

SKILLED**TRADES**^{BC}

PROGRAM OUTLINE

Steamfitter/Pipefitter

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STEAMFITTER/PIPEFITTER PROGRAM OUTLINE

**APPROVED BY INDUSTRY
NOVEMBER 2011**

**BASED ON
NOA 2010**

**Developed by
SkilledTradesBC
Province of British Columbia**

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Section 1

INTRODUCTION

Steamfitter/Pipefitter

Foreword

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

SAFETY ADVISORY

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

Acknowledgements

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

Project Review Committee

- Steve Anderson Department of National Defense
- Danny Bradford BC Federation of Labour
- Larry Daskoch Teck
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Industry Subject Matter Experts retained to assist in the development of Program Outline content 2008-09:

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

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

SkilledTradesBC would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Steamfitter / Pipefitter occupation.

How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

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

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

Achievement Standards

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

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 2

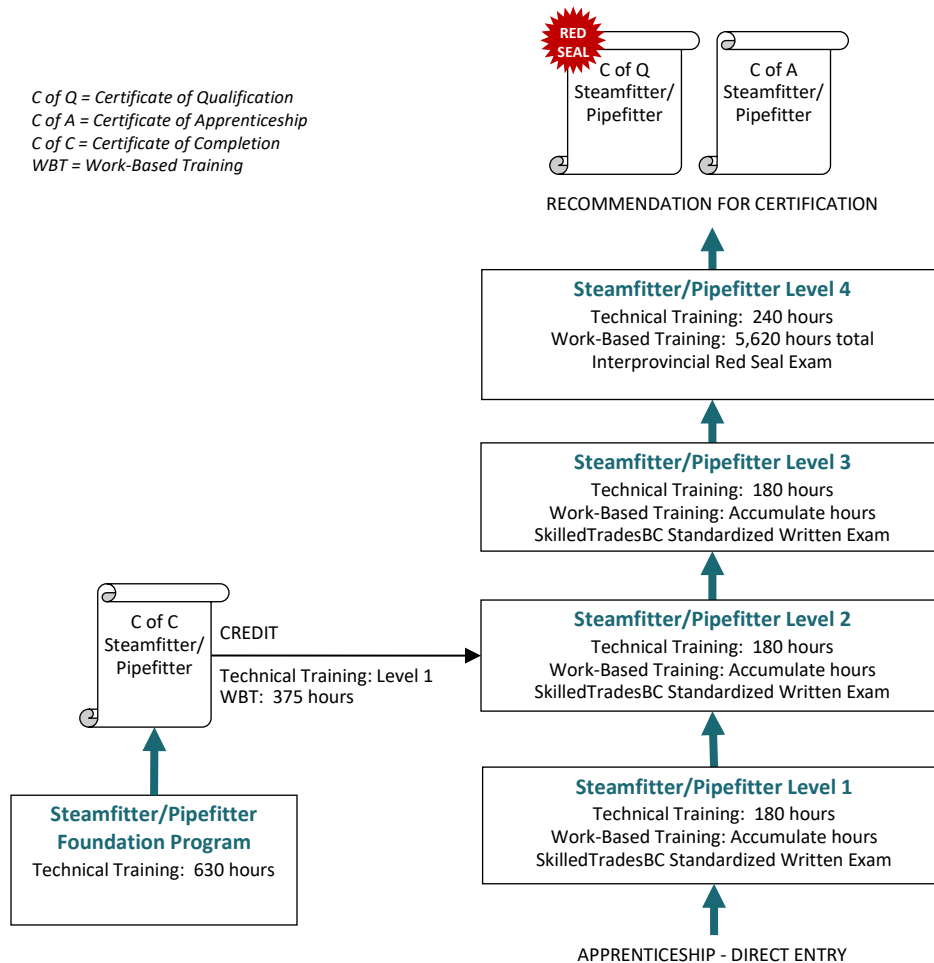
PROGRAM OVERVIEW

Steamfitter/Pipefitter

Program Credentialing Model

Apprenticeship Pathway

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



CROSS-PROGRAM CREDITS

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



Occupational Analysis Chart

STEAMFITTER/PIPEFITTER

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

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

Program Overview

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

Steamfitter/Pipefitter
Program Outline
04/19

Training Topics and Suggested Time Allocation

Steamfitter/Pipefitter – Level 1

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

Training Topics and Suggested Time Allocation

Steamfitter/Pipefitter – Level 2

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line B	Use Tools and Equipment	8%	50%	50%	100%
B4	Use measuring and leveling tools		✓	✓	
B5	Use rigging and hoisting equipment		✓	✓	
Line C	Organize Work	9%	50%	50%	100%
C1	Use mathematics and science (including electricity)		✓	✓	
C2	Read drawings and specifications		✓	✓	
C5	Plan a project		✓	✓	
Line D	Prepare and Assemble Piping Components	8%	75%	25%	100%
D1	Join pipe		✓	✓	
D5	Describe pumps		✓		
Line E	Install Hydronic Heating and Cooling	27%	55%	45%	100%
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		✓	✓	
Line F	Perform Layout, Fabrication and Installation	30%	50%	50%	100%
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			✓	
Line G	Special Application Systems	18%	50%	50%	100%
G1	Install marine systems piping		✓	✓	
G7	Install hydraulic piping systems		✓	✓	
G8	Install pneumatic and compressed air piping systems		✓	✓	
Total Percentage for Steamfitter/Pipefitter Level 2		100%			

