packaged
- Cast iron
- Boiler trim
- Pressure trim
- Syphons
  - Ferrous and non-ferrous materials
  - Inspectors connections
- Forced draft fan
- Induced draft fan
- Evaporator
- Barometric condenser
- Surface condenser
- De-aerator
  - Use as a feed water heater
  - Use as an air removal piece of equipment
  - Use as part of the water treatment
- Use of caustic soda and tri-sodium phosphate compounds in chemical cleaning
- Condenser water treatment
- Stop check valve
- Double block and bleed valve systems
- Pressure reducing station
- Economizers
- Super/desuper heaters
- Feed water heaters



### LEARNING TASKS

5. Describe the installation and the purpose of soot blowers
  
6. Describe the installation and the purpose of water columns, including pipe sizing
  
7. Describe the components used in high pressure steam piping installation
  
8. Describe the testing procedures for a high pressure steam system
  
9. Develop flow diagrams

### CONTENT

- Retractable lances
- Rotating soot blowers
- Permanent soot blowers
- Soot blowing media
  - Water
  - Steam
  - Air
  - Shot
- Inspectors crosses
- Gauge glasses, round and flat
- Simpli port bi-colour
- Tri-cocks
- Gauge glass cocks
- Blow down connection
- Feed water pump controllers
- Hangers
  - Trapeze type of hangers
  - Spring loaded hangers
  - Constant support hangers
  - Counter weight hangers
  - Rollers and saddles
  - Anchors
- Sleeve type expansion joints
- Bellows expansion joints
- Cold draw
- Pipe line construction or bending
- Isolating safety valves
- Isolating equipment
- Isolating controls
- Isolating gauges
- Line under pressure
- Precautions for blanking off open piping
- Develop a flow diagram for a high pressure steam condensing system from a given set of specifications

**Achievement Criteria**

Given information on high pressure steam hazards, codes, regulations, installation and testing of various components of the high pressure steam system, and flow diagrams, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to developing a flow diagram for a high pressure steam condensing system. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on high pressure steam hazards, codes, regulations, installation and testing of various components of the high pressure steam system, and flow diagrams, the learner must correctly install a low pressure steam piping system while following all safety guidelines. Installing a low pressure steam piping system is a highly important part of the job function. Employer assessed accuracy is required for each task.



**Line (GAC):**        **G**    **Special Application Systems**  
**Competency:**     **G5**   **Describe feedwater treatment systems**

**Objectives**

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

- Describe the installation of water treatment and conditioning equipment for commercial, institutional and industrial applications.
- Describe the installation of feedwater treatment piping systems.

**LEARNING TASKS**

1. Identify hazardous materials and related safety codes that apply to water treatment for hydronic and steam systems
2. Describe boiler feed water treatment requirements
3. Describe thermal treatment
4. Describe internal boiler water treatment

**CONTENT**

- ASME B31
- WHMIS
- Chemical storage
- Water Composition
  - Hardness
  - pH level
  - Turbidity
- Contaminants
- Hot water systems
- Low pressure steam
- High pressure steam
- Condensing
- Non-condensing
- High pressure boilers
- Hot well
- Open feedwater heater
- De-aeration
- Closed feedwater heater
- Evaporators
- Economizers
- pH control
- Scale prevention
- Sludge conditioning
- Chemical de-aeration
- Prevention of foaming
- Caustic embrittlement prevention
- Prevention of return line corrosion
- Frost prevention
- Testing methods

**LEARNING TASKS**

5. Describe installation of piping and equipment components for feedwater treatment and conditioning systems

**CONTENT**

- Pumps
- Valves
- Piping materials
  - 304 and 316 stainless steel
  - Carbon steel pipe
  - Chrome moly pipe
  - Copper
- Filters
- Chemical feeders
- Treated water storage
- Deaerator
  - Spray-tray type
  - Scrubber type
- Demineralizer

