

# Steamfitter / Pipefitter Program Outline



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**STEAMFITTER / PIPEFITTER  
PROGRAM OUTLINE**

**November 2009**

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

# TABLE OF CONTENTS

<b>FOREWORD</b>	<b>ii</b>
Subject Matter Experts	iii
Achievement Standards	iv
<b>SECTION 1 OCCUPATION ANALYSIS CHART</b>	<b>1</b>
<b>SECTION 2 STEAMFITTER / PIPEFITTER PROGRAM OUTLINE</b>	<b>4</b>
Suggested Schedule of Time Allotment steamfitter / Pipefitter Level 1	6
Suggested Schedule of Time Allotment steamfitter / Pipefitter Level 2	7
Suggested Schedule of Time Allotment Steamfitter / Pipefitter Level 3	8
Suggested Schedule of Time Allotment Steamfitter / Pipefitter Level 4	9
<b>STEAMFITTER / PIPEFITTER LEVEL 1</b>	<b>11</b>
LINE B: USE TOOLS AND EQUIPMENT	22
LINE C: ORGANIZE WORK	33
LINE D: PREPARE AND ASSEMBLE PIPING COMPONENTS	42
<b>STEAMFITTER / PIPEFITTER LEVEL 2</b>	<b>50</b>
LINE B: USE TOOLS AND EQUIPMENT	50
LINE C: ORGANIZE WORK	54
LINE D: PREPARE AND ASSEMBLE PIPING COMPONENTS	58
LINE E: INSTALL HYDRONIC HEATING AND COOLING	62
LINE F: PERFORM LAYOUT, FABRICATION AND INSTALLATION	68
LINE G: SPECIAL APPLICATION SYSTEMS	83
<b>STEAMFITTER / PIPEFITTER LEVEL 3</b>	<b>96</b>
LINE C: ORGANIZE WORK	96
LINE G: SPECIAL APPLICATION SYSTEMS	100
LINE H: WATER SUPPLY	117
LINE I: INSTALL NATURAL GAS AND PROPANE SYSTEMS	121
<b>STEAMFITTER / PIPEFITTER LEVEL 4</b>	<b>126</b>
LINE C: ORGANIZE WORK	126
LINE G: SPECIAL APPLICATION SYSTEMS	129
LINE I: INSTALL NATURAL GAS AND PROPANE SYSTEMS	141
<b>SECTION 3 TRAINING PROVIDER STANDARDS</b>	<b>155</b>
RECOMMENDED REFERENCE MATERIALS	157
TRAINING FACILITIES STANDARDS	158
INSTRUCTOR QUALIFICATIONS	159

## FOREWORD

The Program Standards for Steamfitter / Pipefitter 2009 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 2007.

### Acknowledgements

Key stakeholders from industry sectors including employers, associations, training providers, and trades workers were integral to the guidance of this program development project.

### Project Review Committee

Members of the Project Review Committee who contributed their valuable time and insights to the project were:

- Steve Anderson      Department of National Defense
- Danny Bradford      BC Federation of Labour
- Larry Doskoch 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

### SAFETY ADVISORY

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. The references to the Workers' Compensation Board of British Columbia 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>.

## **SUBJECT MATTER EXPERTS**

The standards were reviewed and adjusted by a group of Subject Matter Experts (SMEs), all Steamfitters and / or Pipefitters. The SME group met for three days in January 2009 and again for three days in March 2009. The SMEs were drawn from a wide cross section of industry and thanks are extended to them for their dedication and participation in keeping Steamfitter / Pipefitter Program Standards technologically current and aligned with the needs of industry.

### **2008-09 Steamfitter / Pipefitter Standards Project SMEs**

<b>Name</b>	<b>Organization</b>	<b>Position</b>	<b>Sector</b>
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

## **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.

**Achievement Criteria** define what performance is expected in the technical training environment (theory tests and lab based theory assessments and practical exercises).

**Workplace Achievement Criteria** 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 1**

## **OCCUPATION ANALYSIS CHART**

## STEAMFITTER / PIPEFITTER Occupation Analysis Chart

<b>A</b> Safe Work Practices	<b>A1 K</b> Control workplace hazards  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>A2 K</b> Describe occupational health and safety regulations  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>A3 K</b> Describe WHMIS and hazardous materials safety  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>A4 K</b> Use personal protective equipment  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>A5 K</b> Practice fire protection  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1												
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<b>B</b> Use Tools and Equipment	<b>B1 K</b> Use hand tools  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>B2 K</b> Use ladders and platforms  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>B3 K</b> Use cutting, brazing and soldering equipment  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>B4 K</b> Use measuring and leveling tools  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1	2					<b>B5 K</b> Use rigging and hoisting equipment  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1	2					<b>B6 K</b> Use portable power tools  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1					
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<b>B7 K</b> Use stationary power tools  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1																																									
1																																										
<b>C</b> Organize Work	<b>C1 K</b> Use mathematics and science (including electricity)  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1	2					<b>C2 K</b> Read drawings and specifications  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px; text-align: center;">3</td> <td style="width: 10px; text-align: center;">4</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1	2	3	4			<b>C3 K</b> Use codes, regulations and standards  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>C4 W</b> Use manufacturer and supplier documentation  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>C5 K</b> Plan a project  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px;"></td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px; text-align: center;">3</td> <td style="width: 10px; text-align: center;">4</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>		2	3	4									
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<b>D</b> Prepare and Assemble Piping Components	<b>D1 K</b> Join pipe  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1	2					<b>D2 K</b> Select and install valves  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>D3 K</b> Select and install fittings  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>D4 K</b> Describe methods of penetrating structures  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px; text-align: center;">1</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>	1						<b>D5 K</b> Describe pumps  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px;"></td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>		2											
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<b>E</b> Install Hydronic Heating and Cooling	<b>E1 K</b> Describe the operation of hydronic heating and cooling piping systems  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px;"></td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>		2					<b>E2 K</b> Describe controls for hydronic heating and cooling systems  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px;"></td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>		2					<b>E3 K</b> Install, test and commission hydronic heating and cooling systems  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px;"></td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>		2					<b>E4 K</b> Maintain and repair hydronic heating and cooling systems  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10px;"></td> <td style="width: 10px; text-align: center;">2</td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> <td style="width: 10px;"></td> </tr> </table>		2																		
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**F**  
Perform Layout,  
Fabrication and  
Installation

**F1 K**  
Prepare pipe and fittings

	2			
--	---	--	--	--

**F2 K**  
Develop and use  
templates

	2			
--	---	--	--	--

**F3 W**  
Develop a simple spool  
sheet

	2			
--	---	--	--	--

**F4 K**  
Fabricate from spool  
sheets

	2			
--	---	--	--	--

**F5 K**  
Use welding equipment

	2			
--	---	--	--	--

**F6 K**  
Bend pipe

	2			
--	---	--	--	--

**F7 K**  
Install supports, hangers,  
guides and anchors

	2			
--	---	--	--	--

**F8 K**  
Erect a piping assembly

	2			
--	---	--	--	--

**F9 W**  
Test and commission a  
piping assembly

	2			
--	---	--	--	--

**G**  
Special Application  
Systems

**G1 K**  
Install marine systems  
piping

	2			
--	---	--	--	--

**G2 K**  
Install fuel oil piping  
systems

		3		
--	--	---	--	--

**G3 K**  
Install low pressure steam  
piping systems

		3		
--	--	---	--	--

**G4 K**  
Install high pressure  
steam piping systems

		3		
--	--	---	--	--

**G5 K**  
Describe feedwater  
treatment systems

		3		
--	--	---	--	--

**G6 K**  
Install fire protection  
piping systems

		3		
--	--	---	--	--

**G7 K**  
Install hydraulic piping  
systems

	2			
--	---	--	--	--

**G8 K**  
Install pneumatic and  
compressed air piping  
systems

	2			
--	---	--	--	--

**G9 K**  
Install process piping  
systems

			4	
--	--	--	---	--

**G10 K**  
Install air conditioning  
piping systems

			4	
--	--	--	---	--

**G11 K**  
Install refrigeration piping  
systems

			4	
--	--	--	---	--

**G12 K**  
Install medical gas piping  
systems

			4	
--	--	--	---	--

**G13 K**  
Install instrumentation  
piping systems

			4	
--	--	--	---	--

**H**  
Water Supply

**H1 K**  
Describe potable water  
distribution systems

		3		
--	--	---	--	--

**H2 K**  
Describe the installation  
of cross connection  
assemblies

		3		
--	--	---	--	--

**H3 K**  
Test and commission  
cross connection  
assemblies

		3		
--	--	---	--	--

**I**  
Install natural gas and  
propane systems

**I1 K**  
Install and service fuel  
gas systems

		3	4	
--	--	---	---	--

**I2 K**  
Install and service fuel  
gas controls and  
safeguards

			4	
--	--	--	---	--

**I3 K**  
Install and service fuel  
gas equipment

			4	
--	--	--	---	--

**I4 K**  
Install venting and air  
supply

			4	
--	--	--	---	--

**I5 K**  
Apply gas codes,  
regulations and standards

			4	
--	--	--	---	--



# **SECTION 2**

## **STEAMFITTER / PIPEFITTER PROGRAM OUTLINE**

## SUGGESTED SCHEDULE OF TIME ALLOTMENT STEAMFITTER / PIPEFITTER LEVEL 1

LEVEL ONE		% of Time	Theory	Practical
<b>Line A</b>	<b>Safe Work Practices</b>	<b>20%</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 protection		√	
<b>Line B</b>	<b>Use Tools and Equipment</b>	<b>30%</b>		
B1	Use hand tools		√	√
B2	Use ladders and platforms		√	√
B3	Use cutting brazing and soldering equipment		√	√
B4	Use measuring and levelling 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>		
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>		
D1	Join pipe		√	√
D2	Select and install valves		√	√
D3	Select and install fittings		√	√
D4	Describe methods of penetrating structures		√	
	<b>Total</b>	<b>100%</b>		

## SUGGESTED SCHEDULE OF TIME ALLOTMENT STEAMFITTER / PIPEFITTER LEVEL 2

LEVEL TWO			Theory	Practical
<b>Line B</b>	<b>Use Tools and Equipment</b>	<b>8% of Time</b>		
B4	Use measuring and leveling tools		√	√
B5	Use rigging and hoisting equipment		√	√
<b>Line C</b>	<b>Organize Work</b>	<b>9% of Time</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% of Time</b>		
D1	Join pipe		√	√
D5	Describe pumps		√	
<b>Line E</b>	<b>Install Hydronic Heating and Cooling</b>	<b>27% of Time</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% of Time</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% of Time</b>		
G1	Install marine systems piping		√	√
G7	Install hydraulic piping systems		√	√
G8	Install pneumatic and compressed air piping systems		√	√
	<b>Total</b>	<b>100%</b>		

## SUGGESTED SCHEDULE OF TIME ALLOTMENT STEAMFITTER / PIPEFITTER LEVEL 3

LEVEL THREE			Theory	Practical
<b>Line C</b>	<b>Organize Work</b>	<b>10% of Time</b>		
C2	Read drawings and specifications		√	√
C5	Plan a project		√	√
<b>Line G</b>	<b>Special Application Systems</b>	<b>60% of Time</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% of Time</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% of Time</b>		
I1	Install and service fuel gas systems		√	√
	<b>Total</b>	<b>100%</b>		

## SUGGESTED SCHEDULE OF TIME ALLOTMENT STEAMFITTER / PIPEFITTER LEVEL 4

LEVEL FOUR			Theory	Practical
<b>Line C</b>	<b>Organize Work</b>	<b>10% of Time</b>		
C2	Read drawings and specifications		√	√
C5	Plan a project		√	
<b>Line G</b>	<b>Special Application Systems</b>	<b>40% of Time</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		√	√
<b>Line I</b>	<b>Install Natural Gas and Propane Systems</b>	<b>50% of Time</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</b>	<b>100%</b>		



# **STEAMFITTER / PIPEFITTER**

## **LEVEL 1**

**LINE A: SAFE WORK PRACTICES**

**Competency: A 1 Control workplace hazards**

**Learning Objectives:**

The learner will be able to:

- describe workplace hazards
- manage workplace hazards
- demonstrate emergency procedures
- describe non-emergency injury reporting procedures
- describe how worksite safety policies are established

**LEARNING TASKS**

1. Describe short term hazards in the steamfitter / pipefitter trade

2. Describe long term hazards in the steamfitter / pipefitter trade

3. Describe safety precautions when working at elevations

**CONTENT**

- Excavations
- Working around heavy equipment
- Sharp objects
- Ladders
- Work platforms
- Confined space
- Electrical
- Lockout procedures
- Compressed gas
- Explosive material (dust)
- Lifting procedures
- Personal apparel
  - Clothing
  - Hair and beards
  - Jewelry
- Housekeeping
- Horseplay
- Respect for others safety
- Constant awareness of surroundings
- Safe attitude
- Management of hazards
- Respiratory disease
- Repetitive strain injuries
- Management of hazards
- Wind
- Floor openings
- Guard rails

## LEARNING TASKS

## CONTENT

- |  |  |
|--|--|
| 4. Describe emergency procedures                         | <ul style="list-style-type: none"><li>• Safety lines</li><li>• Weather</li><li>• Stressed Cables</li><li>• Emergency shutoffs</li><li>• Fire control systems</li><li>• Eye wash facilities</li><li>• Emergency exits</li><li>• Emergency contact / phone numbers</li><li>• Outside meeting place</li><li>• Disaster meeting place</li></ul>  |
| 5. Describe non-emergency injury reporting procedures    | <ul style="list-style-type: none"><li>• First aid facilities</li><li>• Reports accessories</li></ul>   |
| 6. Describe how a workplace safety policy is established | <ul style="list-style-type: none"><li>• Process</li><li>• Hazard assessment</li><li>• Conditions</li><li>• Meeting requirements</li><li>• Tool box<ul style="list-style-type: none"><li>– Reporting hazards and incidents</li><li>– Reporting injuries</li><li>– Investigations</li><li>– Committees</li><li>– Employee orientation (including new worker / young worker)</li><li>– First-aid</li><li>– Hearing</li><li>– Records and statistics</li><li>– Lock-out</li><li>– Non-compliance procedures</li></ul></li><li>• Minimum standards</li><li>• Acts and Regulations</li></ul> |
| 7. Describe lock-out and tag-out procedures              | <ul style="list-style-type: none"><li>• Understanding of system operation</li><li>• Components requiring lock-out</li><li>• Identification requirements</li><li>• Situations where lock-out is required</li><li>• Lock-out equipment<ul style="list-style-type: none"><li>– Chains</li><li>– Tags</li><li>– Locks</li></ul></li></ul>  |