Training Topics and Suggested Time Allocation

Steamfitter/Pipefitter – Level 3

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line C	Organize Work	10%	50%	50%	100%
C2	Read drawings and specifications		✓	✓	
C5	Plan a project		✓	✓	
Line G	Special Application Systems	60%	20%	80%	100%
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		✓	✓	
Line H	Water Supply	15%	75%	25%	100%
H1	Describe potable water distribution systems		✓		
H2	Describe the installation of cross connection assemblies		✓		
H3	Test and commission cross connection assemblies		✓	✓	
Line I	Install Natural Gas and Propane Systems	15%	50%	50%	100%
I1	Install and service fuel gas systems		✓	✓	
Total Percentage for Steamfitter/Pipefitter Level 3		100%			

Training Topics and Suggested Time Allocation

Steamfitter/Pipefitter – Level 4

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
Line C	Organize Work	10%	75%	25%	100%
C2	Read drawings and specifications		✓	✓	
C5	Plan a project		✓		
Line G	Special Application Systems	40%	50%	50%	100%
G9	Install process piping systems		✓	✓	
G10	Install air conditioning piping systems		✓	✓	
G11	Install refrigeration piping systems		✓	✓	
G12	Install medical gas piping systems		✓	✓	
G13	Install instrumentation piping systems		✓	✓	
G14	Describe renewable energy systems		✓		
Line I	Install Natural Gas and Propane Systems	50%	50%	50%	100%
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		✓	✓	
Total Percentage for Steamfitter/Pipefitter Level 4		100%			

Section 3

PROGRAM CONTENT

Steamfitter/Pipefitter

Level 1

Steamfitter/Pipefitter

Line (GAC):	A	Safe Work Practices
Competency:	A1	Control workplace hazards

Objectives

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

- Describe and 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

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
- Safety lines
- Weather

LEARNING TASKS

4. Describe emergency procedures
5. Describe non-emergency injury reporting procedures
6. Describe how a workplace safety policy is established
7. Describe lock-out and tag-out procedures

CONTENT

- Stressed Cables
- Emergency shutoffs
- Fire control systems
- Eye wash facilities
- Emergency exits
- Emergency contact/phone numbers
- Outside meeting place
- Disaster meeting place
- First aid facilities
- Reports accessories
- Process
- Hazard assessment
- Conditions
- Meeting requirements
- Tool box
 - Reporting hazards and incidents
 - Reporting injuries
 - Investigations
 - Committees
 - Employee orientation (including new worker/young worker)
 - First-aid
 - Hearing
 - Records and statistics
 - Lock-out
- Minimum standards
- Acts and Regulations
- Understanding of system operation
- Components requiring lock-out
- Identification requirements
- Situations where lock-out is required
- Lock-out equipment
 - Chains
 - Tags
 - Locks
- 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 (GAC):	A	Safe Work Practices
Competency:	A2	Describe occupational health and safety regulations

Objectives

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

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

LEARNING TASKS

CONTENT

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

LEARNING TASKS

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

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

CONTENT

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

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Line (GAC): **A Safe Work Practices**
Competency: **A4 Use personal protective equipment**

Objectives

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

- Select and use appropriate personal protective equipment.

LEARNING TASKS

1. Describe personal protective equipment requirements

2. Use personal protective equipment

CONTENT

- Safety footwear
- Eye protection
- Ear protection
- Head protection
- Respiratory protection
- Clothing
- Fall protection

- Selection
- Purpose
- Operating procedures
- Training requirements
 - WCB requirements
 - Job site requirements
- Inspection
- Maintenance
- Storage

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

Objectives

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

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

LEARNING TASKS

CONTENT

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

Line (GAC):	B	Use Tools and Equipment
Competency:	B1	Use hand tools

Objectives

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

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

LEARNING TASKS

1. Describe hand tools used in the trade

CONTENT

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

2. Use all hand tools (as listed above)

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Line (GAC):	B	Use Tools and Equipment
Competency:	B2	Use ladders and platforms

Objectives

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

- Describe ladders and elevated platforms.
- Select and use ladders and platforms.

LEARNING TASKS

1. Describe ladders and elevated platforms

CONTENT

- Types
 - Ladders
 - Platforms
 - Lifts
- Uses
- Safety
- Fall arrest equipment
- Hazard recognition
- Government regulations
- Selection
- Operating procedures
- Limitations
- Securing
- Inspection
- Maintenance
- Storage

Achievement Criteria

Given information on the use of ladders and elevated platforms, 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 ladders and elevated platforms. Tasks must be performed with 100% accuracy.

Workplace Achievement Criteria

Given information use of ladders and elevated platforms, the learner must correctly follow specified operating procedures for their selection and use at all times. The requirements for, and correct use of ladders and elevated platforms is an integral part of the job. Employer assessed accuracy is required for each task.