**Achievement Criteria**

Given information on hazardous materials and related safety codes that apply to water treatment for hydronic and steam systems, boiler feed water treatment requirements, thermal treatment and installation of piping and equipment components for feedwater treatment and conditioning systems, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on hazardous materials and related safety codes that apply to water treatment for hydronic and steam systems, boiler feed water treatment requirements, thermal treatment and installation of piping and equipment components for feedwater treatment and conditioning systems, the learner must correctly describe the installation of water treatment and conditioning equipment for commercial, institutional and industrial applications and the installation of feedwater treatment piping systems . Employer assessed accuracy is required for each task.





## LEARNING TASKS

### 4. Describe water supply considerations

## CONTENT

- Limitations of materials
- Flow alarm switches
- Sprinkler head types
  - Concealed
  - Sidewall
  - Pendant
  - Upright
- Valves
  - Supervisory valves
  - Gear operating butterfly valves
  - Post indicator valves
  - Outside stem and yoke valves
  - Check valves
  - Alarm check valves
  - Dry pipe valves
  - Velocity check valves
- Supervisory switches
- Fire pumps (standpipe systems in highrise structures)
- Pressure regulators
- Water motor gongs
- Fire department connections
- Drains (standpipe systems and wet systems)
- Hose cabinets
- Hose valves
- Fire hoses (in cabinet)
- Risers, branches, feedmains, crossmains
- Fire hydrant
- Detector check
- Size and number of fire streams required
- Length of time streams are required
- Public water systems
- Automatic fire pumps
- Manually controlled fire pumps
- Pressure tanks
- Gravity tanks
- Class I service
- Class II service
- Class III service
- Fire department connection as an auxiliary water supply.
- Pipe connections from the water supply to the standpipe system



**Achievement Criteria**

Given information on fire protection systems and water supply considerations, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on fire protection systems and water supply considerations, the learner must correctly describe fire protection systems, their components and installation and describe water supply considerations including streams, public water systems, pumps, tanks, Class I, II and III services and water supply connections. Employer assessed accuracy is required for each task.





**Line (GAC):** H Water Supply  
**Competency:** H2 Describe the installation of cross connection assemblies

### Objectives

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

- Describe the installation of cross connection assemblies.

### LEARNING TASKS

1. Describe selection and installation of cross-connection control assemblies and devices

### CONTENT

- Terms
- Back pressure
- Back syphonage
- Thermal expansion
- Types of cross connections that occur
- Types of cross connections and operational uses
  - Air gaps
  - Vacuum breakers
  - Double deck valve assemblies
  - Reduced pressure backflow assemblies
- Code and jurisdictional requirements
- Installation requirements
  - Height
  - Location
  - Accessibility
- Hazard assessment
  - Minor, moderate, severe
- Assembly and device selection according to hazards and application



**Line (GAC):**        **H    Water Supply**  
**Competency:**     **H3   Test and commission cross connection assemblies**

**Objectives**

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

- Test and commission cross connection assemblies.

**LEARNING TASKS**

1. Test and commission cross-connection control assemblies and devices

**CONTENT**

- Types
- Code and jurisdictional requirements
- Certification requirements for testing and certifying assemblies
- BCWWA test procedure manual and standards

**Achievement Criteria**

Given information on the types of cross-connection control assemblies and devices, codes and jurisdictional requirements, certification requirements and BCWWA test procedure manual and standards, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy. In addition, the learner must perform practical lab tasks to test and commission cross-connection control assemblies and devices. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on the types of cross-connection control assemblies and devices, codes and jurisdictional requirements, certification requirements and BCWWA test procedure manual and standards, the learner must correctly test and commission cross-connection assemblies. Employer assessed accuracy is required for each task.