## LEARNING TASKS

## CONTENT

- Fabrication of isolation devices
  - Blind flanges
  - Spades
  - Spectacle blinds
- Lock-out procedures
  - disconnection

### 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 A: SAFE WORK PRACTICES**

**Competency: A 2 Describe Occupational Health and Safety Regulations**

**Learning Objectives:**

The learner will 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**

- |  |  |
|--|--|
| 1. Define key terms used in the Workers Compensation Act                             | • Applicable terms   |
| 2. Describe the conditions under which compensation is paid                          | • Applicable regulations   |
| 3. Describe the general duties of employers, employees and others                    | • Applicable regulations   |
| 4. Describe the BC WorkSafe requirements for the reporting of accidents              | • Applicable requirements and procedures   |
| 5. Describe the “Core Requirements” of the Occupational Health and Safety Regulation | • Definitions<br>• Application<br>• 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> • 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> |

## LEARNING TASKS

6. Identify the hazards and safety procedures in the steamfitter / pipefitter workplace

## CONTENT

- Chemical and biological substances
- Substance specific requirements
- Noise, vibration, radiation and temperature
- Personal protective clothing and equipment
- Confined spaces
- De-energization and lockout
- Fall protection
- Tools, machinery and equipment
- Ladders, scaffolds and temporary work platforms
- Cranes and hoists
- Rigging
- Mobile equipment
- Transportation of workers
- Traffic control
- Electrical safety

### Achievement Criteria

Given information on the Workers Compensation Act, BC WorkSafe requirements for accident reporting, core requirements of the Occupational Health and Safety Regulation as well and 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, BC WorkSafe requirements for accident reporting, core requirements of the Occupational Health and Safety Regulation as well and 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 A: SAFE WORK PRACTICES**

**Competency: A 3 Describe WHMIS and Hazardous Materials Safety**

**Learning Objectives:**

The learner will 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.
- apply WHMIS regulations.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <p>1. Describe the regulations that require suppliers of hazardous materials to provide MSDSs and label products as a condition of sale and importation</p> <p>2. State the purpose of the Workplace Hazardous Materials Information System (WHMIS)</p> <p>3. Describe the key elements of WHMIS</p> <p>4. Describe the responsibilities of suppliers under WHMIS</p> <p>5. Describe the responsibilities of employers under WHMIS</p> | <ul style="list-style-type: none"><li>• Hazardous Product Act</li><li>• Controlled Products Regulations</li><li>• Ingredient Disclosure List</li><li>• Hazardous Materials Information Review Act</li><br/><li>• 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</li><li>• Recognition of rights<ul style="list-style-type: none"><li>– Workers</li><li>– Employers</li><li>– Suppliers</li><li>– Regulators</li></ul></li><br/><li>• Material safety data sheets (MSDSs)</li><li>• Labeling of containers of hazardous materials</li><li>• Worker education programs</li><br/><li>• Provide<ul style="list-style-type: none"><li>– MSDSs</li><li>– Labels</li></ul></li><br/><li>• Provide<ul style="list-style-type: none"><li>– MSDSs</li><li>– Labels</li><li>– Work education programs in the workplace</li></ul></li></ul> |
|--|--|

## LEARNING TASKS

6. Describe information to be disclosed on a MSDS
  
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

- Hazardous ingredients
- Preparation information
- Product information
- Physical data
- Fire or explosion
- Reactivity data
- Toxicological properties
- 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 A: SAFE WORK PRACTICES**

**Competency: A 4 Use Personal Protective Equipment**

**Learning Objectives:**

The learner will select and use appropriate personal protective equipment.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe personal protective equipment requirements | <ul style="list-style-type: none"><li>• Safety footwear</li><li>• Eye protection</li><li>• Ear protection</li><li>• Head protection</li><li>• Respiratory protection</li><li>• Clothing</li><li>• Fall protection</li></ul> |
| 2. Use personal protective equipment                   | <ul style="list-style-type: none"><li>• Selection</li><li>• Purpose</li><li>• Operating procedures</li><li>• Training requirements</li><li>• Inspection</li><li>• Maintenance</li><li>• Storage</li></ul>                   |

**Achievement Criteria**

Given information on both requirements for, and use of personal protective equipment, 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 selecting and using personal protective equipment. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on both requirements for, and use of personal protective equipment, the learner must correctly follow requirements at all times. The requirements and use of personal protective equipment is an integral part of the job. Employer assessed accuracy is required for each task.

**LINE A: SAFE WORK PRACTICES**

**Competency: A 5 Practice Fire Prevention**

**Learning Objectives:**

The learner will be able to:

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

**LEARNING TASKS**

**CONTENT**

- |   |  |
|---|--|
| 1. Describe the conditions necessary to support a fire  | <ul style="list-style-type: none"><li>• Air</li><li>• Fuel</li><li>• Heat</li></ul>  |
| 2. Describe the classes of fires according to the materials being burned  | <ul style="list-style-type: none"><li>• Class A</li><li>• Class B</li><li>• Class C</li><li>• Class D</li><li>• Symbols and colours</li></ul>  |
| 3. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus | <ul style="list-style-type: none"><li>• Hot work permit (site specific)</li><li>• Handling and storage of flammable materials</li><li>• Symbols</li><li>• Fuels<ul style="list-style-type: none"><li>– Diesel</li><li>– Gasoline</li><li>– Propane</li><li>– Natural Gas</li></ul></li><li>• Ventilation<ul style="list-style-type: none"><li>– Purging</li></ul></li><li>• Lubricants</li><li>• Oily rags</li><li>• Combustible metals</li><li>• Aerosols</li></ul> |
| 4. Describe the considerations and steps to be taken prior to fighting a fire   | <ul style="list-style-type: none"><li>• Warning others and fire department</li><li>• Evacuation of others</li><li>• Fire contained and not spreading</li><li>• Personal method of egress</li><li>• Training</li></ul>  |
| 5. Describe the procedure for using a fire extinguisher   | <ul style="list-style-type: none"><li>• Extinguisher selection</li><li>• P.A.S.S.</li></ul>  |

## LEARNING TASKS

## CONTENT

- Pull
- Aim
- Squeeze
- Sweep

### Achievement Criteria

Given information on conditions necessary to support a fire, classes of fires, preventative fire safety precautions, steps to take before fighting a fire and the fire extinguisher procedure, 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 fire safety precautions, steps to take prior to fighting the fire and procedure for using a fire extinguisher. Tasks must be performed with 100% accuracy.

**LINE B: USE TOOLS AND EQUIPMENT**

**Competency: B 1 Use Hand Tools**

**Learning Objectives:**

The learner will be able to:

- select hand tools appropriate to steamfitter and pipefitter trade.
- use, inspect and maintain hand tools.

**LEARNING TASKS**

**CONTENT**

1. Describe hand tools used in the trade

- 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

2. Use all hand tools (as listed above)

- 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 B: USE TOOLS AND EQUIPMENT**

**Competency: B 3 Use Cutting, Brazing and Soldering Equipment**

**Learning Objectives:**

The learner will be able to:

- select cutting, brazing and soldering equipment appropriate to the steamfitter and pipefitter processes.
- use cutting brazing and soldering equipment.
- inspect and maintain cutting, brazing and soldering equipment.

**LEARNING TASKS**

**CONTENT**

1. Describe oxy-acetylene and air / fuel equipment

- Parts
  - Oxygen cylinders
  - Acetylene cylinders
  - Regulators
  - Gauges
  - Spark arrestors
  - Torches (oxy / fuel, air / fuel)
- Safety Devices
- Transportation of Dangerous Goods Legislation
- Ventilation

2. Describe cutting, brazing and soldering techniques

- Selection
- Procedure
- Limitations
- Inspection

3. Use oxy-acetylene equipment to cut, braze and solder

- Safety
- Flammable material recognition
- Types
- Parts
- Purpose / Uses
- Procedures / Operations
  - Setup
  - Take down
  - Tip selection
  - Alloy selection
  - Flux selection
- Adjustment
- Inspection

## LEARNING TASKS

## CONTENT

- 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 B: USE TOOLS AND EQUIPMENT**

**Competency: B 4 Use Measuring and Leveling Tools**

**Learning Objectives:**

The learner will be able to:

- describe pressure measuring tools.
- use pressure measuring tools.

**LEARNING TASKS**

1. Describe pressure measuring tools

2. Use manometers and mechanical gauges

**CONTENT**

- Manometers
  - Types
  - Filling
  - Fluids
- Mechanical gauges
  - Analog
  - Digital
  - Standard
  - Compound
- Gas pressure testing
  - Identify hazards
  - Gauge pressures
  - Absolute pressures
  - Conversion between measurement units
  - Leak detection
  - Hydrostatic testing
  - Pneumatic testing
  - Vacuum testing
- Testing procedures

**Achievement Criteria**

Given information on pressure measuring tools, manometers and mechanical gauges, 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 use of pressure measuring tools, including manometers and mechanical gauges. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on pressure measuring tools, including manometers and mechanical gauges, the learner must correctly use pressure measuring tools at all times. Employer assessed accuracy is required for each task.

**LINE B: USE TOOLS AND EQUIPMENT**

**Competency: B5 Use Rigging and Hoisting Equipment**

**Learning Objectives:**

The learner will be able to:

- use hoisting, lifting and rigging equipment.
- tie knots, bends and hitches.

**LEARNING TASKS**

1. Describe the principles of lifting and hoisting
2. Describe hoisting, lifting and rigging equipment
3. Describe lifting and hoisting communication
4. Tie knots, bends and hitches

**CONTENT**

- Mechanical advantage
- Balance points
- Applicable safety codes and regulations
- Lifting and Hoisting
  - Cranes
  - Boom trucks
  - Loaders
  - Tirlors
  - Come-alongs
  - Tuggers
  - Chain falls
  - Jacks
- Accessories
  - Slings / chokers
  - Shackles
  - Chains
  - Tag lines
  - Spreader bars
  - Snatch blocks
  - Turnbuckles
  - Softeners
  - U clips
  - J clips
- Types
  - Hand signals
  - Communication with the operator
  - Communication with others
- Purpose / meaning
- Types

## LEARNING TASKS

## CONTENT

- Half hitch
  - Timber hitch
  - Rolling hitch
  - Clove hitch
  - Figure of eight
  - Reef knot
  - Sheet bend
  - Bowline
  - Bowline on a bight
  - Trucker's hitch
  - Purposes
  - Limitations
5. Use hoisting, lifting and rigging equipment

### Achievement Criteria

Given information on the principles of lifting and hoisting, hoisting, lifting and rigging equipment, communication, knots, bends and hitches, 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 use of hoisting, lifting, and rigging equipment, communication while lifting and hoisting; knots, bends and hitches. Tasks must be performed with 100% accuracy.

### Workplace Achievement Criteria

Given information on hoisting, lifting and rigging equipment, types of communication and their meaning, ties, bends, knots and hitches, the learner must perform safe and correct hoisting, lifting and rigging at all times. Employer assessed accuracy is required for each task.

**LINE B: USE TOOLS AND EQUIPMENT**

**Competency: B6 Use Portable Power Tools**

**Learning Objectives:**

The learner will be able to:

- select portable power tools appropriate to steamfitter and pipefitter processes.
- use portable power tools.
- inspect and maintain portable power tools.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe portable power tools used in the trade | <ul style="list-style-type: none"><li>• Types<ul style="list-style-type: none"><li>– Electric</li><li>– Pneumatic</li></ul></li><li>• Cutting tools</li><li>• Grinding and abrasive tools</li><li>• Threading tools</li><li>• Drilling and boring tools</li><li>• Specialty tools<ul style="list-style-type: none"><li>– Fusion tools</li><li>– Power crimpers</li><li>– Grooving tools</li><li>– T-Drill</li></ul></li><li>• Accessories</li></ul> |
| 2. Use portable power tools as listed above        | <ul style="list-style-type: none"><li>– Types</li><li>– Parts</li><li>– Purpose / Uses</li><li>– Procedures / Operations</li><li>– Safety</li><li>– Adjustment</li><li>– Inspection</li><li>– Maintenance</li><li>– Storage</li></ul>   |

**Achievement Criteria**

Given information on portable power tools, 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 portable power tools at all times. Tasks must be performed with 100% accuracy.

### **Workplace Achievement Criteria**

Given information on portable power tools, the learner must correctly use portable power tools at all times. Use of portable power tools is an important part of the job. Employer assessed accuracy is required for each task.

**LINE B: USE TOOLS AND EQUIPMENT**

**Competency: B7 Use Stationary Power Tools**

**Learning Objectives:**

The learner will be able to:

- select stationary power tools appropriate to the steamfitter and pipefitter trade.
- use stationary power tools.
- inspect and maintain stationary power tools.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| 1. Describe stationary power tools used in the trade | <ul style="list-style-type: none"><li>• Cutting tools</li><li>• Grinding and abrasive tools</li><li>• Threading tools</li><li>• Drilling and boring tools</li><li>• Specialty tools</li><li>• Accessories</li><li>• Grooving tools</li></ul> |
| 2. Use stationary power tools as listed above        | <ul style="list-style-type: none"><li>• Types</li><li>• Parts</li><li>• Purpose / Uses</li><li>• Procedures / Operations</li><li>• Safety</li><li>• Adjustment</li><li>• Inspection</li><li>• Maintenance</li><li>• Storage</li></ul>        |

**Achievement Criteria**

Given information on the use of stationary power tools, 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 stationary power tools at all times. Tasks must be performed with 100% accuracy.