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

Objectives

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

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

LEARNING TASKS

CONTENT

- | | |
|---|---|
| 1. Describe oxy-acetylene and air/fuel equipment | <ul style="list-style-type: none"> • Parts <ul style="list-style-type: none"> ○ 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 | <ul style="list-style-type: none"> • Selection • Procedure • Limitations • Inspection |
| 3. Use oxy-acetylene equipment to cut, braze and solder | <ul style="list-style-type: none"> • Safety • Flammable material recognition • Types • Parts • Purpose/uses • Procedures/operations <ul style="list-style-type: none"> ○ Setup ○ Take down ○ Tip selection ○ Alloy selection ○ Flux selection • Adjustment • Inspection • Minor maintenance • Storage |

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

Objectives

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

- 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 hoisting, lifting and communication

CONTENT

- Mechanical advantage
- Balance points
- Applicable safety codes and regulations
- Lifting and Hoisting
 - Cranes
 - Boom trucks
 - Loaders
 - Tirfors
 - 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

LEARNING TASKS

4. Tie knots, bends and hitches

CONTENT

- Types
 - 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
- Perform safe hoisting, lifting and rigging tasks in a practical shop exercise

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 (GAC): **B Use Tools and Equipment**
Competency: **B6 Use portable power tools**

Objectives

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

- Select portable power tools appropriate to steamfitter/pipefitter processes.
- Use portable power tools.
- Inspect and maintain portable power tools.

LEARNING TASKS

1. Describe portable power tools used in the trade

CONTENT

- Types
 - Electric
 - Pneumatic
 - Cutting tools
 - Grinding and abrasive tools
 - Threading tools
 - Drilling and boring tools
 - Specialty tools
 - Fusion tools
 - Power crimpers
 - Grooving tools
 - T-Drill
 - Accessories
2. Use portable power tools as listed above
- Types
 - Parts
 - Purpose/uses
 - Procedures/operations
 - Safety
 - Adjustment
 - Inspection
 - Maintenance
 - Storage

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 (GAC):	B	Use Tools and Equipment
Competency:	B7	Use stationary power tools

Objectives

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

- Select and use stationary power tools appropriate to the steamfitter/pipefitter trade.
- Inspect and maintain stationary power tools.

LEARNING TASKS

1. Describe stationary power tools used in the trade
2. Use stationary power tools as listed above

CONTENT

- Cutting tools
- Grinding and abrasive tools
- Threading tools
- Drilling and boring tools
- Specialty tools
- Accessories
- Grooving tools
- Types
- Parts
- Purpose/uses
- Procedures/operations
- Safety
- Adjustment
- Inspection
- Maintenance
- Storage

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

Objectives

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

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

LEARNING TASKS

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

CONTENT

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

LEARNING TASKS

CONTENT

- | | |
|--|--|
| 7. Calculate piping measurements | <ul style="list-style-type: none"> • Terms <ul style="list-style-type: none"> ○ Thread allowance ○ Fitting allowance ○ End to end ○ End to centre ○ Centre to centre ○ Face to face ○ End to back ○ Back to back ○ Socket depth • Calculations • Grades • Elevations • Benchmarks |
| 8. Use the Pythagorean theorem of right angles | <ul style="list-style-type: none"> • Hypotenuse • Side opposite • Side adjacent |
| 9. Calculate offsets using the applicable trigonometric function | <ul style="list-style-type: none"> • Calculator methods • Table-based methods |
| 10. Calculate the required measurements for a parallel piping offset | <ul style="list-style-type: none"> • Equal spread • Rolling • Jumper |
| 11. Define the properties of matter | <ul style="list-style-type: none"> • Density • Cohesion • Adhesion • Tensile strength • Ductility • Malleability • Elasticity • Conductivity • Heat properties <ul style="list-style-type: none"> ○ BTUs ○ Calories ○ Gigajoules ○ Specific Heat |
| 12. Use Pascal's theory of pressure and force | <ul style="list-style-type: none"> • Pounds • Newtons |
| 13. Use Archimedes' principles of displacement and floatation | <ul style="list-style-type: none"> • Specific weight • Specific gravity |
| 14. Define mechanical advantage as it relates to fluid power | <ul style="list-style-type: none"> • Hydraulics • Hydrostatics |

LEARNING TASKS

15. Describe factors that affect fluid flow in a piping system

16. Describe factors that affect gas volumes and pressures

17. Calculate the expansion and contraction of various piping materials due to heating and cooling

18. Define methods of heat transfer

19. Perform heat load calculations

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

1. Describe drafting tools and materials

CONTENT

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

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

LEARNING TASKS

5. Describe drawing projections

6. Use drawing projections

7. Use tools to sketch irregular shapes

8. Create isometric drawings of piping systems

CONTENT

- Isometric
- Orthographic
- Oblique
- Views

- Isometric
- Orthographic
- Conversion from one to the other

- French curves
- Templates
- Compasses
- Splines

- Lettering
- Line type
- Information to be contained
- Detail required
- Dimensioning
- Pipe sizing

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Line (GAC):	C	Organize Work
Competency:	C3	Use codes, regulations and standards

Objectives

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

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

LEARNING TASKS

1. Identify code, standards and organizations affecting the steamfitter/pipefitter trade
2. Describe where the above codes and standards are applied within 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)
- Planning
- Installation
- 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 (GAC):	C	Organize Work
Competency:	C4	Use manufacturer and supplier documentation

Objectives

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

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

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

1. Describe piping and tubing materials
2. Describe the method of manufacture
3. Describe methods of pipe support
4. Describe methods of protecting piping

CONTENT

- Copper pipe and tubing
- Cast iron soil and pressure
- Brass pipe and tubing
- Copper pipe and tubing
- Cast iron pipe
- Types
 - Hangers
 - Supports
 - Seismic
 - Anchors
 - Guides
 - Slide plates
- Compatibility with piping
- Size
- Spacing
- Fasteners
 - Beam clamps
 - Drop-in anchors
 - Draw bolts
 - Toggle bolts
- Interferences
- Insulation thickness
- Elevation of hangers
- Attachment methods
- Tools and equipment
- Frost protection
 - Heat tape
 - Frost boxes
 - Circulating pumps
- Ultraviolet protection
- Corrosion protection
 - Coatings
 - Tape