**LEARNING TASKS**

4. Describe residential and commercial gas pipe installation

5. Install piping, tubing and hoses

**CONTENT**

- Code requirements
- Pressures
  - Low Pressure
  - 2 psig (14 kPa)
  - High Pressure
- Pipe/tube sizing
  - Appliance rating
  - Distance
  - Allowable pressure drop
  - Piping or tubing type
  - Type of gas
  - Fittings
- Hanger spacing
- Leak testing
  - Rough in
  - After appliance connection
- Leak repair
- Valve tightness of closure testing and repair
- Purging
  - Air with gas
  - Gas with inert gases
  - Pressure measurement
  - Standing
  - Operating
  - Manifold
  - Differential
  - Drop
- Pressure adjustment
  - Gas line
  - Manifold
  - Appliance connection
  - Approved hose
  - Flexible metallic hose
  - Connectors
- Methods
- Size
- Pressures
- Identification
- Procedures
- Fittings
- Valves
- Prohibited practice
- Location limitations
- Outlets
- Drip or dirt pockets



## LEARNING TASKS

6. Describe gas meters
  
7. Use calorific values of fuel and meter readings to determine input
  
8. Install propane cylinder systems

## CONTENT

- Between buildings
- Concealment
- In concrete
- Underground
- Support
- Protection
- Tools
- Testing
  - Prior to appliance connection
  - After appliance connection
- Purging
  - Under 4 inch
  - 4 inch and larger
- Types
  - Low pressure propane
  - Low pressure natural gas
  - Pressure factor metering
  - Positive displacement
  - Non-positive displacement
- Principles of operation
  - Positive displacement
- Capacity
- Pressure compensation
- Reading
  - Test dials
- Clocking
- Calorific values
- Clocked flow rates
- Calculated inputs
- High altitude installations
- Code requirements
- Sizing
  - Load factors
- Temperature effects on pressure
- Filled capacity effect on vaporization rate
- Cylinder sizing
  - Vaporization capacity of cylinders
- Describe cylinder clearances
- Installation procedures
- Safety relief valves
  - Pressures
  - Location of discharge outlets



## LEARNING TASKS

9. Describe combustion requirements

10. Describe atmospheric burners

## CONTENT

- Calculations of rate of discharge
- Maintenance
- Valves and accessories for vapour withdrawal applications
- Valves and accessories for liquid withdrawal applications
- Valves and accessories for filling applications
- Filling density at standard temperature
- Filling capacity by mass
- Vehicle access for filling storage tanks
- Filling safety
- Emergency procedures
- Terminology
- Methane
- Propane
- Chemical equations
  - Theoretical
  - Complete
  - Incomplete
- Flammability
  - Range of flammability
  - Upper limit of flammability
  - Lower limit of flammability
  - Ignition temperature
- Gas properties
  - Rate of flame propagation
  - Flashback
  - Turndown ratio
- Combustion air
  - Primary
  - Secondary
  - Excess
- Terminology
- Characteristics
- Types
  - Main burners
  - Pilot burners
- Parts
- Operation
- Application

**LEARNING TASKS**

11. Describe burner orifices

**CONTENT**

- Types
  - Plug
  - Cap
  - Adjustable
- Sizing
  - Tables
  - Calculations
  - Drilling

**Achievement Criteria**

Given information on the properties of gas, the parts of a natural gas fuel delivery system, propane gas systems, residential and commercial gas pipe installation, piping, tubing and hoses, gas meters, calorific values, propane cylinder systems, combustion requirements, atmospheric burners and burner orifices, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to perform combustion analysis and adjust equipment for maximum efficiency, install gas piping and tubing and read gas meters and calculate heat flow rates. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on the properties of gas, the parts of a natural gas fuel delivery system, propane gas systems, residential and commercial gas pipe installation, piping, tubing and hoses, gas meters, calorific values, propane cylinder systems, combustion requirements, atmospheric burners and burner orifices, the learner must correctly install and service a fuel gas system. Employer assessed accuracy is required for each task.