**Workplace Achievement Criteria**

Given information on stationary power tools, the learner must correctly use stationary power tools at all times. Use of the stationary power tools is an important part of the job. Employer assessed accuracy is required for each task.

**LINE C: ORGANIZE WORK**

**Competency: C1 Use Mathematics and Science (Including Electricity)**

**Learning Objectives:**

The learner will be able to use mathematics and science to solve problems in the steamfitter / pipefitter trade.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| <ol style="list-style-type: none"><li>1. Add, subtract, multiply and divide numbers</li><li>2. Use formulas to calculate area</li><li>3. Use formulas to calculate volumes</li><li>4. Use formulas to calculate capacity</li><li>5. Transpose formulas</li><li>6. Perform conversions</li></ol> | <ul style="list-style-type: none"><li>• Whole numbers</li><li>• Fractions</li><li>• Decimals</li><li>• Percentages</li><br/><li>• Cross-sectional area of pipe</li><br/><li>• Cylinders</li><li>• Rectangular tanks</li><br/><li>• Imperial gallons</li><li>• US gallons</li><li>• Liters</li><br/><li>• Processes</li><br/><li>• Length</li><li>• Volume</li><li>• Capacity</li><li>• Area</li><li>• Mass</li><li>• Weight</li><li>• Heat energy<ul style="list-style-type: none"><li>– Kilowatts</li><li>– BTUs</li><li>– Gigajoules</li><li>– Calories</li></ul></li><li>• Temperature<ul style="list-style-type: none"><li>– Fahrenheit</li><li>– Centigrade</li><li>– Kelvin</li><li>– Rankin</li></ul></li><li>• Pressure<ul style="list-style-type: none"><li>– Absolute</li></ul></li></ul> |
|---|---|

## LEARNING TASKS

## CONTENT

- |  |  |
|--|--|
| 7. Calculate piping measurements                                     | <ul style="list-style-type: none"><li>– Gauge</li><li>• Terms<ul style="list-style-type: none"><li>– Thread allowance</li><li>– Fitting allowance</li><li>– End to end</li><li>– End to centre</li><li>– Centre to centre</li><li>– Face to face</li><li>– End to back</li><li>– Back to back</li><li>– Socket depth</li></ul></li><li>• Calculations</li><li>• Grades</li><li>• Elevations</li><li>• Benchmarks</li></ul> |
| 8. Use the Pythagorean theorem of right angles                       | <ul style="list-style-type: none"><li>• Hypotenuse</li><li>• Side opposite</li><li>• Side adjacent</li></ul>   |
| 9. Calculate offsets using the applicable trigonometric function     | <ul style="list-style-type: none"><li>• Calculator methods</li><li>• Table-based methods</li></ul>   |
| 10. Calculate the required measurements for a parallel piping offset | <ul style="list-style-type: none"><li>• Equal spread</li><li>• Rolling</li><li>• Jumper</li></ul>  |
| 11. Define the properties of matter                                  | <ul style="list-style-type: none"><li>• Density</li><li>• Cohesion</li><li>• Adhesion</li><li>• Tensile strength</li><li>• Ductility</li><li>• Malleability</li><li>• Elasticity</li><li>• Conductivity</li><li>• Heat properties<ul style="list-style-type: none"><li>– BTUs</li><li>– Calories</li><li>– Gigajoules</li><li>– Specific Heat</li></ul></li></ul>  |

## LEARNING TASKS

## CONTENT

- |  |   |
|--|---|
| 12. Use Pascal's theory of pressure and force  | <ul style="list-style-type: none"><li>• Pounds</li><li>• Newtons</li></ul>  |
| 13. Use Archimedes' principles of displacement and floatation                                      | <ul style="list-style-type: none"><li>• Specific weight</li><li>• Specific gravity</li></ul>  |
| 14. Define mechanical advantage as it relates to fluid power                                       | <ul style="list-style-type: none"><li>• Hydraulics</li><li>• Hydrostatics</li></ul>   |
| 15. Describe factors that affect fluid flow in a piping system                                     | <ul style="list-style-type: none"><li>• Viscosity</li><li>• Laminar flow</li><li>• Turbulent flow</li><li>• Velocity</li><li>• Piping material</li><li>• Fittings</li></ul> |
| 16. Describe factors that affect gas volumes and pressures   | <ul style="list-style-type: none"><li>• Boyle's Law</li><li>• Charles Law</li><li>• Combined Gas Law</li></ul>  |
| 17. Calculate the expansion and contraction of various piping materials due to heating and cooling | <ul style="list-style-type: none"><li>• Ferrous</li><li>• Non-ferrous</li><li>• Thermoplastic</li></ul>   |
| 18. Define methods of heat transfer  | <ul style="list-style-type: none"><li>• Conduction</li><li>• Convection</li><li>• Radiation</li></ul>   |
| 19. Perform heat load calculations   | <ul style="list-style-type: none"><li>• Sensible</li><li>• Latent</li><li>• Specific heat as it applies to change of state</li><li>• Steam tables</li></ul>                 |

## 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 C: ORGANIZE WORK**

**Competency: C 2 Read Drawings and Specifications**

**Learning Objectives:**

The learner will be able to:

- use drafting tools, 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**

**CONTENT**

- |   |  |
|---|--|
| 1. Describe drafting tools and materials  | <ul style="list-style-type: none"><li>• Drawing boards</li><li>• T-squares</li><li>• Triangles</li><li>• Protractors</li><li>• French curves</li><li>• Pencils</li><li>• Erasers and shields</li><li>• Scale rulers</li><li>• Compasses</li><li>• Dividers</li><li>• Templates</li></ul> |
| 2. Use scale rulers to determine actual dimensions from a piping diagram                  | <ul style="list-style-type: none"><li>• Scale rulers</li></ul>   |
| 3. Describe piping and fixture symbols currently used in the steamfitter pipefitter trade | <ul style="list-style-type: none"><li>• Tees</li><li>• Wyes</li><li>• Flanges</li><li>• Elbows</li><li>• Valves</li></ul>  |
| 4. Describe lettering and dimensioning of piping diagrams                                 | <ul style="list-style-type: none"><li>• Hidden lines</li><li>• Object lines</li><li>• Border lines</li><li>• Center lines</li><li>• Dimension lines</li><li>• Extension lines</li><li>• Phantom lines</li></ul>  |
| 5. Describe drawing projections   | <ul style="list-style-type: none"><li>• Isometric</li><li>• Orthographic</li></ul>   |

## LEARNING TASKS

## CONTENT

6. Use drawing projections

- Oblique
- Views
- Isometric
- Orthographic
- Conversion from one to the other

7. Use tools to sketch irregular shapes

- French curves
- Templates
- Compasses
- Splines

8. Create isometric drawings of piping systems

- 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.

**LINE C: ORGANIZE WORK**

**Competency: C3 Use Codes, Regulations and Standards**

**Learning Objectives:**

The learner will be able to:

- identify codes and standards encountered in the steamfitter / pipefitter trade.
- identify various environmental agencies that affect the steamfitter / pipefitter plumbing trade.

**LEARNING TASKS**

1. Identify code, standards and organizations affecting the steamfitter / pipefitter trade

**CONTENT**

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

2. Describe where the above codes and standards are applied within the

- Planning
- Installation

## LEARNING TASKS

steamfitter / pipefitter trade

## CONTENT

- Maintenance

### 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 C: ORGANIZE WORK**

**Competency: C 4 Use Manufacturer and Supplier Documentation**

**Learning Objectives:**

The learner will 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**

**CONTENT**

- |  |  |
|--|--|
| 1. Describe documentation encountered in the steamfitter pipefitter trade    | <ul style="list-style-type: none"><li>• Tool and equipment documentation</li><li>• Material Safety and Data Sheets</li><li>• System component documentation</li><li>• Proprietary product documentation</li><li>• Certification agencies</li></ul> |
| 2. Describe information contained in manufacturer and supplier documentation | <ul style="list-style-type: none"><li>• Installation instructions and requirements</li><li>• Operation and maintenance manuals</li><li>• Product specifications</li><li>• Warranty information</li></ul>   |
| 3. Source and use manufacturer's documentation                               | <ul style="list-style-type: none"><li>• Manufacturer's web-sites</li><li>• Search engines</li><li>• Archival sources</li><li>• On-site documentation</li></ul>   |

**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.

**LINE D:                    PREPARE AND ASSEMBLE PIPING COMPONENTS**

**Competency:            D 1   Join Pipe**

**Learning Objectives:**

The learner will be able to:

- describe piping and tubing materials used in the steamfitter / pipefitter trade.
- join tubing and piping.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| 1. Describe piping and tubing materials  | <ul style="list-style-type: none"><li>• Copper pipe and tubing</li><li>• Cast iron soil and pressure</li><li>• Brass pipe and tubing</li></ul>   |
| 2. Describe the method of manufacture    | <ul style="list-style-type: none"><li>• Copper pipe and tubing</li><li>• Cast iron pipe</li><li>• Brass pipe and tubing</li></ul>  |
| 3. Describe methods of pipe support      | <ul style="list-style-type: none"><li>• Types<ul style="list-style-type: none"><li>– Hangers</li><li>– Supports</li><li>– Seismic</li><li>– Anchors</li><li>– Guides</li><li>– Slide plates</li></ul></li><li>• Compatibility with piping</li><li>• Size</li><li>• Spacing</li><li>• Fasteners<ul style="list-style-type: none"><li>– Beam clamps</li><li>– Drop-in anchors</li><li>– Draw bolts</li><li>– Toggle bolts</li></ul></li><li>• Interferences</li><li>• Insulation thickness</li><li>• Elevation of hangers</li><li>• Attachment methods</li><li>• Tools and equipment</li></ul> |
| 4. Describe methods of protecting piping | <ul style="list-style-type: none"><li>• Frost protection<ul style="list-style-type: none"><li>– Heat tape</li><li>– Frost boxes</li><li>– Circulating pumps</li></ul></li></ul>  |

## LEARNING TASKS

## CONTENT

- Ultraviolet protection
  - Corrosion protection
    - Coatings
    - Tape
  - Physical damage
    - Protective plates
    - Sleeving
    - Metal stud grommets
  - Protective measures
    - Insulating
    - Water treatment
    - Dielectric protection
5. Describe the inspection of pipe before installation
- 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
6. Describe the installation of tubing and pipe
- Types
  - Sizes
  - Uses
  - Hazards
  - Safety
  - Measuring procedures
  - Selection for application
  - Calculations
    - Length
    - Fitting allowances
    - Offsets
    - Gain or loss
  - Cutting

## LEARNING TASKS

## CONTENT

7. Install tubing and pipe

- 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 D: PREPARE AND ASSEMBLE PIPING COMPONENTS**

**Competency: D 2 Select and Install Valves**

**Learning Objectives:**

The learner will be able to:

- describe valves used in the steamfitter / pipefitter trade.
- select and install valves.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe basic valve types.               | <ul style="list-style-type: none"><li>• Types</li><li>• Purpose</li><li>• Materials</li><li>• Seating design</li><li>• Orientation</li><li>• Temperature limitations</li><li>• Pressure limitations</li><li>• Applications</li><li>• Specifications</li><li>• Special purpose<ul style="list-style-type: none"><li>– Pressure relief</li><li>– Temperature relief</li><li>– Pressure reducing / Regulator</li></ul></li></ul> |
| 2. Describe the methods of installing valves | <ul style="list-style-type: none"><li>• Selection<ul style="list-style-type: none"><li>– Applications</li><li>– Specifications</li><li>– Pressure limitations</li></ul></li><li>• Orientation</li><li>• Installation requirements</li></ul>   |
| 3. Select and install valves                 | <ul style="list-style-type: none"><li>• Select and install valves in a practical shop exercise</li></ul>  |

**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 D: PREPARE AND ASSEMBLE PIPING COMPONENTS**

**Competency: D 3 Select and Install Fittings**

**Learning Objectives:**

The learner will be able to:

- describe fittings and connection methods used in the steamfitter / pipefitter trade.
- select and install fittings.

**LEARNING TASKS**

**CONTENT**

- |   |  |
|---|--|
| 1. Describe fittings used in the steamfitter pipefitter trade | <ul style="list-style-type: none"><li>• Purpose</li><li>• Types</li><li>• Applications</li><li>• Limitations</li></ul>   |
| 2. Describe connection methods of fittings                    | <ul style="list-style-type: none"><li>• Welded</li><li>• Threaded</li><li>• Compression</li><li>• Flared</li><li>• Soldered / brazed</li><li>• Mechanical</li><li>• Solvent welded</li></ul> |
| 3. Describe considerations in selecting fittings              | <ul style="list-style-type: none"><li>• Applications</li><li>• Specifications</li></ul>  |
| 4. Select and install fittings                                | <ul style="list-style-type: none"><li>• Select and install fittings in a practical shop exercise</li></ul>   |

**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 D: PREPARE AND ASSEMBLE PIPING COMPONENTS**

**Competency: D 4 Describe Methods of Penetrating Structures**

**Learning Objectives:**

The learner will describe acceptable methods of structure penetration.

**LEARNING TASKS**

1. Describe considerations when making penetrations in structures

1.

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
- B.C. 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.