LEARNING TASKS

CONTENT

- | | |
|--|--|
| | <ul style="list-style-type: none"> • Physical damage <ul style="list-style-type: none"> ○ Protective plates ○ Sleeving ○ Metal stud grommets • Protective measures <ul style="list-style-type: none"> ○ Insulating ○ Water treatment ○ Dielectric protection |
| 5. Describe the inspection of pipe before installation | <ul style="list-style-type: none"> • Potential defects <ul style="list-style-type: none"> ○ Pin holes ○ Cracked fittings ○ Bent ends ○ Uneven casting ○ Damaged pipe and coatings • Environmental effects • Inspection techniques <ul style="list-style-type: none"> ○ Visual ○ Sounding of cast iron pipe and fittings • Interpretation of markings • Checking against specifications |
| 6. Describe the installation of tubing and pipe | <ul style="list-style-type: none"> • Types • Sizes • Uses • Hazards • Safety • Measuring procedures • Selection for application • Calculations <ul style="list-style-type: none"> ○ Length ○ Fitting allowances ○ Offsets ○ Gain or loss • Cutting • Bending • Joining methods • Common fitting angles • Tools and equipment |
| 7. Install tubing and pipe | <ul style="list-style-type: none"> • Install tubing and pipe in a practical shop exercise |

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

1. Describe basic valve types

CONTENT

- Types
- Purpose
- Materials
- Seating design
- Orientation
- Temperature limitations
- Pressure limitations
- Applications
- Specifications
- Special purpose
 - Pressure relief
 - Temperature relief
 - Pressure reducing/Regulator

2. Describe the methods of installing valves

- Selection
 - Applications
 - Specifications
 - Pressure limitations
- Orientation
- Installation requirements
- Select and install valves in a practical shop exercise

3. Select and install valves

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Line (GAC):	D Prepare and Assemble Piping Components
Competency:	D4 Describe methods of penetrating structures

Objectives

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

- Describe acceptable methods of structure penetration.

LEARNING TASKS

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

CONTENT

- Structural integrity
- Fire separation
- Interference with other building components and systems
- Hidden components behind the surface
- Electrical wiring
- Reinforcing bars
- Piping
- Post tension cables
- Sleeve installation
 - Fabrication
 - Timing
 - Sealing around
 - Fire stopping
 - Water-proofing
 - Isolating groundwater
 - Protecting pipe
 - Preventing oxidation
 - Sizing
 - Positioning
 - Fastening
 - Protection during concrete pour
- BC Building Code
- Manufacturer's literature
- Fire stopping
 - Doughnut type
 - Gasket type
 - Caulking
 - Mineral wool
- Fire rating requirements
- Required gaps
- Codes, specifications and requirements
- Fastening or wrapping fire stopping to pipes
- Sealing of vertical and horizontal penetrations
- Selection of sealants according to specifications

Achievement Criteria

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

Workplace Achievement Criteria

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

Level 2

Steamfitter/Pipefitter

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

Objectives

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

- Use measuring and leveling equipment.

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

- Select and use hoisting, lifting and rigging equipment.

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

1. Identify electrical hazards

2. Describe electrical terms

3. Describe forms of electricity and principles

CONTENT

- Electrical shock
- Codes
- Isolation/lockout/tagout
- Stored energy
- Fuses
- Circuit breakers
- Volts
- Amperes (amps)
- Watts
- Ohms
- Conductance
- Resistance
- Series (circuits)
- Parallel (circuits)
- Series/parallel (circuits)
- Direct acting
- Reverse acting
- SPST, SPDT, DPST, DPDT
- Piezoelectricity
- Thermal electricity
- Chemical electricity
- Generated electricity
- Impressed current circuit
- Electron flow between dissimilar metals

LEARNING TASKS

4. Describe electrical equipment components and their functions

CONTENT

- Transformers
- Relays
- Thermostats
- Humidistats
- Aquastats
- Pressuretrols
- Differential controls
- Switches
 - Single contact
 - Double contact
 - Normally open
 - Normally closed
- Anodes
- Cathodes
- Dielectric unions
- Dielectric couplings
- Dielectric flanges
- Anodes
- Cathodes
- Dielectric unions
- Dielectric couplings
- Dielectric flanges

5. Describe cathodic protection

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

Objectives

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

- Read and interpret blueprints.

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

Workplace Achievement Criteria

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

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

Objectives

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

- Plan a commercial heating project.

LEARNING TASKS

1. Describe the organization of a commercial heating project

CONTENT

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

Achievement Criteria

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

1. Describe piping and tubing materials including effects of heat and pressure

2. Describe the method of manufacture

3. Install tubing and pipe

CONTENT

- Carbon and stainless steel pipe and tubing
- Thermoplastic pipe and tubing
- Thermoset plastic pipe
- Glass pipe
- Specialty piping and tubing
- Potential defects

- Carbon and stainless steel
- Thermoplastic pipe and tubing
- Specialty piping and tubing

- Types
- Sizes
- Uses
- Selection for application
- Cutting
- Bending
- Joining methods
- Hot air plastic welding
- Tools and equipment

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Line (GAC): **D Prepare and Assemble Piping Components**
Competency: **D5 Describe pumps**

Objectives

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

- Describe theory and operation of pumps in piping systems.