# Level 4

## Steamfitter/Pipefitter



**Line (GAC):** C Organize Work  
**Competency:** C2 Read drawings and specifications

### Objectives

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

- Describe electrical drawings.
- Interpret electrical drawings.

### LEARNING TASKS

1. Describe electrical drawings

### CONTENT

- Types
  - Pictorial
  - Ladder
  - Schematic
- Symbols
  - Manual switches
  - Pressure switches
  - Temperature switches
  - Relays
  - Transformers
  - Aquastats
  - Overcurrent protection
  - Power and lighting panels
  - Receptacles

### Achievement Criteria

Given information on the types of electrical drawings and various associated symbols, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to describe and interpret electrical drawings.

Tasks must be performed with 100% accuracy.

### Workplace Achievement Criteria

Given information on the types of electrical drawings and various associated symbols, the learner must correctly read and interpret drawings and specifications that include electrical drawings. Employer assessed accuracy is required for each task.





**Line (GAC):        G    Special Application Systems**

**Competency:      G9    Install process piping systems**

**Objectives**

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

- Describe the installation of process piping for industrial process systems.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Identify codes and standards and describe piping procedures for use in industrial process piping systems</li> <br/> <li>2. Describe the applications of common metal pipe types</li> <br/> <li>3. Describe the applications of common plastic pipe types</li> <br/> <li>4. Describe the effects of heat and pressure on pipe types</li> </ol> | <ul style="list-style-type: none"> <li>• ASME <ul style="list-style-type: none"> <li>○ Power boilers (Section 1)</li> <li>○ Nuclear vessels (Section III)</li> <li>○ Heating boilers (Section IV)</li> <li>○ Pressure vessels (Section VIII)</li> <li>○ Welding qualifications (Section IX)</li> </ul> </li> <li>• ANSI/ASME B31.1 (boiler and first service valve) and B31.3 (piping in chemical plants and refineries)</li> <li>• CAN3-Z245. I MS6</li> <li>• Ferrous</li> <li>• Ferrous alloy</li> <li>• Stainless steel</li> <li>• Copper</li> <li>• Copper-nickel</li> <li>• Monel</li> <li>• Brass</li> <li>• Aluminium</li> <li>• Titanium</li> <li>• Acrylonitrile butadiene styrene (ABS)</li> <li>• Poly (vinyl chloride) (PVC)</li> <li>• Chlorinated poly (vinyl chloride) (CPVC)</li> <li>• Polyethylene</li> <li>• Chlorinated polyether pipe (Penton)</li> <li>• Vinylidene fluoride pipe (Kynar)</li> <li>• Teflon</li> <li>• Ferrous</li> <li>• Stainless</li> <li>• Non-ferrous</li> <li>• Plastic</li> <li>• Glass</li> <li>• FRP</li> </ul> |
|---|---|

**LEARNING TASKS**

5. Describe the service requirements in different industrial piping process systems

**CONTENT**

- Erosion
- Corrosion
- Scaling
- Thermal fatigue
- Mechanical fatigue
- Creep
- Metallurgical instability at high temperatures and pressures

**Achievement Criteria**

Given information on industrial process piping system codes and standards, applications of common metal and plastic pipe types, effects of heat and pressure on pipes and service requirements, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on industrial process piping system codes and standards, applications of common metal and plastic pipe types, effects of heat and pressure on pipes and service requirements, the learner must correctly install process piping systems. Employer assessed accuracy is required for each task.



**LEARNING TASKS**

3. Describe the components in an air conditioning piping system

**CONTENT**

- Chilling coils:
  - Parallel flow coils
  - Reverse flow coils
  - DX or DE coils (refrigerative)
- Mixing valves
- Pan type humidifiers and water chillers
- Blast coils
- Condenser coils
- Water spray humidifiers
- Steam grid humidifiers
- De-humidifiers
- Viscous impingement filter
- Dry cartridge filter
- Electronic filter
- Water spray filter

**Achievement Criteria**

Given information on the types of psychometric charts, air conditioning systems and their components, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on the types of electrical drawings and various associated symbols, the learner must correctly install air conditioning piping systems. Employer assessed accuracy is required for each task.