# **STEAMFITTER / PIPEFITTER**

## **LEVEL 2**

**LINE B: USE TOOLS AND EQUIPMENT**

**Competency: B4 Use Measuring and Leveling Tools**

**Learning Objectives:**

The learner will use measuring and levelling equipment.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| <p>1. Describe leveling equipment used in the steamfitter pipefitter trade to establish elevations</p> <p>2. Use measuring and leveling equipment to establish elevations</p> | <ul style="list-style-type: none"><li>• Builder’s level</li><li>• Laser levels</li><li>• Laser measuring tools</li><li>• Level rods and scales</li><li>• Plumb bob</li><li>• Rules and squares</li><br/><li>• Grade and pitch calculations</li><li>• Procedures</li><li>• Manufacturers documentation</li><li>• Inspection</li><li>• Adjustment</li><li>• Maintenance</li><li>• Storage</li></ul> |
|---|---|

**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 B: USE TOOLS AND EQUIPMENT**

**Competency: B5 Use Rigging and Hoisting Equipment**

**Learning Objectives:**

The learner will select and use hoisting, lifting and rigging equipment.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| <p>1. Identify and interpret WorkSafe BC regulations</p>   | <ul style="list-style-type: none"><li>• Scaffolding</li><li>• Shoring</li><li>• Rigging</li><li>• Confined spaces</li><li>• Combustibles</li><li>• Ladders</li><li>• Safety harnesses, lines etc.</li><li>• Slings</li><li>• Working loads of ropes</li></ul>   |
| <p>2. Describe equipment used to work from height when performing hoisting and rigging in the steamfitter pipefitter trade</p> | <ul style="list-style-type: none"><li>• Ladders</li><li>• Scaffolding</li><li>• Shoring</li><li>• Pneumatic, hydraulic and electric lifts</li><li>• Elevated work platform</li></ul>  |
| <p>3. Use hoisting, lifting and rigging equipment in a multi-point lift for piping installation</p>                            | <ul style="list-style-type: none"><li>• Certification requirements</li><li>• Estimation of weights</li><li>• Equipment capacities</li><li>• Equipment selection</li><li>• Lifting location</li><li>• Operating procedures</li><li>• Communication / hand signals</li><li>• Securing of loads</li><li>• Equipment inspection</li><li>• Equipment maintenance</li><li>• Equipment storage</li><li>• Disposal procedures</li><li>• Centre of gravity</li><li>• Load orientation</li><li>• Multi-point pick</li></ul> |

### **Achievement Criteria**

Given information on WorkSafe BC 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 WorkSafe BC 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 WorkSafe BC 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 C: ORGANIZE WORK**

**Competency: C1 Use Mathematics and Science (Including Electricity)**

**Learning Objectives:**

The learner will be able to:

- use mathematics and science to solve problems in the steamfitter / pipefitter trade.
- describe the fundamentals and use of basic electricity in the steamfitter / pipefitter trade.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| 1. Identify electrical hazards                                  | <ul style="list-style-type: none"><li>• Electrical shock</li><li>• Codes</li><li>• Isolation / lockout / tagout</li><li>• Stored energy</li><li>• Fuses</li><li>• Circuit breakers</li></ul>  |
| 2. Describe electrical terms                                    | <ul style="list-style-type: none"><li>• Volts</li><li>• Amperes (amps)</li><li>• Watts</li><li>• Ohms</li><li>• Conductance</li><li>• Resistance</li><li>• Series (circuits)</li><li>• Parallel (circuits)</li><li>• Series/parallel (circuits)</li><li>• Direct acting</li><li>• Reverse acting</li><li>• SPST, SPDT, DPST, DPDT</li></ul> |
| 3. Describe forms of electricity and principles                 | <ul style="list-style-type: none"><li>• Piezoelectricity</li><li>• Thermal electricity</li><li>• Chemical electricity</li><li>• Generated electricity</li><li>• Impressed current circuit</li><li>• Electron flow between dissimilar metals</li></ul>   |
| 4. Describe electrical equipment components and their functions | <ul style="list-style-type: none"><li>• Transformers</li><li>• Relays</li><li>• Thermostats</li><li>• Humidistats</li><li>• Aquastats</li><li>• Pressuretrols</li></ul>   |

## LEARNING TASKS

## CONTENT

- Differential controls
  - Switches
    - Single contact
    - Double contact
    - Normally open
    - Normally closed
  - Anodes
  - Cathodes
  - Dielectric unions
  - Dielectric couplings
  - Dielectric flanges
5. Describe cathodic protection
- Anodes
  - Cathodes
  - Dielectric unions
  - Dielectric couplings
  - Dielectric flanges

### Achievement Criteria

Given information on electrical hazards, electrical terms, forms of electricity and principles, electrical equipment components and their functions and cathodic protection, 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 math and science to correctly solve problems. Tasks must be performed with 100% accuracy.

### Workplace Achievement Criteria

Given information on electrical hazards, electrical terms, forms of electricity and principles, electrical equipment components and their functions and cathodic protection, the learner must correctly use math and science principles to solve problems and apply fundamentally sound decisions for use of basic electricity. Use of math and science to solve problems and knowing the fundamentals of basic electricity is a highly important part of the job. Employer assessed accuracy is required for each task.

**LINE C: ORGANIZE WORK**

**Competency: C2 Read Drawings and Specifications**

**Learning Objectives:**

The learner will read and interpret blueprints.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Identify and explain pipefitting symbols      | <ul style="list-style-type: none"><li>• Tees</li><li>• Wyes</li><li>• Flanges</li><li>• Elbows</li><li>• Valves</li><li>• Anchors</li><li>• Brackets</li></ul>  |
| 2. Identify the types of drawings                | <ul style="list-style-type: none"><li>• Architectural drawings</li><li>• Structural drawings</li><li>• Mechanical drawings</li><li>• Isometric drawings</li><li>• Shop drawings</li><li>• Specification sheets</li><li>• Spool sheets</li></ul> |
| 3. Identify and describe the three types of view | <ul style="list-style-type: none"><li>• Plan view</li><li>• Side view</li><li>• Elevation view</li></ul>  |
| 4. Describe the uses of different views          | <ul style="list-style-type: none"><li>• Sectional views</li><li>• Isometric views (projections)</li><li>• Orthographic views (projections)</li><li>• Detailed views</li><li>• Additions and revisions</li></ul>                                 |

**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 C: ORGANIZE WORK**

**Competency: C 5 Plan a Project**

**Learning Objectives:**

The learner will plan a commercial heating project.

**LEARNING TASKS**

1. Describe the organization of a commercial heating project

**CONTENT**

- Project specifications
- Safety
- Installation permits
- Quality assurance
- 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 D:                    PREPARE AND ASSEMBLE PIPING COMPONENTS**

**Competency:            D 1   Join Pipe**

**Learning Objectives:**

The learner will be able to:

- describe piping and tubing materials used in the steamfitter / pipefitter trade.
- join piping.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| 1. Describe piping and tubing materials including effects of heat and pressure | <ul style="list-style-type: none"><li>• Carbon and stainless steel pipe and tubing</li><li>• Thermoplastic pipe and tubing</li><li>• Thermoset plastic pipe</li><li>• Glass pipe</li><li>• Specialty piping and tubing</li><li>• Potential defects</li></ul> |
| 2. Describe the method of manufacture  | <ul style="list-style-type: none"><li>• Carbon and stainless steel</li><li>• Thermoplastic pipe and tubing</li><li>• Specialty piping and tubing</li></ul>   |
| 3. Install tubing and pipe   | <ul style="list-style-type: none"><li>• Types</li><li>• Sizes</li><li>• Uses</li><li>• Selection for application</li><li>• Cutting</li><li>• Bending</li><li>• Joining methods</li><li>• Hot air plastic welding</li><li>• Tools and equipment</li></ul>     |

**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 D:                    PREPARE AND ASSEMBLE PIPING COMPONENTS**

**Competency:            D 5   Describe Pumps**

**Learning Objectives:**

The learner will describe theory and operation of pumps in piping systems.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe the meaning of pump related terms and concepts | <ul style="list-style-type: none"><li>• Piping practices</li><li>• Static suction lift</li><li>• Static suction head</li><li>• Static discharge head</li><li>• Total discharge head</li><li>• Atmospheric pressure affects pump suction</li><li>• Maximum theoretical suction lift of a pump</li><li>• Maximum practical lift of a pump</li><li>• Calculations for pressure to head conversions</li><li>• Lifts between 22 and 25 feet (6.5 and 7.5 metres) reasons for recommendations</li><li>• Pump orientation</li><li>• Priming</li><li>• Pump curves and sizing</li></ul> |
| 2. Describe non-positive displacement pumps                | <ul style="list-style-type: none"><li>• Closed faced impeller</li><li>• Open faced impeller</li><li>• Single suction</li><li>• Double suction</li><li>• Diffuser body</li><li>• Single stage</li><li>• Multi-stage</li><li>• Turbine</li><li>• Injector</li></ul>   |
| 3. Describe positive displacement pumps                    | <ul style="list-style-type: none"><li>• Gear</li><li>• Lobe</li><li>• Crescent (internal gear)</li><li>• Vane (balanced, unbalanced)</li><li>• Piston</li><li>• Screw</li></ul>   |





- Boiler trim
- 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 E:                   INSTALL HYDRONIC HEATING AND COOLING**

**Competency:            E2   Describe Controls for Hydronic Heating and Cooling Systems**

**Learning Objectives:**

The learner will describe the operation of hydronic heating and cooling system controls and sensors.

**LEARNING TASKS**

1. Describe the principles of electrical controls

**CONTENT**

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

2. Describe control systems for hydronic heating and cooling

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

**Achievement Criteria**

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

### **Workplace Achievement Criteria**

Given information on principles of electrical controls and control systems for hydronic heating and cooling, the learner must correctly operate hydronic heating and cooling system controls and sensors. Employer assessed accuracy is required for each task.

**LINE E:                   INSTALL HYDRONIC HEATING AND COOLING**

**Competency:           E3   Install, Test and Commission Hydronic Heating and Cooling Systems**

**Learning Objectives:**

The learner will install, test and commission hydronic systems.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| <p>1. Describe the installation, testing and commissioning of hydronic heating and cooling systems</p> | <ul style="list-style-type: none"><li>• Applicable codes</li><li>• Inspection</li><li>• Air removal</li><li>• Limits</li><li>• System balancing</li><li>• Control sequencing</li><li>• Temperature checks</li><li>• Sensor checks</li><li>• Water treatment</li><li>• Hydrostatic tests</li><li>• Pump circulation</li><li>• Component operation</li><li>• Expansion tank</li><li>• Safety limits</li><li>• Operating limits</li><li>• Flushing</li></ul> |
| <p>2. Install, test and commission hydronic heating and cooling systems</p>                            | <ul style="list-style-type: none"><li>• Install, test and commission a hydronic heating and cooling system in a practical shop exercise, including:<ul style="list-style-type: none"><li>– Mechanical components</li><li>– Electrical components</li></ul></li></ul>  |

**Achievement Criteria**

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

In addition, the learner must perform practical tasks to install, test and commission hydronic heating and cooling systems. Tasks must be performed with 90% accuracy.

**Workplace Achievement Criteria**

Given information on the installation testing and commissioning of hydronic heating and cooling systems, the learner must correctly install, test and commission hydronic heating and cooling systems. Employer assessed accuracy is required for each task.

**LINE E:                   INSTALL HYDRONIC HEATING AND COOLING**

**Competency:           E4   Maintain and Repair Hydronic Heating and Cooling Systems**

**Learning Objectives:**

The learner will maintain and repair hydronic heating and cooling systems.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe maintenance and repair of hydronic heating and cooling systems | <ul style="list-style-type: none"><li>• Testing</li><li>• Replacement</li><li>• Adjustment</li><li>• Components</li><li>• Leak checks</li><li>• Temperature checks</li><li>• Pressure checks</li><li>• Safety limits</li><li>• Operating limits</li><li>• Inspection</li><li>• Cross-connection controls</li><li>• Fluid analysis</li></ul> |
| 2. Maintain and repair hydronic heating and cooling systems                | <ul style="list-style-type: none"><li>• Install, test and commission a hydronic heating and cooling system in a practical shop exercise</li></ul>   |

**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 F:                      PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency:                F1    Prepare Pipe and Fittings**

**Learning Objectives:**

The learner will describe the preparation of pipe and fittings.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| <p>1. Describe the appropriate fabrication practice for ferrous and non-ferrous material</p>  | <ul style="list-style-type: none"><li>• Squaring up</li><li>• Backer rings</li><li>• Quartering a pipe using a carpenter's square, a wrap-around, or a centering head</li><li>• Use of a template development or contour maker</li><li>• Use of a disk grinder and/or an oxy-acetylene torch</li><li>• Bevel a joint as per A.S.M.E. codes</li><li>• Assemble the pieces to produce a fitting</li><li>• Tack weld the joints together</li><li>• Pre-manufactured fittings</li><li>• Pipeline assembly</li></ul> |
| <p>2. Identify the materials that will require preheating and / or post heating of metals</p> | <ul style="list-style-type: none"><li>• Identify materials List of materials</li></ul>  |
| <p>3. Select practices and procedures for piping fabrication or erection</p>                  | <ul style="list-style-type: none"><li>• A.S.M.E.</li><li>• A.N.S.L.</li></ul>   |

**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 F:                      PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency:              F2    Develop and Use Templates**

**Learning Objectives:**

The learner will be able to:

- develop templates for the pipe fabrication and assembly process.
- use templates to fabricate fittings.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Use tools to sketch irregular shapes                | <ul style="list-style-type: none"><li>• French curves</li><li>• Templates</li><li>• Compasses</li><li>• Splines</li></ul>   |
| 2. Explain terms used with piping and piping templates | <ul style="list-style-type: none"><li>• Offset</li><li>• Advance</li><li>• Travel</li><li>• Cut-back</li><li>• Set</li><li>• Stretch-out</li><li>• Ordinates</li><li>• Mitres</li><li>• Bends</li><li>• Line development</li><li>• Quartering a pipe</li><li>• True wye</li><li>• Lateral</li><li>• Reducer</li><li>• Orange peel</li><li>• Tee</li></ul> |
| 3. Develop a template                                  | <ul style="list-style-type: none"><li>• Develop a template using the parallel line method</li></ul>   |
| 4. Use templates to fabricate fittings                 | <ul style="list-style-type: none"><li>• Fabricate fittings from templates in practical shop exercises</li></ul>   |

**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 F:                      PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency:                F3    Develop a Simple Spool Sheet**

**Learning Objectives:**

The learner will develop a spool sheet for a simple piping project.