LEARNING TASKS

1. Describe the meaning of pump related terms and concepts

CONTENT

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

2. Describe non-positive displacement pumps

3. Describe positive displacement pumps

LEARNING TASKS

Describe pump applications

5. Describe pump components and their functions

6. Describe pump troubleshooting procedures and solutions

CONTENT

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

Achievement Criteria

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

Line (GAC):	E	Install Hydronic Heating and Cooling
Competency:	E1	Describe Hydronic Heating and Cooling Systems

Objectives

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

- Describe the design and operation of hydronic heating and cooling systems.

LEARNING TASKS

- Describe the principles of the design and operation of hydronic heating and cooling systems
- Describe hydronic heating and cooling systems

CONTENT

- Applicable codes
- Purpose
- Operation
- Zoning
 - Location of controls and sensors
 - Temperature settings
- Select and size
 - Boiler
 - Circulators
 - Distribution piping
 - Terminal units
- System components
 - Circulating pumps
 - Flanges
 - Unions
 - Y-strainer and side stream filters
 - Check valves
 - Isolation valves
 - Pressure and temperature relief valves
 - Pressure reducing valves
 - Air scoops
 - Automatic air vents
 - Flow switches
 - Gauges
 - Pot feeders
 - Chemical treatment and backflow prevention
 - Expansion tanks
 - Low-water cutoffs
 - Expansion joints
- Piping system configurations
- Series loop
- Primary / secondary
- Reverse return / direct return
- Boiler trim
- Heating and cooling generating equipment
 - Boilers

LEARNING TASKS

CONTENT

- Heat pumps
- Heat exchangers
- Solar panels
- Radiant panels
- Unit heaters
- Coils
- Green technology

Achievement Criteria

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

Workplace Achievement Criteria

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

Line (GAC):	E	Install Hydronic Heating and Cooling
Competency:	E2	Describe controls for hydronic heating and cooling systems

Objectives

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

- Describe the operation of hydronic heating and cooling system controls and sensors.

LEARNING TASKS

1. Describe the principles of electrical controls
2. Describe control systems for hydronic heating and cooling

CONTENT

- Circuit concepts
 - Source
 - Load
 - Switches
 - Conductors
- Circuit types
- Test equipment
- Circuit diagrams
- Symbols
- Electronic
- Electro-mechanical
- 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 (GAC):	E	Install Hydronic Heating and Cooling
Competency:	E3	Install, test and commission hydronic heating and cooling systems

Objectives

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

- Install, test and commission hydronic systems.

LEARNING TASKS

1. Describe the installation, testing and commissioning of hydronic heating and cooling systems
2. Install, test and commission hydronic heating and cooling systems

CONTENT

- Applicable codes
- Inspection
- Air removal
- Limits
- System balancing
- Control sequencing
- Temperature checks
- Sensor checks
- Water treatment
- Hydrostatic tests
- Pump circulation
- Component operation
- Expansion tank
- Safety limits
- Operating limits
- Flushing
- Install, test and commission a hydronic heating and cooling system in a practical shop exercise, including:
 - Mechanical components
 - Electrical components

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

Objectives

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

- Maintain and repair hydronic heating and cooling systems.

LEARNING TASKS

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

CONTENT

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

2. Maintain and repair hydronic heating and cooling systems

Achievement Criteria

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

Workplace Achievement Criteria

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

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

Objectives

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

- Describe the preparation of pipe and fitting.

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

- Develop a spool sheet for a simple piping project.

LEARNING TASKS

1. Develop a spool sheet from a supplied drawing

CONTENT

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

Workplace Achievement Criteria

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

Line (GAC): **F Perform Layout, Fabrication and Installation**
Competency: **F4 Fabricate from spool sheets**

Objectives

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

- Fabricate piping systems from spool sheets.

LEARNING TASKS

CONTENT

- | | |
|---|--|
| 1. Demonstrate operations and procedures for spool sheets | <ul style="list-style-type: none"> • List fittings from a spool sheet • Select measurements from a spool sheet • Identify fittings that will require fabrication • Determine sizes of pipe and fittings from the spool sheet |
| 2. Demonstrate calculations and formulas | <ul style="list-style-type: none"> • Layout a pipe run • Lengths of pipe runs • Angles of cuts and bends • Establishing the number of pieces, cuts and welds in a pipe run |
| 3. Identify and interpret codes | <ul style="list-style-type: none"> • Fabrication of joints from: <ul style="list-style-type: none"> ○ ASME Power piping ○ ASTM Petro-chemical piping • Spool sheet material list <ul style="list-style-type: none"> ○ ASME codes ○ ANSI codes |
| 4. Select and/or describe tools used for fabrication | <ul style="list-style-type: none"> • 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 |
| 5. Fabricate piping assemblies | <ul style="list-style-type: none"> • 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 (GAC): **F** **Perform Layout, Fabrication and Installation**
Competency: **F5** **Use welding equipment**

Objectives

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

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

LEARNING TASKS

1. Identify safety devices used on oxygen and acetylene tanks and equipment
2. Describe the use of personal protective equipment
3. Describe the characteristics of acetylene gas
4. Demonstrate the proper method of cleaning a torch
5. Describe the use of oxy-acetylene welding equipment
6. Describe the use of arc welding equipment

CONTENT

- Fuseable plugs
- Rupture discs
- Check valves
- Double seated valves
- Goggles or shield
- Gloves
- Boots
- Ventilation
- Flammability limits
- Stability
- Odour
- Demonstrate the safety requirements related to oxy-acetylene equipment
- Oxygen bottles
- Acetylene bottles
- Oxy-acetylene regulators
- Oxy-acetylene hoses
- Oxy-acetylene outfit
- Cutting torch
- Cutting tips
- Wrap-around
- Welding rod
- Procedures to set up a pipe joint to be welded
- Procedures to cut or burn pipe
- Arc welding equipment
- Types of equipment
- Applications of rods

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Line (GAC): **F Perform Layout, Fabrication and Installation**
Competency: **F6 Bend pipe**

Objectives

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

- Prepare and bend pipe.