**Achievement Criteria**

Given information on refrigeration function and design, piping technology and refrigerant piping components, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on refrigeration function and design, piping technology and refrigerant piping components, the learner must correctly install refrigeration piping systems. Employer assessed accuracy is required for each task.







**Line (GAC):**        **G    Special Application Systems**  
**Competency:**     **G13 Install instrumentation piping systems**

**Objectives**

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

- Describe instrumentation piping systems.

**LEARNING TASKS**

1. Describe pressure related measuring instruments and components
  
2. Describe flow measuring devices
  
3. Describe temperature measuring devices
  
4. Describe level measuring devices

**CONTENT**

- Manometer
- Bourdon tube gauge
- Diaphragm
- Bellows
- Differential
- Pressure gauge piping
  
- Orifice plates
- Flow nozzles
- Dall tubes
- Venturi tubes
- Pitot tubes
- Annubars
- Rotary meters
- Ultrasonic
- Weir
- Magnahelic gauges
- Positive displacement meters
- Flow measurement in the metering run
  
- Liquid filled thermometers
- Gas filled thermometers
- Remote bulb thermometers
- Bimetallic thermometers
- Thermisters
- Contact type pyrometers
- Non-contact type pyrometers
- Temperature capillary coils
  
- Floats
- Gauge glass
- Ultrasonic
- D/P cells



**LEARNING TASKS**

5. Describe density measuring devices
  
6. Describe valves
  
7. Explain the function of instrument air equipment
  
8. Describe instrumentation piping system components
  
9. Describe steam tracing systems

**CONTENT**

- Scimitar blades
- Moving elements
- Stationary elements
- Hydrometers
- Linear valves
- Ported valves
- Throttle valves
- Equal percentage valves
- Diaphragm valves
- Piston actuators
- Manual actuators
- Diaphragm actuators
- Electro-hydraulic actuators
- Compressors
- Dryers
- Receivers
- Filters
- Pressure reducing stations
- Plastic tubing
- Metallic tubing
- Tube coatings
- Tube bundles
- Flared fittings
- Compression fittings
- Symbols used in instrumentation
- Equipment which must be isolated before testing begins
- Flushing or blowing out lines before testing
- Types
  - Jacketed pipe
  - Tubing - various methods
- Components
  - Trapping
  - Controls
  - Piping selection

**Achievement Criteria**

Given information on types of pressure related measuring instruments and components, flow and temperature measuring devices, instrument air equipment, steam tracing systems and instrumentation piping system components, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**Workplace Achievement Criteria**

Given information on types of pressure related measuring instruments and components, flow and temperature measuring devices, instrument air equipment, steam tracing systems and instrumentation piping system components, the learner must correctly install instrument piping systems. Employer assessed accuracy is required for each task.





**Line (GAC):** I **Install Natural Gas and Propane Systems**  
**Competency:** I1 **Install and service fuel gas systems**

### Objectives

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

- Describe the purpose and operation of gas pressure regulators.
- Select, install and adjust gas pressure regulators.
- Service gas pressure regulators.

### LEARNING TASKS

1. Describe pressure regulators

### CONTENT

- Types
  - Appliance
  - Line pressure
  - Service
  - Direct operated
  - Lever operated
  - Propane
- First stage
- Second stage
- Operating elements
  - Loading
  - Measuring
  - Restricting
- Parts
  - Pressure relief
- Operating principles
  - Droop
  - Lock-up
  - Set point
  - Critical flow
- Applications
- Sizing tables
  - Flow rate
  - Pressure drop
- Maintenance
- Troubleshoot
- Freeze ups