**LEARNING TASKS**

**CONTENT**

1. Develop a spool sheet from a supplied drawing

- 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 F:                      PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency:                F4    Fabricate from Spool Sheets**

**Learning Objectives:**

The learner will fabricate piping systems from spool sheets.

**LEARNING TASKS**

**CONTENT**

- |   |  |
|---|--|
| 1. Demonstrate operations and procedures for spool sheets | <ul style="list-style-type: none"><li>• List fittings from a spool sheet</li><li>• Select measurements from a spool sheet</li><li>• Identify fittings that will require fabrication</li><li>• Determine sizes of pipe and fittings from the spool sheet</li></ul>  |
| 2. Demonstrate calculations and formulas                  | <ul style="list-style-type: none"><li>• Layout a pipe run</li><li>• Lengths of pipe runs</li><li>• Angles of cuts and bends</li><li>• Establishing the number of pieces and number of cuts and welds in a pipe run</li></ul>   |
| 3. Identify and interpret codes                           | <ul style="list-style-type: none"><li>• Fabrication of joints from:<ul style="list-style-type: none"><li>– A.S.M.E. Power piping</li><li>– A.S.T.M. Petro-chemical piping</li></ul></li><li>• Spool sheet material list<ul style="list-style-type: none"><li>– A.S.M.E. codes</li><li>– A.N.S.I. codes</li></ul></li></ul>   |
| 4. Select and / or describe tools used for fabrication    | <ul style="list-style-type: none"><li>• Tape measure</li><li>• Carpenter’s square</li><li>• Wrap-around</li><li>• Contour markers</li><li>• Centering head</li><li>• Angle finder</li><li>• Centre punch</li><li>• Flange and pipe aligner</li><li>• Spirit level</li><li>• Chalkline</li><li>• Cut-off saw</li><li>• Disk grinders</li><li>• Straight edge</li><li>• Oxy-acetylene cutting torch.</li></ul> |

## LEARNING TASKS

5. Select and / or describe tools used for fabrication

## CONTENT

- 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.

6. Fabricate piping assemblies

- 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.

**LINE F:                      PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency: F5            Use Welding Equipment**

**Learning Objectives:**

The learner will be able to:

- describe and use oxy-acetylene welding and burning equipment.
- describe the use of arc welding equipment.
- use welding equipment.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| 1. Identify safety devices used on oxygen and acetylene tanks and equipment | <ul style="list-style-type: none"><li>• Fuseable plugs</li><li>• Rupture discs</li><li>• Check valves</li><li>• Double seated valves</li></ul>  |
| 2. Describe the use of personal protective equipment                        | <ul style="list-style-type: none"><li>• Goggles or shield</li><li>• Gloves</li><li>• Boots</li><li>• Ventilation</li></ul>  |
| 3. Describe the characteristics of acetylene gas                            | <ul style="list-style-type: none"><li>• Flammability limits</li><li>• Stability</li><li>• Odour</li></ul>   |
| 4. Demonstrate the proper method of cleaning a torch                        | <ul style="list-style-type: none"><li>• Demonstrate the safety requirements related to oxy-acetylene equipment</li></ul>  |
| 5. Describe the use of oxy-acetylene welding equipment                      | <ul style="list-style-type: none"><li>• Oxygen bottles</li><li>• Acetylene bottles</li><li>• Oxy-acetylene regulators</li><li>• Oxy-acetylene hoses</li><li>• Oxy-acetylene outfit</li><li>• Cutting torch</li><li>• Cutting tips</li><li>• Wrap-around</li><li>• Welding rod</li><li>• Procedures to set up a pipe joint to be welded</li><li>• Procedures to cut or burn pipe</li></ul> |
| 6. Describe the use of arc welding equipment                                | <ul style="list-style-type: none"><li>• Arc welding equipment</li><li>• Types of equipment</li><li>• Applications of rods</li></ul>   |

## 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 F:                    PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency:            F6    Bend Pipe**

**Learning Objectives:**

The learner will prepare and bend pipe.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Demonstrate pipe bending calculations to determine pipe lengths | <ul style="list-style-type: none"><li>• Calculate<ul style="list-style-type: none"><li>– Radius</li><li>– Tangents</li><li>– Length of bend</li><li>– Gain</li></ul></li></ul>          |
| 2. Explain pipe-bending terms                                      | <ul style="list-style-type: none"><li>• Throat</li><li>• Heel</li><li>• Tangents</li><li>• Centre lines</li><li>• Pipe gain</li><li>• Radius to diameter</li></ul>                      |
| 3. Identify equipment used for hot bending                         | <ul style="list-style-type: none"><li>• Wooden plugs</li><li>• Vibrators</li><li>• Oxy-acetylene outfit</li><li>• Oil torches</li><li>• Vises</li><li>• Clamps</li><li>• Slab</li></ul> |
| 4. Identify equipment used for cold bending                        | <ul style="list-style-type: none"><li>• Draw benders</li><li>• Compression benders</li><li>• Ram benders</li><li>• Roll benders</li><li>• Stretch benders</li></ul>                     |
| 5. Explain purpose of materials                                    | <ul style="list-style-type: none"><li>• Sand fillers</li><li>• Salt fillers</li><li>• Rosins</li><li>• Cerrobend</li><li>• Cerrobase</li><li>• Lead</li></ul>                           |

## LEARNING TASKS

6. Describe bending qualities of materials

- Carbon steel pipe
- Copper pipe
- Copper-nickel pipe
- Brass pipe
- Aluminum pipe
- Stainless pipe
- Plastic pipe

7. Describe hot bending procedures

- Steel pipe
- Copper pipe
- Aluminum pipe

8. Demonstrate cold bending procedures

- Steel pipe
- Copper pipe
- Aluminum pipe

## CONTENT

### 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 F:                      PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency: F7            Install Supports, Hangers, Guides, Anchors**

**Learning Objectives:**

The learner will describe the installation of supports, hangers, guides and anchors.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe the forces that act on a piping system           | <ul style="list-style-type: none"><li>• Weight of the system including components</li><li>• Change in direction of flow</li><li>• Friction loss and inertia</li><li>• Thermal expansion and contraction</li><li>• Electrolysis</li></ul>  |
| 2. Describe types of hangers, supports, guides and fasteners | <ul style="list-style-type: none"><li>• Pipe hangers</li><li>• Clevis hangers</li><li>• Ring hangers</li><li>• Roller hanger</li><li>• Saddles and stanchions</li><li>• Roller support</li><li>• Thrust blocks</li><li>• Pipe clamps and guides</li><li>• Fasteners and attachments<ul style="list-style-type: none"><li>– Hanger bolts</li><li>– Beam clamps</li><li>– Concrete fasteners</li><li>– Metal fasteners</li><li>– Anchors</li></ul></li><li>• Location, spacing and selection considerations</li></ul> |
| 3. Describe the installation of supports and anchors         | <ul style="list-style-type: none"><li>• Selection of appropriate anchor brackets</li><li>• Selection of appropriate spacing for brackets and anchors</li><li>• Fabrication by cutting and welding<ul style="list-style-type: none"><li>– Brackets</li><li>– Sway bracing</li><li>– Anchors</li></ul></li><li>• Installation of brackets or anchors using:<ul style="list-style-type: none"><li>– Expansion shields</li></ul></li></ul>  |

## LEARNING TASKS

## CONTENT

- 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 F:                      PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency: F8            Erect a Piping Assembly**

**Learning Objectives:**

The learner will 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 F:                      PERFORM LAYOUT, FABRICATION AND INSTALLATION**

**Competency: F9            Test and Commission a Piping Assembly**

**Learning Objectives:**

The learner will test and commission a piping assembly.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| 1. Describe commissioning requirements for piping assemblies | <ul style="list-style-type: none"><li>• Quality control requirements</li><li>• Bolt selection</li><li>• Gasket selection</li><li>• Torquing</li><li>• Tensioning</li></ul>   |
| 2. Describe the cleaning of a piping assembly                | <ul style="list-style-type: none"><li>1. Bracketing<ul style="list-style-type: none"><li>• Pickling solution</li><li>• Caustic solution</li><li>• Water flushing</li></ul></li><li>3. Air flushing</li></ul>   |
| 4. Describe testing procedures for piping assemblies         | <ul style="list-style-type: none"><li>• Equipment needing isolation<ul style="list-style-type: none"><li>– Controls</li><li>– Gauges</li><li>– Valves</li><li>– Equipment</li></ul></li><li>• Test Media<ul style="list-style-type: none"><li>– Water</li><li>– Air</li><li>– Oil</li><li>– Other prescribed media</li></ul></li><li>• Hydrostatic testing</li><li>• Pneumatic testing</li><li>• Non-destructive testing</li></ul> |

**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.

**LINE G: SPECIAL APPLICATION SYSTEMS**

**Competency: G1 Install Marine Systems Piping**

**Learning Objectives:**

The learner will be able to:

- describe piping systems in marine applications.
- fabricate piping assemblies for marine applications.

**LEARNING TASKS**

**CONTENT**

1. Identify applicable hazards, codes and regulations

- Welding
- Cutting
- Fabricating
- Scaling
- Buffing
- Grinding and chipping
- Confined space entry
- Lloyds shipping regulations
- Bu-ships regulations
- C.S.I, regulations
- ASTM
- ASME
- NFPA
- ABS
- Transport Canada
- USCG
- Det Norsk Veritas (DNV)

1. Describe terms found in the marine steamfitter / pipefitter workplace

- Forward
- Aft
- Port
- Starboard
- Aft perpendicular
- Forward perpendicular
- Bulwark
- Ceiling
- Cofferdam
- Bulkhead
- Draft
- Forecastle
- Forepeak
- Freeboard

## LEARNING TASKS

## 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
2. Describe different types of marine vessels
- Tankers
  - Ore carriers
  - L.P.G. carriers
  - Coastal vessels
  - Passenger vessels
  - Ferries
  - Freighters
  - Naval vessels
    - Frigates
    - Coastal patrol boat
    - Coast guard
3. Identify marine systems and their functions
- 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

## LEARNING TASKS

## CONTENT

- 4. Describe water tight integrity considerations
  - Cargo pumping systems
  - Lubricating oil systems
  - High pressure air systems
  - Low pressure air systems
  - Interpret blueprint and drawing symbols
- 5. Describe marine piping arrangements
  - 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
- 6. Fabricate a marine piping assembly
  - 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, and 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.

**LINE G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 7 Install Hydraulic Piping Systems**

**Learning Objectives:**

The learner will be able to:

- describe hydraulic piping systems.
- install hydraulic piping systems.

**LEARNING TASKS**

1. Describe terms and principles used in hydraulic fluid power

**CONTENT**

- Flow
- Pressure
- Force
- Area
- Volumes
- Pascal's law
- Horsepower formulas
- Viscosity
- J.I.C.
- A.N.S.I.
- A.S.M.E.
- D S.S.A.
- S.A.E.
- Lubricity
- Oxidation
- Pour point
- Petroleum
- Glycol oil
- Water-oil emulsions
- Synthetics

2. Describe the components of hydraulic piping systems

- Reservoir
- Strainers and filters
- Accumulators
- Pumps
  - Gear
  - Lobe
  - Gerotor
  - Vane
  - Piston

## LEARNING TASKS

## CONTENT

- Centrifugal
- Directional control valves
  - Check
  - Spool
  - Rotary
  - Servo
- Pressure control devices
  - Relief valves
  - Compound relief valves
  - Unloading valves
  - Sequence valves
  - Counterbalance valves
  - Brake valves
  - Pressure reducing valves
- Volume control
  - Meter-in
  - Meter-out
  - Meter-bypass
  - Remote flow controls
- Fittings
  - Hose fittings
    - Expendable
    - Reusable
  - Flare
  - Flareless
  - Screw type
- 3. Describe material considerations for a hydraulic piping system
  - Gaskets
    - Fluids used
    - Pressures
    - Temperatures
  - Pipe thread lubricants and sealants
  - Minimum system requirements
    - Pressures
    - Temperatures
    - Fluids
    - Services
  - Brackets

## LEARNING TASKS

## CONTENT

- Tubing and piping
    - Steel
    - Copper
    - Brass
    - Plastic
    - Stainless
  - Hoses
    - Fluids used
    - Pressures
    - Temperatures
4. Describe troubleshooting procedures for a hydraulic piping system
- Cleaning a system before, during, and after assembly
  - Blanking off all piping, tubing, and hoses when a system is opened
  - Flushing procedures for contaminants
  - 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
5. Assemble a hydraulic piping system
- Given appropriate drawings, assemble a hydraulic piping system in a practical shop exercise
  - Interpret drawings
    - Symbols
    - Specifications

## LEARNING TASKS

## CONTENT

- 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 G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 8 Install Pneumatic and Compressed Air Piping Systems**

**Learning Objectives:**

- The learner will be able to:
- describe pneumatic and compressed air piping systems.
- install pneumatic and compressed air piping systems.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe the laws and terms that apply to fluid power, pneumatics     | <ul style="list-style-type: none"><li>• Boyle's law</li><li>• Charles' law</li><li>• Avogadro's laws</li><li>• Air flow formulas</li><li>• Isothermal</li><li>• Adiabatic</li><li>• Force and speed</li></ul>   |
| 2. Identify and interpret standards and symbols that apply to pneumatics | <ul style="list-style-type: none"><li>• A.N.S.I.</li><li>• A.S.M.E.</li><li>• A.S.T.M.</li></ul>  |
| 3. Describe compressed air systems                                       | <ul style="list-style-type: none"><li>• Hazards</li><li>• Pipe types</li><li>• Codes and regulations regarding vessels</li><li>• Piping arrangements<ul style="list-style-type: none"><li>– Straight line</li><li>– Loop</li></ul></li><li>• Tools and equipment</li><li>• Joining methods</li><li>• Draining of moisture</li><li>• Compressors<ul style="list-style-type: none"><li>– Types</li><li>– Operation</li></ul></li><li>• Safety devices</li><li>• Codes and regulations</li><li>• Lubricators (FRLs)</li><li>• Vibration isolation</li><li>• Connection of equipment to piping</li><li>• Components<ul style="list-style-type: none"><li>– Air driers</li></ul></li></ul> |

## LEARNING TASKS

## CONTENT

- Flex-connectors
  - Auto drains
  - Pressure regulators
  - Filters
4. Describe the effects of contaminants in a compressed air system
- Liquids
  - Droplets
  - Dust
  - Dirt
  - Vapours
5. Describe components used in a pneumatic piping system
- 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
6. Describe the operation of pneumatic tools
- Grinders
  - Drills
  - Hammers
  - Flaring tools (rolling tools)
  - Vibrators
7. Describe controls used in air conditioning piping systems
- 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

## LEARNING TASKS

## CONTENT

- valves
  - Mixing valves
  - Diverting valves
  - Balance valves
  - Stop valves
  - Master-submaster controls
  - Restrictor
  - Receiver controller
  
- 8. Describe controls used in industrial pneumatic piping systems
  - Spool valves
  - Check valves
  - Relief valves
  - Pressure regulating valves
  - Quick release valves
  - Pilot air valves
  - Relay air valves
  - Accumulators
  - Volumes
  - Cylinders
  - Rotary motors
  
- 9. Describe the function and material limitations of pneumatic piping system components
  - 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

## LEARNING TASKS

## CONTENT

10. Describe installation of pneumatic piping systems

- 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
- Pipe drips
- Branch take-offs
- Run identifications
- Running and nesting of control piping
- Installing raceways
- Brackets

11. Describe testing and maintenance consideration for pneumatic piping systems

- 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

12. Describe troubleshooting procedures for pneumatic piping systems

- Partially closed valves
- Filters plugged
- Pressure reducing valve failure
- Leaks at fitted joints

13. Assemble a pneumatic piping system

- Given appropriate drawings, assemble a pneumatic piping system in a

## LEARNING TASKS

## CONTENT

- 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.