LEARNING TASKS

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

CONTENT

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

LEARNING TASKS

CONTENT

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

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

1. Describe the forces that act on a piping system

2. Describe types of hangers, supports, guides and fasteners

3. Describe the installation of supports and anchors

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

- Erect a piping assembly.

LEARNING TASKS

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

CONTENT

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

2. Erect a piping assembly

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

- Test and commission a piping assembly.

LEARNING TASKS

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

CONTENT

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

Workplace Achievement Criteria

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

Line (GAC): **G Special Application Systems**
Competency: **G1 Install marine systems piping**

Objectives

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

- Describe piping systems in marine applications.
- Fabricate piping assemblies for marine applications.

LEARNING TASKS

1. Identify applicable hazards, codes and regulations

CONTENT

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

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

LEARNING TASKS

CONTENT

- | | |
|--|--|
| | <ul style="list-style-type: none"> • 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 |
| 3. Describe different types of marine vessels | <ul style="list-style-type: none"> • Tankers • Ore carriers • L.P.G. carriers • Coastal vessels • Passenger vessels • Ferries • Freighters • Naval vessels <ul style="list-style-type: none"> ○ Frigates ○ Coastal patrol boat ○ Coast guard |
| 4. Identify marine systems and their functions | <ul style="list-style-type: none"> • Fuel oil systems • Fire main systems • Fresh water systems • Salt water systems • Bilge and ballast systems • Pumping and flooding systems • Scupper and drain systems • Hydraulic systems • Pneumatic systems • Cargo pumping systems • Lubricating oil systems |

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Line (GAC): **G Special Application Systems**
Competency: **G7 Install hydraulic piping systems**

Objectives

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

- Describe and 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.
- ANSI
- ASME
- 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
 - Centrifugal
- Directional control valves
 - Check
 - Spool
 - Rotary
 - Servo

LEARNING TASKS

CONTENT

- | | |
|---|---|
| <p>3. Describe material considerations for a hydraulic piping system</p> | <ul style="list-style-type: none"> • Pressure control devices <ul style="list-style-type: none"> ○ Relief valves ○ Compound relief valves ○ Unloading valves ○ Sequence valves ○ Counterbalance valves ○ Brake valves ○ Pressure reducing valves • Volume control <ul style="list-style-type: none"> ○ Meter-in ○ Meter-out ○ Meter-bypass ○ Remote flow controls • Fittings <ul style="list-style-type: none"> ○ Hose fittings <ul style="list-style-type: none"> – Expendable – Reusable ○ Flare ○ Flareless ○ Screw type • Gaskets <ul style="list-style-type: none"> ○ Fluids used ○ Pressures ○ Temperatures • Pipe thread lubricants and sealants • Minimum system requirements <ul style="list-style-type: none"> ○ Pressures ○ Temperatures ○ Fluids ○ Services • Brackets • Tubing and piping <ul style="list-style-type: none"> ○ Steel ○ Copper ○ Brass ○ Plastic ○ Stainless • Hoses <ul style="list-style-type: none"> ○ Fluids used ○ Pressures ○ Temperatures |
| <p>4. Describe troubleshooting procedures for a hydraulic piping system</p> | <ul style="list-style-type: none"> • 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 |

LEARNING TASKS

CONTENT

5. Assemble a hydraulic piping system

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

- Describe and install pneumatic and compressed air piping systems.

LEARNING TASKS

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

CONTENT

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

LEARNING TASKS

4. Describe the effects of contaminants in a compressed air system

5. Describe components used in a pneumatic piping system

6. Describe the operation of pneumatic tools

7. Describe controls used in air conditioning piping systems

CONTENT

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

LEARNING TASKS

8. Describe controls used in industrial pneumatic piping systems

9. Describe the function and material limitations of pneumatic piping system components

10. Describe installation of pneumatic piping systems

CONTENT

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

LEARNING TASKS
CONTENT

- | | |
|--|--|
| <p>11. Describe testing and maintenance consideration for pneumatic piping systems</p> <p>12. Describe troubleshooting procedures for pneumatic piping systems</p> <p>13. Assemble a pneumatic piping system</p> | <ul style="list-style-type: none"> • Pipe drips • Branch take-offs • Run identifications • Running and nesting of control piping • Installing raceways • Brackets • Flushing and blowing out of a system • Cleaning out the drips and filters after flushing • Identify minimum test requirements • Isolating • Gauges • Relief valves • Equipment • Soap testing joints • Draining down and activating the system • Partially closed valves • Filters plugged • Pressure reducing valve failure • Leaks at fitted joints • Given appropriate drawings, assemble a pneumatic piping system in a practical shop exercise • Interpret drawings <ul style="list-style-type: none"> ○ Symbols ○ Specifications ○ Standards • Tubing and fittings • Pipe and fittings • Hose and fittings |
|--|--|