**LEARNING TASKS**

6. Service pressure regulators

**CONTENT**

- Pressure testing
- Procedures for adjusting
- Verification of correct operation of all safety features
- Manufacturer's recommendations
- Troubleshooting
  - Obstructed vents
  - Foreign material between seat and disc
  - Corrosion
  - Outlet gas pressure too high
  - Outlet gas pressure too low
  - Slow response
  - Not retaining outlet pressure
  - Propane freeze ups
- Repair and replacement
- Lockout procedures
- Safety

**Achievement Criteria**

Given information on regulator types, operating principles, troubleshooting, mechanical burners, regulator venting, combustion analysis and installation and service procedures for pressure regulators, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to select, install, adjust and service gas pressure regulators. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on regulator types, operating principles, troubleshooting, mechanical burners, regulator venting, combustion analysis and installation systems and service procedures for pressure regulators, the learner must correctly install and service fuel gas systems. Employer assessed accuracy is required for each task.



**Line (GAC):**        **I**     **Install Natural Gas and Propane Systems**  
**Competency:**     **I2**    **Install and service fuel gas controls and safeguards**

**Objectives**

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

- Describe the principles of direct and alternating current circuits.
- Describe the principles of magnetism and magnetic induction.
- Connect and test electric circuits.
- Describe the principles of operation for gas controls on appliances.
- Describe the installation requirements for gas controls used on appliances.
- Install and adjust gas controls on appliances.
- Identify code rules and regulations applicable to the Level B Gasfitter certification.

**LEARNING TASKS**

1. Describe principles of electricity

**CONTENT**

- Safety
- Electron Theory
- Circuit components
  - Sources of electricity
  - Loads
  - Controls
- Terminology
  - Electromotive force
  - Current
  - Resistance
  - Power
  - Conduction
- Units
  - Volt
  - Ampere
  - Ohm
  - Watt
  - Volt-ampere
- Ohm’s Law
- Watt’s Law
  - Effects of changing voltage, current or resistance on power.
- Series, parallel, series/parallel
- Polarity
- Direct current principles
- Schematic symbols



## LEARNING TASKS

2. Describe principles of magnetism and magnetic induction

## CONTENT

- Diagrams
  - Wiring
  - Schematic
  - Ladder
  - Block (one-line)
- Use of measuring instruments
  - Connections
  - Range selection
  - Voltage
  - Current
  - Resistance
- Alternating current principles
- Rectification
- Wire types and sizing
- Overcurrent protection
- Overload protection
- Fan motor drives
  - Function
  - Testing
- Characteristics of magnetic lines of force
- Factors affecting the strength of a magnetic field
- Electromagnetism
- Electromagnetic induction
- Coils and solenoids
- Relays
  - Types
- Time delay
- Single contact
- Multiple contact
  - Troubleshooting
- Transformers
  - Operating principles
  - Ratings
  - Uses
- Control
- Ignition
  - Symbols
  - Installation
  - Phasing
  - Troubleshooting







**LEARNING TASKS**

3. Adjust and commission appliances

**CONTENT**

- Setup
- Code requirements
- Testing
  - Air flow
  - Temperature rise
  - Circulation
  - Safety and limits
- Purging and flushing
- Check electrical and air supply
- Clocking for gas consumption rate
- Orifice sizing
- Gas pressure measurement
- Instructions to the consumer
- Deration for altitude

**Achievement Criteria**

Given information on gas fired appliances, installation requirements, and how to adjust and commission appliances, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to install and adjust gas fired appliances. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on gas fired appliances, installation requirements, and how to adjust and commission appliances, the learner must correctly install and adjust gas fired appliances according to code and safety regulations. Employer assessed accuracy is required for each task.



**Line (GAC):** I **Install Natural Gas and Propane Systems**  
**Competency:** I4 **Install venting and air supply**

### Objectives

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

- Size and install venting systems for gas appliances.
- Describe and install air supply systems.