# **STEAMFITTER / PIPEFITTER**

## **LEVEL 3**

**LINE C: ORGANIZE WORK**

**Competency: C2 Read Drawings and Specifications**

**Learning Objectives:**

The learner will be able to:

- read contract documents and specifications.
- plan take-offs to establish material and labour components.

**LEARNING TASKS**

**CONTENT**

1. Describe contract documents used in the construction industry

- 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

2. Describe drawings

- Types
  - Architectural
  - Structural
  - Mechanical
  - Electrical
- Parts
  - Plot plan
  - Foundation plan
  - Floor plan
  - Elevation
  - Sections
  - Details
  - Title block
  - Revisions
  - Schedules
  - Legends

## LEARNING TASKS

## CONTENT

- Information contained
  - Building dimensions
  - Construction type
  - Room layout
  - Equipment locations
  - Finish details
- Symbols
- Conventions
- 3. Plan take-offs to establish material and labour components
  - Take-off terminology
  - Take-off calculations
  - Take-off lists and formulas
  - Utilize various construction documents to perform calculations for piping and associated product take-offs
  - Factors to consider
- 4. Develop a materials list
  - Develop a materials list for a practical project from provided drawings

### Achievement Criteria

Given information on documents used in the construction industry, drawings, and formulas and calculations to plan a take-off and develop a materials list, 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 documents used in the construction industry, drawings, and formulas and calculations to plan a take-off and develop a materials list, the learner must correctly read drawings and specifications and plan a take-off to establish materials and labour components. Take-off is a highly important part of the job function. Employer assessed accuracy is required for each task.

**LINE C: ORGANIZE WORK**

**Competency: C 5 Plan a Project**

**Learning Objectives:**

The learner will plan an industrial piping project.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe organization of an industrial piping project | <ul style="list-style-type: none"><li>• Project specifications</li><li>• Safety</li><li>• Installation permits</li><li>• Sequence of operation</li><li>• Prioritization</li><li>• Coordination with other trades</li><li>• Estimate material</li><li>• Tools and equipment</li><li>• Inventory requirements<ul style="list-style-type: none"><li>– Secure storage</li><li>– Time delivery</li><li>– Labeling materials</li><li>– Stock maintenance</li><li>– Consumables</li></ul></li><li>• Checklist utilization</li><li>• Cost efficiency</li><li>• Post job efficiency analysis</li></ul> |
| 2. Plan an industrial piping project                     | <ul style="list-style-type: none"><li>• Plan an industrial piping project based on supplied documentation</li></ul>   |

**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 G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 2 Install Fuel Oil Systems**

**Learning Objectives:**

The learner will install fuel oil systems.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <p>1. Identify applicable hazards and regulations for fuel oil systems piping</p> <p>2. Describe underground tank piping safety practices</p> <p>3. Describe fuel oil terms</p> <p>4. Describe tank considerations</p> | <ul style="list-style-type: none"><li>• National Fire Protection Association (N.F.P.A.) standards for<ul style="list-style-type: none"><li>– Buried tanks</li><li>– Above ground tanks</li><li>– Vent piping</li><li>– System piping</li></ul></li><li>• Building codes</li><li>• Tank filling before piping begins</li><li>• Tank testing after filling</li><li>• "Seney" valve installation before piping is commenced (check valve)</li><li>• Tank never left open or empty</li><li>• Cathodic protection is installation</li><li>• Residual oils</li><li>• Crude petroleum</li><li>• Distillate oils</li><li>• Blended oils</li><li>• #1 light domestic</li><li>• #2 medium domestic</li><li>• #3 heavy domestic</li><li>• #4 light industrial</li><li>• #5 medium industrial</li><li>• #6 heavy industrial</li><li>• Heating<ul style="list-style-type: none"><li>– Steam coils</li><li>– Hot water coils</li><li>– Shell and tube type of heaters</li></ul></li><li>• Underground piping<ul style="list-style-type: none"><li>– Fuel filling lines</li><li>– Fuel sounding lines</li><li>– Dirty oil suction lines</li><li>– Fuel oil return lines</li></ul></li></ul> |
|--|--|

## LEARNING TASKS

## CONTENT

- Fuel oil suction lines
  - Fuel oil vents
  - Steam heating lines
  - Welded construction
  - Insulation
  - Concrete trenching
  - Schedule 80 for steam condensate lines
  - Copper tubing
  - Flared or brazed connections
  - Schedule 40 steel pipe
  - Welded connections
  - Flex type connections
5. Describe the purpose and applications of fuel oil burner components
- Duplex strainer
  - Filters (suction and discharge type)
  - Thermometers
  - Gauges
  - Relief valves (pressure and temperature)
  - Air chambers
  - Pressure regulators
  - Fuel oil firing valves and solenoid valves
  - Flow meters
  - Steam fuel oil heaters
  - Electric fuel oil heaters
  - Burner nozzles
    - Air atomizing
    - Steam atomizing
    - Pressure atomizing
  - Flame safeguards
    - Photo-electric cells
    - Infra-red cells
    - Ultra-violet cells
    - Flame rods
    - Bi-metal strips
  - Forced draft and induced draft fans
  - Ignition transformers

## LEARNING TASKS

## CONTENT

- |   |   |
|---|---|
| 6. Describe pumps   | <ul style="list-style-type: none"><li>• Pumps</li><li>• Pump governors</li><li>• Duplex pumps</li><li>• Electric gear pumps</li></ul>   |
| 7. Describe burners   | <ul style="list-style-type: none"><li>• Rotary</li><li>• Cup</li></ul>  |
| 8. Describe the fuel oil firing sequence                        | <ul style="list-style-type: none"><li>• Purge periods</li><li>• Fuel supply periods</li><li>• Ignition periods</li><li>• Flame proving period</li><li>• Automatic shut-down</li></ul>   |
| 9. Describe combustion requirements                             | <ul style="list-style-type: none"><li>• Primary air</li><li>• Secondary air</li><li>• Fuel</li><li>• Fuel preparation</li><li>• Analysis equipment</li><li>• Chemical absorption<ul style="list-style-type: none"><li>– Electronic analysers</li><li>– Flue products readings</li></ul></li></ul> |
| 10. Describe combustion analysis for oil or gas fired equipment | <ul style="list-style-type: none"><li>• CO</li><li>• CO<sup>2</sup></li><li>• Stack temperature</li><li>• Draft</li><li>• Smoke</li></ul>   |
| 11. Set-up and fire an oil-fired appliance                      | <ul style="list-style-type: none"><li>• Set-up and fire an oil-fired appliance in a practical shop exercise</li></ul>   |

### 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 G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 3 Install Low Pressure Steam Piping Systems**

**Learning Objectives:**

The learner will install low pressure steam piping systems.

**LEARNING TASKS**

**CONTENT**

- |   |  |
|---|--|
| <p>1. Identify applicable hazards, codes and regulations related to low pressure steam piping</p> <p>2. Describe low pressure steam terms</p> <p>3. Interpret steam tables</p> <p>4. Describe low pressure steam piping systems</p> | <ul style="list-style-type: none"><li>• B.C. Boiler Code</li><li>• A.S.M.E</li><li>• A. N. S. I.</li><br/><li>• BTUs</li><li>• Kilowatts</li><li>• Sensible heat</li><li>• Equivalent direct radiation (EDR)<ul style="list-style-type: none"><li>– Calculations for surface areas and the steam emissions from those surface areas</li></ul></li><li>• Measurement</li><li>• Boiler horsepower (BHP)</li><li>• Latent heat</li><li>• Specific heat</li><li>• Specific weight</li><li>• Specific gravity</li><li>• Vacuum<ul style="list-style-type: none"><li>– Measurement</li><li>– Pumps</li><li>– Piping up a vacuum pump</li></ul></li><br/><li>• Pressures</li><li>• Temperatures</li><li>• Heat contents</li><li>• Latent heat</li><li>• Total heat</li><li>• Specific volumes</li><br/><li>• Counter flow systems</li><li>• One-pipe systems</li><li>• Two-pipe systems</li><li>• Two-pipe gravity return systems</li><li>• Sub-atmospheric systems</li><li>• Steam heating systems symbols</li></ul> |
|---|--|

## 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

## CONTENT

- Pipe
  - Supply mains
  - Return mains
  - Riser mains
  - Runouts
  - Spring pieces
  - Stubs
  
- 7. Describe piping practices
  - Compensate for expansion and contraction
  - Expansion joints
    - Mechanical
    - Bending
    - Cold-springing
  
- 8. Describe control components for a low pressure boiler
  - 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
  
- 9. Install low pressure steam piping system
  - In a practical show 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 G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 4 Install High Pressure Steam Piping Systems**

**Learning Objectives:**

The learner will describe the installation of high pressure steam piping systems.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| 1. Identify applicable hazards, codes and regulations related to high pressure steam piping      | <ul style="list-style-type: none"><li>• B.C. Boiler Code</li><li>• A.S.M.E</li><li>• A. N. S. I.</li><li>• Power plant piping codes</li><li>• Petrochemical piping codes</li><li>• A.S.T.M. A 120</li><li>• A.S.T.M. A53(A,B)</li><li>• A.S.T.M. A106(A,B,C)</li><li>• A.S.T.M. A335(P1 &amp;P11)</li></ul>  |
| 2. Describe high pressure steam piping terms   | <ul style="list-style-type: none"><li>• Wet saturated steam</li><li>• Dry saturated steam</li><li>• Pounds per hour</li><li>• Condensing and non-condensing systems</li><li>• Flash steam</li><li>• Cubic feet per minute</li><li>• De-superheated system</li></ul>  |
| 3. Describe calculations for high pressure steam piping systems                                  | <ul style="list-style-type: none"><li>• Thomas formula<ul style="list-style-type: none"><li>– Pipe diameter</li><li>– Steam flow in pounds per minute (lbs/min.)</li><li>– Pressure drop/100 ft.</li></ul></li><li>• Expansion and contraction of steam and condensate line</li></ul>  |
| 4. Describe the installation of high pressure steam piping system components and their functions | <ul style="list-style-type: none"><li>• "Pop safety valves" including:<ul style="list-style-type: none"><li>– Open spring type</li><li>– Enclosed spring type</li><li>– Torsion bar type</li><li>– Electromatic type</li></ul></li><li>• Piping of "pop safety valves"<ul style="list-style-type: none"><li>– Drip pan elbow</li><li>– Drains from elbow and valve</li></ul></li></ul> |

## LEARNING TASKS

## CONTENT

- Exhaust pipe
- Sleeve, rain, cap, pipe chamfer
- - Anchors and brackets
- 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
  - a use as part of the water treatment
- Use of caustic soda and tri-sodium phosphate compounds in chemical cleaning
- Condenser water treatment

## LEARNING TASKS

## CONTENT

- |  |  |
|--|--|
| 5. Describe the installation and the purpose of soot blowers                         | <ul style="list-style-type: none"><li>• Stop check valve</li><li>• Double block and bleed valve systems</li><li>• Pressure reducing station</li><li>• Economizers</li><li>• Super / desuper heaters</li><li>• Feed water heaters</li></ul>   |
| 6. Describe the installation and the purpose of water columns, including pipe sizing | <ul style="list-style-type: none"><li>• Retractable lances</li><li>• Rotating soot blowers</li><li>• Permanent soot blowers</li><li>• Soot blowing media<ul style="list-style-type: none"><li>– water</li><li>– steam</li><li>– air</li><li>– shot</li></ul></li><li>• Inspectors crosses</li><li>• Gauge glasses, round and flat</li><li>• Simpli port bi-colour</li><li>• Tri-cocks</li><li>• Gauge glass cocks</li><li>• Blow down connection</li><li>• Feed water pump controllers</li></ul> |
| 7. Describe the components used in high pressure steam piping installation           | <ul style="list-style-type: none"><li>• Hangers<ul style="list-style-type: none"><li>– Trapeze type of hangers</li><li>– Spring loaded hangers</li><li>– Constant support hangers</li><li>– Counter weight hangers</li><li>– Rollers and saddles</li><li>– Anchors</li></ul></li><li>• Sleeve type expansion joints</li><li>• Bellows expansion joints</li><li>• Cold draw</li><li>• Pipe line construction or bending</li></ul>   |
| 8. Describe the testing procedures for a high pressure steam system                  | <ul style="list-style-type: none"><li>• Isolating safety valves</li><li>• Isolating equipment</li><li>• Isolating controls</li><li>• Isolating gauges</li><li>• Line under pressure</li></ul>  |