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Level 3

Steamfitter/Pipefitter

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

Objectives

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

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

LEARNING TASKS

1. Describe contract documents used in the construction industry

CONTENT

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

LEARNING TASKS

2. Describe drawings

3. Plan take-offs to establish material and labour components

4. Develop a materials list

CONTENT

- Types
 - Architectural
 - Structural
 - Mechanical
 - Electrical
- Parts
 - Plot plan
 - Foundation plan
 - Floor plan
 - Elevation
 - Sections
 - Details
 - Title block
 - Revisions
 - Schedules
 - Legends
- Information contained
 - Building dimensions
 - Construction type
 - Room layout
 - Equipment locations
 - Finish details
- Symbols
- Conventions
- 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
- 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 (GAC):	C	Organize Work
Competency:	C5	Plan a Project

Objectives

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

- Plan an industrial piping project.

LEARNING TASKS

1. Describe organization of an industrial piping project

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

- Install fuel oil systems.

LEARNING TASKS

1. Identify applicable hazards and regulations for fuel oil systems piping

2. Describe underground tank piping safety practices

3. Describe fuel oil terms

4. Describe tank considerations

CONTENT

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

LEARNING TASKS

CONTENT

- 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
- 6. Describe pumps
 - Pumps
 - Pump governors
 - Duplex pumps
 - Electric gear pumps
- 7. Describe burners
 - Rotary
 - Cup

LEARNING TASKS

8. Describe the fuel oil firing sequence

9. Describe combustion requirements

10. Describe combustion analysis for oil or gas fired equipment

11. Set-up and fire an oil-fired appliance

CONTENT

- Purge periods
- Fuel supply periods
- Ignition periods
- Flame proving period
- Automatic shut-down
- Primary air
- Secondary air
- Fuel
- Fuel preparation
- Analysis equipment
- Chemical absorption
 - Electronic analysers
 - Flue products readings
- CO
- CO²
- Stack temperature
- Draft
- Smoke
- Set-up and fire an oil-fired appliance in a practical shop exercise

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

- Install low pressure steam piping systems.

LEARNING TASKS

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

CONTENT

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

LEARNING TASKS

5. Describe low pressure steam piping system components

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

6. Identify and size equipment and components

LEARNING TASKS

CONTENT

- | | |
|--|---|
| | <ul style="list-style-type: none"> • Pipe <ul style="list-style-type: none"> ○ Supply mains ○ Return mains ○ Riser mains ○ Runouts ○ Spring pieces ○ Stubs |
| 7. Describe piping practices | <ul style="list-style-type: none"> • Compensate for expansion and contraction • Expansion joints <ul style="list-style-type: none"> ○ Mechanical ○ Bending ○ Cold-springing |
| 8. Describe control components for a low pressure boiler | <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> ○ Siphon • High limit pressure switch <ul style="list-style-type: none"> ○ Siphon |
| 9. Install low pressure steam piping system | <ul style="list-style-type: none"> • In a practical exercise, install a low pressure steam piping system, including: <ul style="list-style-type: none"> ○ Piping around obstacles ○ Supporting pipe runs and equipment ○ Eccentric reducers ○ Bracketing <ul style="list-style-type: none"> – Guides – Rollers – Anchors |

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

- Describe the installation of high pressure steam piping systems.

LEARNING TASKS

CONTENT

- | | |
|--|---|
| 1. Identify applicable hazards, codes and regulations related to high pressure steam piping | <ul style="list-style-type: none"> • B.C. Boiler Code • ASME • ANSI • Power plant piping codes • Petrochemical piping codes • ASTM A120 • ASTM A53(A,B) • ASTM A106(A,B,C) • ASTM A335(P1 & P11) |
| 2. Describe high pressure steam piping terms | <ul style="list-style-type: none"> • Wet saturated steam • Dry saturated steam • Pounds per hour • Condensing and non-condensing systems • Flash steam • Cubic feet per minute • De-superheated system |
| 3. Describe calculations for high pressure steam piping systems | <ul style="list-style-type: none"> • Thomas formula <ul style="list-style-type: none"> ○ Pipe diameter ○ Steam flow in pounds per minute (lbs/min.) ○ Pressure drop/100 ft. • Expansion and contraction of steam and condensate lines |
| 4. Describe the installation of high pressure steam piping system components and their functions | <ul style="list-style-type: none"> • "Pop safety valves" including <ul style="list-style-type: none"> ○ Open spring type ○ Enclosed spring type ○ Torsion bar type ○ Electromatic type • Piping of "pop safety valves" <ul style="list-style-type: none"> ○ Drip pan elbow ○ Drains from elbow and valve ○ Exhaust pipe ○ Sleeve, rain, cap, pipe chamfer ○ Anchors and brackets |