### LEARNING TASKS

1. Describe gas appliance venting

### CONTENT

- Purpose
- Venting action
  - Natural draft
  - Mechanical draft
- Direct venting
- Types
  - A
  - B
  - Single wall
  - L
  - BW
  - BH
- Appliance categories
- Materials
- Application
- Temperature rating
- Parts of a venting system
- Problems
  - Spillage
  - Condensation
  - Causes
  - Solutions
- Draft control devices
  - Applications
  - Installation procedures
  - Draft hoods
  - Barometric dampers
- Thermally operated flue dampers
- Electrically operated flue dampers





**LEARNING TASKS**

5. Describe gas appliance air supply requirements
  
6. Determine combustion air requirements for gas appliance installations with a combined input of up to and including 400 MBH
  
7. Determine combustion air requirements for gas appliance installations with a combined input exceeding 400 MBH

**CONTENT**

- Purpose
  - Combustion air
- Primary air
- Secondary air
- Excess air
  - Dilution air
  - Ventilation air
- Building as a system
  - Negative air pressure
- Openings and ducts
  - Terminations
- Code requirements
- Building envelope and construction
- Category of the appliance
- Draft control
- Air requirement calculations
  - Combustion
  - Ventilation
  - Flue gas dilution
- Table selection
- Grills and louvers
  - Types
  - Sizing
  - Free area calculations
- Air ducts
  - Length
  - Size
- Code requirements
- Dilution air requirements
- Air requirement calculations
  - Combustion
  - Ventilation
  - Flue gas dilution
- Calculations
- Grills and louvers
  - Types
  - Sizing
  - Free area calculations
- Air ducts
  - Length
  - Size

**LEARNING TASKS**

8. Install air supply

**CONTENT**

- Code requirements
- Structural penetrations
- Sealing
- Openings and ducts
  - Terminations
- Wind conditions
- Supply by mechanical means

**Achievement Criteria**

Given information on gas appliance venting, and its installation, mechanical draft appliances, direct vented flues, air supply requirements, and combustion air requirements, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to size and install venting systems for gas appliances and install air supply systems according to code requirements. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on gas appliance venting, and its installation, mechanical draft appliances, direct vented flues, air supply requirements, and combustion air requirements the learner must correctly size and install venting systems for gas appliances and install air supply systems according to code requirements. Employer assessed accuracy is required for each task.



**Achievement Criteria**

Given information on gas codes and regulations and the Canadian Electrical Code Part 1, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to apply code rules and regulations applicable to the level B Gasfitter certification. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on gas codes and regulations and the Canadian Electrical Code Part 1, the learner must correctly apply code rules and regulations applicable to the level B Gasfitter certification. Employer assessed accuracy is required for each task.



# Section 4

## TRAINING PROVIDER STANDARDS



## Facility Requirements

### **Classroom Area** (assuming class groups of 16 learners)

- 350 square feet of floor space (22 square feet per learner)
- Overhead and multimedia projectors and screen
- Moveable tables and comfortable chairs
- Whiteboard with marking pens and erasers
- Lighting controls (windows and fixtures) for screen viewing
- Acoustics that allow audibility of the instructor

### **Shop Area**

- 3,000 square feet of shop area as a minimum
- Space for tool cribs and work stations
- 10 foot ceiling height
- Adequate heating, lighting and ventilation
- Shops will be equipped to support the practical lab exercises as outlined in this document, including:
  - Cross-connections
  - Gasfitting
  - Hydronics
  - Hydraulics
  - Steam
  - Pneumatics
  - Fuel oil
  - Fiberglass piping
  - Plastic welding
  - Welding (oxy-fuel and arc)

### **Instructor's Office Space**

- 150 square feet, including space for meetings with learners
- Desk and filing space, allowing for storage of training materials
- Computer with internet access and printer
- Photocopier access