## LEARNING TASKS

9. Develop flow diagrams

## CONTENT

- 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 G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 5 Describe Feedwater Treatment Systems**

**Learning Objectives:**

The learner will 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**

**CONTENT**

- |   |  |
|---|--|
| 1. Identify hazardous materials and related safety codes that apply to water treatment for hydronic and steam systems | <ul style="list-style-type: none"><li>• ASME B31</li><li>• WHMIS</li><li>• Chemical storage</li></ul>  |
| 2. Describe boiler feed water treatment requirements  | <ul style="list-style-type: none"><li>• Water Composition<ul style="list-style-type: none"><li>– Hardness</li><li>– pH level</li><li>– Turbidity</li></ul></li><li>• Contaminants</li><li>• Hot water systems</li><li>• Low pressure steam</li><li>• High pressure steam</li><li>• Condensing</li><li>• Non-condensing</li><li>• High pressure boilers</li></ul> |
| 3. Describe thermal treatment   | <ul style="list-style-type: none"><li>• Hot well</li><li>• Open feedwater heater</li><li>• De-aeration</li><li>• Closed feedwater heater</li><li>• Evaporators</li><li>• Economizers</li></ul>   |
| 4. Describe internal boiler water treatment   | <ul style="list-style-type: none"><li>• pH control</li><li>• Scale prevention</li><li>• Sludge conditioning</li><li>• Chemical de-aeration</li><li>• Prevention of foaming</li><li>• Caustic embrittlement prevention</li><li>• Prevention of return line corrosion</li><li>• Frost prevention</li></ul>   |

## LEARNING TASKS

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

## CONTENT

- Testing methods
- 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

**LINE G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 6 Describe Fire Protection Piping Systems**

**Learning Objectives:**

The learner will be able to:

- describe the components of fire protection systems.
- describe the installation of fire protection systems.

**LEARNING TASKS**

**CONTENT**

1. Describe fire protection systems

- Purpose
- Codes and regulations
  - Class I
  - Class II
  - Class III
- System types
  - Wet sprinkler system
  - Foam
  - Halon
  - CO
  - Deluge
  - Flow-through systems
  - Preaction
  - Mist
  - Stand pipe
  - Combined sprinkler/standpipe system
- Tools and equipment
- Pressures and heads
- Pipe sizing
- Testing

2. Describe the installation of fire protection systems

- Pump requirements
- Cross-connection prevention
- Tools and equipment
- Fire extinguishers
- Hose cabinets
- Trim
- Pipe connection to equipment
- Coordination of power to equipment
- Protection of a building during construction

## LEARNING TASKS

3. Describe the components of fire protection systems

4. Describe water supply considerations

## CONTENT

- Sway bracing
- Gauges
- Inspector test connections
- Pressure switches
- Piping materials
- 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

## LEARNING TASKS

## CONTENT

- 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 H: WATER SUPPLY**

**Competency: H 1 Describe Potable Water Distribution Systems**

**Learning Objectives:**

The learner will be able to:

- describe the function of the parts of a water service.
- plan, install, repair and maintain a potable water service.

**LEARNING TASKS**

**CONTENT**

- |   |  |
|---|--|
| 1. Describe the components of water services  | <ul style="list-style-type: none"><li>• Municipal systems<ul style="list-style-type: none"><li>– Water main layouts</li></ul></li><li>• Codes and jurisdictional requirements</li><li>• Health services act requirements</li><li>• Equipment<ul style="list-style-type: none"><li>– Water meters</li><li>– Flow restrictors</li><li>– Pressure reducing valves</li><li>– Isolation valves</li><li>– Bypasses</li></ul></li><li>• Restraining systems<ul style="list-style-type: none"><li>– Thrust blocks</li><li>– Anchors</li><li>– Guides</li></ul></li></ul> |
| 2. Describe the installation of potable water systems                                 | <ul style="list-style-type: none"><li>• Tools and equipment</li><li>• Pipe type and size</li><li>• Joining methods</li><li>• Testing</li><li>• Inspection</li></ul>  |
| 3. Describe the components of a potable water distribution system (inside a building) | <ul style="list-style-type: none"><li>• Code requirements</li><li>• Piping materials</li><li>• Check valves</li><li>• Isolation valves</li><li>• Pressure relief valves</li><li>• Water hammer arrestors</li><li>• Stop-and-waste cocks</li><li>• Hot water storage tanks</li><li>• Hot water recirculation equipment</li><li>• Boilers and heat exchangers</li><li>• Temper water valves and equipment</li></ul>  |

## LEARNING TASKS

## CONTENT

- Booster pump assemblies

### Achievement Criteria

Given information on the components of water services, installation of potable water distribution systems and their components, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**LINE H: WATER SUPPLY**

**Competency: H2 Describe the Installation of Cross Connection Assemblies**

**Learning Objectives:**

The learner will 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

**Achievement Criteria**

Given information on the selection and installation of cross-connection control assemblies and devices, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

**LINE H: WATER SUPPLY**

**Competency: H 3 Test and Commission Cross Connection Assemblies**

**Learning Objectives:**

The learner will 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.

**LINE I:                   INSTALL NATURAL GAS AND PROPANE SYSTEMS**

**Competency:           I 1   Install and Service Fuel Gas Systems**

**Learning Objectives:**

The learner will be able to:

- describe types of fuel gases and their characteristics.
- perform combustion analysis and adjust equipment for maximum efficiency.
- describe the parts of a natural gas delivery and distribution system.
- describe the parts of a propane delivery and storage system.
- install gas piping and tubing.
- read gas meters and calculate heat flow rates.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| 1. Describe gas  | <ul style="list-style-type: none"><li>• Types</li><li>• Specific gravity</li><li>• Calorific value</li><li>• Parameters of combustibility</li><li>• Air/gas ratio for combustion</li><li>• Ignition and flame temperatures</li><li>• Flame speeds</li><li>• Odorant</li><li>• Chemistry</li><li>• Heat value</li><li>• Specific gravity</li><li>• Flow characteristics</li></ul> |
| 2. Describe the parts of a natural gas fuel delivery system  | <ul style="list-style-type: none"><li>• Utility provider</li><li>• Consumer</li><li>• Gas pressures<ul style="list-style-type: none"><li>– High</li><li>– Low</li></ul></li></ul>  |
| 3. Describe the parts of a propane gas system                | <ul style="list-style-type: none"><li>• Vapour distribution</li><li>• Liquid distribution</li><li>• Storage</li></ul>  |
| 4. Describe residential and commercial gas pipe installation | <ul style="list-style-type: none"><li>• Code requirements</li><li>• Pressures<ul style="list-style-type: none"><li>– Low Pressure</li><li>– 2 psig (14 kPa)</li><li>– High Pressure</li></ul></li><li>• Pipe/tube sizing</li></ul>   |

## LEARNING TASKS

## CONTENT

- 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
  
- 5. Install piping, tubing and hoses
  - Methods
  - Size
  - Pressures
  - Identification
  - Procedures
  - Fittings
  - Valves
  - Prohibited practice
  - Location limitations
  - Outlets

## LEARNING TASKS

## CONTENT

- Drip or dirt pockets
  - 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
6. Describe gas meters
- Calorific values
  - Clocked flow rates
  - Calculated inputs
  - High altitude installations
7. Use calorific values of fuel and meter readings to determine input
- Code requirements
  - Sizing
    - Load factors
  - Temperature effects on pressure
  - Filled capacity effect on vaporization rate
  - Cylinder sizing
8. Install propane cylinder systems

## LEARNING TASKS

## CONTENT

- vaporization capacity of cylinders
  - Describe cylinder clearances
  - Installation procedures
  - Safety relief valves
    - Pressures
    - Location of discharge outlets
    - 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
9. Describe combustion requirements
- 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

## LEARNING TASKS

10. Describe atmospheric burners

## CONTENT

- Terminology
- Characteristics
- Types
  - Main burners
  - Pilot burners
- Parts
- Operation
- Application

11. Describe burner orifices

- 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.

# **STEAMFITTER / PIPEFITTER**

## **LEVEL 4**

**LINE C: ORGANIZE WORK**

**Competency: C2 Read Drawings and Specifications**

**Learning Objectives:**

The learner will 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 C: ORGANIZE WORK**

**Competency: C 5 Plan a Project**

**Learning Objectives:**

The learner will plan a complex industrial piping project.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <p>1. Describe organization of a complex industrial piping project</p> | <ul style="list-style-type: none"><li>• Project specifications</li><li>• Safety</li><li>• Installation permits</li><li>• Sequence of operation</li><li>• Prioritization</li><li>• Coordination with other trades</li><li>• Estimate material</li><li>• Tools and equipment</li><li>• Inventory requirements<ul style="list-style-type: none"><li>– Secure storage</li><li>– Time delivery</li><li>– Labeling materials</li><li>– Stock maintenance</li><li>– Consumables</li></ul></li><li>• Checklist utilization</li><li>• Cost efficiency</li><li>• Post job efficiency analysis</li><li>• Hot permits</li><li>• Hydrostatic tests</li><li>• Non-destructive tests</li><li>• Weld mapping</li></ul> |
| <p>2. Develop a plan for a complex industrial piping project</p>       | <ul style="list-style-type: none"><li>• Develop a plan for a complex industrial piping project based on supplied drawings and specifications, including quality control documentation</li></ul>  |

**Achievement Criteria**

Given information on considerations for a complex industrial piping project including safety, permits, sequence of operation, prioritization and coordination with other trades, tools and equipment, inventory, post-job analysis, permits and tests, 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 develop a plan for a complex industrial piping project. Tasks must be performed with 100% accuracy.

**LINE G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 9 Install Process Piping Systems**

**Learning Objectives:**

The learner will describe the installation of process piping for industrial process systems.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <p>1. Identify codes and standards and describe piping procedures for use in industrial process piping systems</p> <p>2. Describe the applications of common metal pipe types</p> <p>3. Describe the applications of common plastic pipe types</p> <p>4. Describe the effects of heat and pressure on pipe types</p> | <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><br/><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><br/><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><br/><li>• Ferrous</li><li>• Stainless</li><li>• Non-ferrous</li><li>• Plastic</li><li>• Glass</li></ul> |
|--|--|

## LEARNING TASKS

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

## CONTENT

- FRP
- 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.

**LINE G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 10 Install Air Conditioning Piping Systems**

**Learning Objectives:**

The learner will describe the installation of air conditioning piping.

**LEARNING TASKS**

1. Describe and interpret the psychometric chart
  
  
  
  
  
  
  
  
  
  
2. Describe air conditioning systems

**CONTENT**

- Dry bulb temperatures
- Wet bulb temperatures
- Dew point temperatures
- Relative humidity
- Specific volumes
- Enthalpy
- Grains of moisture
  
- Air handling equipment
- Chillers
  - Evaporative
  - Brine
  - Refrigerative
- Heat sources
  - Hot water boilers
  - Steam boilers
  - Solar panels
  - Electric resistive heaters
- Cooling towers
- Heat exchangers
- Heat pump systems
- Distribution piping
  - Hanging chilled water piping
- Pumps
- Control strategies

## 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 a 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.

**LINE G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 11 Install Refrigeration Piping Systems**

**Learning Objectives:**

The learner will describe the installation process for refrigeration piping.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| 1. Describe refrigeration function and design | <ul style="list-style-type: none"><li>• Definition of refrigeration</li><li>• Units of measurement (tons of refrigerant)</li><li>• Heat transfer</li><li>• Frozen hard point</li><li>• Temperature range</li><li>• Temperature/pressure relationship</li></ul>  |
| 2. Describe refrigeration piping technology   | <ul style="list-style-type: none"><li>• Reciprocating Systems<ul style="list-style-type: none"><li>– Evaporator</li><li>– Compressor</li><li>– Condenser</li></ul></li><li>• Defrost components</li><li>• Centrifugal systems</li><li>• Absorption systems</li><li>• Cooling tower systems</li><li>• Evaporative cooling systems</li><li>• Heat/cold producing components</li><li>• Refrigerant Metering Device</li><li>• Coils</li><li>• Temperature sensors and thermostats</li><li>• Gage Connections<ul style="list-style-type: none"><li>– Schrader valve</li><li>– High pressure line tap valve</li></ul></li></ul> |
| 3. Describe refrigerant piping components     | <ul style="list-style-type: none"><li>• Refrigerant types<ul style="list-style-type: none"><li>– Ozone depletion</li></ul></li><li>• Refrigerant cycle</li><li>• Enthalpy and temperatures</li><li>• Refrigerant safety precautions</li><li>• Leaks<ul style="list-style-type: none"><li>– Evaporator leaks</li><li>– Condenser leaks</li><li>– Refrigerant piping leaks</li></ul></li></ul>  |

### **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.



## LEARNING TASKS

3. Describe the installation of piping for medical gas systems

4. Describe the installation of equipment for medical gas systems

## CONTENT

- Where located
- Codes and regulations
- Pipe types
- Hangers and supports
- Joining methods
- Cleaning and storing methods
- Cutting, fitting and brazing methods
- Degreasing
- Capping
- Certification requirements
- Purging requirements and procedures
- Brazing material requirements and characteristics
- Dangers associated with cross-connection
- Tools and equipment
- Coordination with other trades
- Pipe and component labeling
- Purging braze piping
- Pressure testing
  - Gauge requirements
- Testing for cross-connection
- Codes and regulations
- Jurisdictional requirements
- Equipment
  - Vacuum pumps
  - Air compressors
  - Bulk systems
  - Reserve systems
- Characteristics and requirements of equipment
  - Zone valves
  - Alarms
  - Manifolds
  - Accessories
  - Pressure reducing valves
  - Pressure relief valves
  - Dew-point sensors
- Diameter Index Safety System (DISS)

## LEARNING TASKS

5. Install medical gas piping

## CONTENT

- Tools and equipment
- Pipe connection to equipment
- Pressure testing equipment
- Location of alarm points
- Install piping for a medical gas system in a practical shop exercise

### Achievement Criteria

Given information on types of medical gas piping systems and their components, layout, equipment and installation 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 install piping for a medical gas system. Tasks must be performed with 100% accuracy.