## Tools and Equipment

### Measuring Tools

- Ampere probe
- Calculator
- Calipers
- Centre finder
- Rulers
- Feeler gauge
- Squares – standard 24 in., combination, Flange straightedge
- Micrometer (Thread, inside, outside, depth)
- Multimeter
- Plumb bob
- Gauges – temperature, pressure, liquid, vacuum, specialty
- Geometry set
- Thermometer
- Measuring tape

### Power Tools

- Air compressor
- Bending machine
- Bolt tensioner
- Drills (electric, pneumatic, hammer, bench or stand press, mag)
- Grinders (electric or pneumatic, angle, bench, die, pedestal)
- Hydrostatic pump
- Impact driver
- Portable end-prep milling (pneumatic, electric)
- Saws (circular, cut-off, jig, saber)

### Rigging and Hoisting Equipment

- Cable puller
- Shackle
- Chain block
- Sling
- Chain puller
- Snatch block
- Cranes
- Spreader bar
- D-ring
- Tag line
- Grip hoist
- Rigger
- Jacks (hydraulic, ram and piston)

### Hand Tools

- Alignment clamps (external and internal)
- Angle finder
- Bending tools (hand and hydraulic)
- Bolt cutter
- Bolt die
- Bolt tap
- Bucket pump
- C-clamp
- Centre punch
- Chain pipe tongs
- Coil fin straightener
- Cold chisels
- Contour markers
- Bench, power vise (power driver pliers)
- Prying tool
- Ratchet
- Screwdriver
- Shear
- Spacing tool
- Swaging tool
- Tip cleaner
- Drafting accessories



- Files
- Flange alignment pins
- Flange spreader (jacks)
- Flaring tool
- Levels (laser, standard, builders)
- Marking tool
- Pin punch
- Pipe cutters (single-wheel, multi-wheel)
- Pipe reamer (spiral, fluted)
- Pipe tap
- 
- Pipe threader
- Pipe vises (chain and jacks, tri-stand and tube cleaner)
- Vise-grip pliers
- Wheel and bearing pullers
- Wrap-around
- Wrenches (adjustable/crescent, chain)
- Combination (open/closed end, hammer, hex-key, non-spark, pin, pipe, socket, torque)

### Welding and Soldering Tools

- Arc
- welders (electric, fuel)
- Orbital welder
- Beveling tools (hand, electric drive, oxy-fuel)
- Oxy-fuel cutting, heating and welding torches
- Compressed gas cylinders (purge, shield, cutting)
- Plasma cutters
- Propane tiger torches (preheating)
- Hot air welding machine
- Welding machines (stick, MIG, TIG)

### Ladders and Platforms

- Combination ladder
- Material lifts
- Extension ladder
- Scaffolding (staging)
- Manlifts (electrical, hydraulic, pneumatic, hand winch, power winch, one-man, platform, scissor lift, articulating boom)
- Pipe racks
- Pipe stands (roller)



## Reference Materials

### Required Reference Materials

- IPT's Pipe Trades Handbook
- WorkSafeBC Regulations Online
- Student Materials Package

### Recommended Resources

- IPT's Guide to Blueprint Interpretation
- CSA B.149 Gas Code
- CSA B.214 Installation of Hydronic Heating Systems
- Modern Heating – Seigenthaler
- Canadian Electrical Code
- Fundamentals of Gas Utilization – Dutton
- Design of Fluid Systems – Spirex Sarco

**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, plus
- Minimum 'B' Level Gas certification

### Work Experience

A minimum of 5 years' experience working in the industry as a Steamfitter/Pipefitter journeyman after earning Red Seal certification.

### Instructional Experience and Education

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

- Provincial (BC) Instructor Diploma or completion of a similar Trainer Training / Instructional Methods program (i.e.: UA Trainer Certificate), plus
- 2 years of supervisory or administrative experience
- Cross-connection Testing Certificate (BCWWA)
  - Experienced user of relevant software Word processing
  - Spreadsheets
  - Presentations
- CAD