### Workplace Achievement Criteria

Given information on types of medical gas piping systems and their components, layout, equipment and installation requirements, the learner must correctly install medical gas piping according to codes and regulations. Employer assessed accuracy is required for each task.

**LINE G: SPECIAL APPLICATION SYSTEMS**

**Competency: G 13 Install Instrumentation Piping Systems**

**Learning Objectives:**

The learner will describe instrumentation piping systems.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| 1. Describe pressure related measuring instruments and components | <ul style="list-style-type: none"><li>• Manometer</li><li>• Bourdon tube gauge</li><li>• Diaphragm</li><li>• Bellows</li><li>• Differential</li><li>• Pressure gauge piping</li></ul>   |
| 2. Describe flow measuring devices                                | <ul style="list-style-type: none"><li>• Orifice plates</li><li>• Flow nozzles</li><li>• Dall tubes</li><li>• Venturi tubes</li><li>• Pitot tubes</li><li>• Annubars</li><li>• Rotary meters</li><li>• Ultrasonic</li><li>• Weir</li><li>• Magnahelic gauges</li><li>• Positive displacement meters</li><li>• Flow measurement in the metering run</li></ul> |
| 3. Describe temperature measuring devices                         | <ul style="list-style-type: none"><li>• Liquid filled thermometers</li><li>• Gas filled thermometers</li><li>• Remote bulb thermometers</li><li>• Bimetallic thermometers</li><li>• Thermistors</li><li>• Contact type pyrometers</li><li>• Non-contact type pyrometers</li><li>• Temperature capillary coils</li></ul>                                     |
| 4. Describe level measuring devices                               | <ul style="list-style-type: none"><li>• Floats</li><li>• Gauge glass</li><li>• Ultrasonic</li><li>• D/P cells</li></ul>   |
| 5. Describe density measuring devices                             | <ul style="list-style-type: none"><li>• Scimitar blades</li></ul>   |

## LEARNING TASKS

## CONTENT

- 6. Describe valves
  - 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
- 7. Explain the function of instrument air equipment
  - Compressors
  - Dryers
  - Receivers
  - Filters
  - Pressure reducing stations
- 8. Describe instrumentation piping system components
  - 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
- 9. Describe steam tracing systems
  - 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 I:                                   INSTALL NATURAL GAS AND PROPANE SYSTEMS**

**Competency:                   I 1    Install and Service Fuel Gas Systems**

**Learning Objectives:**

The learner will 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**

**CONTENT**

1. Describe pressure regulators

- 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

2. Describe mechanical burners

- Terminology
- Characteristics
- Types

## LEARNING TASKS

3. Describe combustion analysis in appliances

4. Describe regulator venting

5. Install pressure regulators

## CONTENT

- Parts
- Air adjustment
- Operation
- Applications
- Start-up procedures
  
- Related factors
- Efficiency
- Adjustments
- ~ Primary air
- ~ Secondary air
- ~ Excess air
- ~ Dilution air
- Methods for testing and adjusting
- ~ Manifold pressure
- ~ Gas consumption
- ~ Primary air
- ~ Secondary air
- ~ Excess air
- Types of analyzers
- ~ Calibration
- ~ Readings
- Liabilities
- Calculating volume of excess air
- Flue gas temperature measurement
- Efficiency determination
- Optimizing efficiency
  
- Vent attachments
  - Lines
  - Limiting orifices
  - Surge arrestors
- Sizing
- Orientation
- Termination
  
- Code requirements
- Procedures
- Gas pressure readings upstream and downstream of each regulator

## 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 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 I:****INSTALL NATURAL GAS AND PROPANE SYSTEMS****Competency:****I 2 Install and Service Fuel Gas Controls and Safeguards****Learning Objectives:**

The learner will 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

## LEARNING TASKS

## CONTENT

### 3. Describe nonelectric controls

- Installation
- Phasing
- Troubleshooting
- Thermal expansion of solids, liquids and gases
- Hydraulic
  - Temperature sensing
  - Remote dial
- Bi-metallic
  - Rod and tube
- On-off control
- Modulating control
- Thermostatic control valve
- Energy cut-off switch
- Manual gas valve
- Seismic
- Fire suppression system valves

### 4. Describe electric control circuits

- Transformer circuits
- Fan circuits
- Control circuits
- Safety circuits
- Pump circuits
- Heating/cooling units
- Ignition circuits
- Vent damper circuits
- Air supply circuits
- Forced vent draft

### 5. Describe electric control components

- Operating Controls
- Limit and safety controllers
- Combustion safety controllers
- Ignition systems
- Gas valves

### 6. Describe control modules

- Ignition control modules
  - Intermittent pilot
  - Direct spark ignition
  - Hot surface ignition
- Fan timers

## LEARNING TASKS

### 7. Wire controls for appliances

## CONTENT

- Integrated appliance
- Installation
- Limits and safety controllers
- Gas valves
- Ignition systems
- Transformers
- Matching controls to the appliance
- Wiring to manufacturer's specifications
- Flame rods
- Thermostats
  - Wiring

### 8. Test and service controls for appliances

- Operational checks
- Set point adjustments
- Set and adjust calibration
- Lockout
- Troubleshooting
  - Electrical controls
  - Mechanical controls
- Repair and/or replacement

## Achievement Criteria

Given information on principles of electricity, principles of magnetism and magnetic induction, non-electric controls, electric control circuits, components and modules, wire controls and test and service controls for 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 connect test electric circuits, install and adjust gas controls on appliances according to the code rules and regulations applicable to the level B Gasfitter certification. Tasks must be performed with 100% accuracy.

## Workplace Achievement Criteria

Given information on principles of electricity, principles of magnetism and magnetic induction, non-electric controls, electric control circuits, components and modules, wire controls and test and service controls for appliances, the learner must correctly install and service fuel gas controls and safeguards according to the code rules and regulations applicable to the level B Gasfitter certification. Employer assessed accuracy is required for each task.

**LINE I:                                   INSTALL NATURAL GAS AND PROPANE SYSTEMS**

**Competency:                   I 3   Install and Service Fuel Gas Equipment**

**Learning Objectives:**

The learner will be able to:

- describe installation requirements for gas fired appliances.
- install and adjust gas fired appliances.

**LEARNING TASKS**

**CONTENT**

- |                                       |   |
|---------------------------------------|---|
| 1. Describe gas fired appliances      | <ul style="list-style-type: none"><li>• Types<ul style="list-style-type: none"><li>– Boilers</li><li>– Instantaneous water heaters</li><li>– Direct fired make-up air heaters</li><li>– Direct vent appliances</li><li>– Fireplaces</li><li>– Furnaces</li><li>– Infrared heaters</li><li>– Radiant tube heaters</li><li>– Ranges</li><li>– Rooftop units</li><li>– Unit heaters</li><li>– Water heaters</li><li>– Gas fired refrigerators</li></ul></li><li>• Characteristics</li><li>• Applications</li><li>• Approval agencies</li></ul> |
| 2. Describe installation requirements | <ul style="list-style-type: none"><li>• Impact of type of building construction on installation requirements</li><li>• Altitude rating requirement</li><li>• Code and Regulation requirements</li><li>• Manufacturer's requirements<ul style="list-style-type: none"><li>– Rating plate requirements</li></ul></li><li>• Appliance sizing</li><li>• Site preparation</li><li>• Clearances</li><li>• Installer's responsibilities</li></ul>  |
| 3. Adjust and commission appliances   | <ul style="list-style-type: none"><li>• Setup</li><li>• Code requirements</li><li>• Testing</li></ul>   |

## LEARNING TASKS

## CONTENT

- 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 I:                                   INSTALL NATURAL GAS AND PROPANE SYSTEMS**

**Competency:                   I 4   Install Venting and Air Supply**

**Learning Objectives:**

The learner will be able to:

- size and install venting systems for gas appliances.
- describe and install air supply systems.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| 1. Describe gas appliance venting       | <ul style="list-style-type: none"><li>• Purpose</li><li>• Venting action<ul style="list-style-type: none"><li>– Natural draft</li><li>– Mechanical draft</li></ul></li><li>• Direct venting</li><li>• Types<ul style="list-style-type: none"><li>– A</li><li>– B</li><li>– Single wall</li><li>– L</li><li>– BW</li><li>– BH</li></ul></li><li>• Appliance categories</li><li>• Materials</li><li>• Application</li><li>• Temperature rating</li><li>• Parts of a venting system</li><li>• Problems<ul style="list-style-type: none"><li>– Spillage</li><li>– Condensation</li><li>– Causes</li><li>– Solutions</li></ul></li><li>• Draft control devices<ul style="list-style-type: none"><li>– Applications</li><li>– Installation procedures</li><li>– Draft hoods</li><li>– Barometric dampers</li></ul></li><li>• Thermally operated flue dampers</li><li>• Electrically operated flue dampers</li></ul> |
| 2. Describe mechanical draft appliances | <ul style="list-style-type: none"><li>• Types</li><li>• Parts</li></ul>   |

## LEARNING TASKS

3. Install venting systems for gas appliances

4. Install direct vented flues

5. Describe gas appliance air supply requirements

## CONTENT

- Operation
- Applications
- Fan sizing limitations
- Fan location
  - Natural draft
  - Induced draft
  - Forced draft
- Code requirements
  
- Code and manufacturer requirements
- Installation procedures
  - Terminations
  - Support
  - Fire stopping
  - Location
- Building construction
  - Tightness and ventilation
- Sizing
  - Vent connectors
  - Vents
  - Chimney
- Clearances
  - Clearance reductions
- Height
- Length
- Appliance gas input rating
- More than one appliance
- Chimney area conversions
  - Round to square
  - Square to round
  
- Description
- Operation
- Code and manufacturer requirements
- Termination clearances
  - Building construction
  - Fresh air intakes
  - Regulator and meter sets
  
- Purpose
  - Combustion air

## LEARNING TASKS

## CONTENT

- Primary air
  - Secondary air
  - Excess air
    - Dilution air
    - Ventilation air
  - Building as a system
    - Negative air pressure
  - Openings and ducts
    - Terminations
6. Determine combustion air requirements for gas appliances installations with a combined input of up to and including 400 MBH
- 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
7. Determine combustion air requirements for gas appliance installations with a combined input exceeding 400 MBH
- 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

## LEARNING TASKS

8. Install air supply

## CONTENT

- Size
- 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.

**LINE I:                                   INSTALL NATURAL GAS AND PROPANE SYSTEMS**

**Competency:                   I 5    Use Gas Codes, Regulations and Standards**

**Learning Objectives:**

The learner will be able to:

- identify code rules and regulations applicable to the level B Gasfitter certification.
- The learner will apply code rules and regulations applicable to the level B Gasfitter certification.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe the B149.1 Gas Code              | <ul style="list-style-type: none"><li>• Layout</li><li>• Sections</li><li>• Contents</li><li>• Index</li><li>• Annexes</li><li>• Tables</li><li>• Definitions</li><li>• Scope</li><li>• Revisions</li></ul>   |
| 2. Interpret Sections of the B149.1 Gas Code | <ul style="list-style-type: none"><li>• Scope</li><li>• Reference Publications</li><li>• Definitions</li><li>• General</li><li>• Pressure Controls</li><li>• Piping and Tubing Systems, Hose, and Fittings</li><li>• Installation of Specific Types of Appliances</li><li>• Venting Systems and Air Supply for Appliances</li><li>• Natural Gas Compressors and Cylinders</li></ul> |
| 3. Use the Gas Regulations                   | <ul style="list-style-type: none"><li>• Gas Safety Act</li><li>• Gas Safety Regulations</li><li>• Permits</li><li>• Notification of completion</li><li>• Approvals</li><li>• Variations to the National Gas Code</li><li>• Bulletins and Directives</li></ul>   |

## LEARNING TASKS

4. Use the Canadian Electrical Code Part 1

## CONTENT

- Sections required for Gasfitters
  - 0, 2, 4, 8, 10, 12, 14, 16, 26, 28

### 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 3**

## **TRAINING PROVIDER STANDARDS**

## RECOMMENDED REFERENCE MATERIALS

The following list of textbooks and learning materials may be needed to enhance the technical training component of the Steamfitter / Pipefitter Apprenticeship program.

### Required

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

### Recommended

- 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

## TRAINING FACILITIES STANDARDS

### Classrooms (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 Areas (assuming class groups of 16 learners)

- 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 Area

- 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

## INSTRUCTOR QUALIFICATIONS

A Steamfitter / Pipefitter Training Instructor will have the following combination of qualifications and experience:

- Steamfitter / Pipefitter Red Seal certification, plus
- 5 years of hands-on working experience as a Steamfitter / Pipefitter after earning Red Seal certification, plus
- Minimum 'B' Level Gas certification.

Also preferred for a Steamfitter / Pipefitter Training Instructor:

- 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 for:
  - Word processing
  - Spreadsheets
  - Presentations
  - CAD

## 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  
rulers  
gauges - temperature, pressure, liquid,  
vacuum, specialty  
string line  
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

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 yokes, tri-stand and

bench, power vise (power drive pliers)  
prying tool  
ratchet  
screwdriver  
shear  
spacing tool  
swaging tool  
tip cleaner

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, SOLDERING AND BRAZING EQUIPMENT**

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)

winch (hand power), one-man, platform,  
scissor lift, articulating boom  
pipe racks  
pipe stands - roller and V type  
step ladder

manlifts - electrical, hydraulic, pneumatic,