LEARNING TASKS

CONTENT

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

LEARNING TASKS
CONTENT

- | | |
|--|---|
| 5. Describe the installation and the purpose of soot blowers | <ul style="list-style-type: none"> • Retractable lances • Rotating soot blowers • Permanent soot blowers • Soot blowing media <ul style="list-style-type: none"> ○ Water ○ Steam ○ Air ○ Shot |
| 6. Describe the installation and the purpose of water columns, including pipe sizing | <ul style="list-style-type: none"> • Inspectors crosses • Gauge glasses, round and flat • Simpli port bi-colour • Tri-cocks • Gauge glass cocks • Blow down connection • Feed water pump controllers |
| 7. Describe the components used in high pressure steam piping installation | <ul style="list-style-type: none"> • Hangers <ul style="list-style-type: none"> ○ Trapeze type of hangers ○ Spring loaded hangers ○ Constant support hangers ○ Counter weight hangers ○ Rollers and saddles ○ Anchors • Sleeve type expansion joints • Bellows expansion joints • Cold draw • Pipe line construction or bending |
| 8. Describe the testing procedures for a high pressure steam system | <ul style="list-style-type: none"> • Isolating safety valves • Isolating equipment • Isolating controls • Isolating gauges • Line under pressure • Precautions for blanking off open piping |
| 9. Develop flow diagrams | <ul style="list-style-type: none"> • Develop a flow diagram for a high pressure steam condensing system from a given set of specifications |

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

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

CONTENT

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

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

Workplace Achievement Criteria

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

Line (GAC):	G	Special Application Systems
Competency:	G6	Install Fire Protection Piping Systems

Objectives

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

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

LEARNING TASKS

1. Describe fire protection systems

CONTENT

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

2. Describe the installation of fire protection systems

3. Describe the components of fire protection systems

LEARNING TASKS

CONTENT

4. Describe water supply considerations

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

Achievement Criteria

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

Workplace Achievement Criteria

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

Line (GAC):	H	Water Supply
Competency:	H1	Describe potable water distribution systems

Objectives

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

- Describe the function of the parts of a water service.
- Plan, install, repair and maintain a potable water service.

LEARNING TASKS

1. Describe the components of water services

CONTENT

- Municipal systems
 - Water main layouts
- Codes and jurisdictional requirements
- Health services act requirements
- Equipment
 - Water meters
 - Flow restrictors
 - Pressure reducing valves
 - Isolation valves
 - Bypasses
- Restraining systems
 - Thrust blocks
 - Anchors
 - Guides

2. Describe the installation of potable water systems

- Tools and equipment
- Pipe type and size
- Joining methods
- Testing
- Inspection

3. Describe the components of a potable water distribution system (inside a building)

- Code requirements
- Piping materials
- Check valves
- Isolation valves
- Pressure relief valves
- Water hammer arrestors
- Stop-and-waste cocks
- Hot water storage tanks
- Hot water recirculation equipment
- Boilers and heat exchangers
- Temper water valves and equipment
- Booster pump assemblies

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

Objectives

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

- Describe the installation of cross connection assemblies.

LEARNING TASKS

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

CONTENT

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

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

Objectives

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

- Test and commission cross connection assemblies.

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

Given information on the types of cross-connection control assemblies and devices, codes and jurisdictional requirements, certification requirements and BCWWA test procedure manual and standards, the learner must correctly identify and answer a series of multiple-choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to test and commission cross-connection control assemblies and devices. Tasks must be performed with 90% accuracy.

Workplace Achievement Criteria

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

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

Objectives

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

- Describe 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

1. Describe gas

CONTENT

- Types
- Specific gravity
- Calorific value
- Parameters of combustibility
- Air/gas ratio for combustion
- Ignition and flame temperatures
- Flame speeds
- Odorant
- Chemistry
- Heat value
- Specific gravity
- Flow characteristics

2. Describe the parts of a natural gas fuel delivery system

- Utility provider
- Consumer
- Gas pressures
 - High
 - Low

3. Describe the parts of a propane gas system

- Vapour distribution
- Liquid distribution
- Storage

LEARNING TASKS

4. Describe residential and commercial gas pipe installation

CONTENT

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

5. Install piping, tubing and hoses

- Methods
- Size
- Pressures
- Identification
- Procedures
- Fittings
- Valves
- Prohibited practice
- Location limitations
- Outlets
- Drip or dirt pockets

LEARNING TASKS

CONTENT

- Between buildings
 - Concealment
 - In concrete
 - Underground
 - Support
 - Protection
 - Tools
 - Testing
 - Prior to appliance connection
 - After appliance connection
 - Purging
 - Under 4 inch
 - 4 inch and larger
- 6. Describe gas meters
 - 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
- 7. Use calorific values of fuel and meter readings to determine input
 - Calorific values
 - Clocked flow rates
 - Calculated inputs
 - High altitude installations
- 8. Install propane cylinder systems
 - Code requirements
 - Sizing
 - Load factors
 - Temperature effects on pressure
 - Filled capacity effect on vaporization rate
 - Cylinder sizing
 - Vaporization capacity of cylinders
 - Describe cylinder clearances
 - Installation procedures
 - Safety relief valves
 - Pressures
 - Location of discharge outlets

LEARNING TASKS

9. Describe combustion requirements

10. Describe atmospheric burners

CONTENT

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

LEARNING TASKS

11. Describe burner orifices

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Level 4

Steamfitter/Pipefitter

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

Objectives

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

- Describe electrical drawings.
- Interpret electrical drawings.

LEARNING TASKS

1. Describe electrical drawings

CONTENT

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

Achievement Criteria

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

In addition, the learner must perform practical lab tasks to describe and interpret electrical drawings. Tasks must be performed with 100% accuracy.

Workplace Achievement Criteria

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

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

Objectives

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

- Plan a complex industrial piping project.

LEARNING TASKS

1. Describe organization of a complex industrial piping project

CONTENT

- Project specifications
- Safety
- Installation permits
- Sequence of operation
- Prioritization
- Coordination with other trades
- Estimate material
- Tools and equipment
- Inventory requirements
 - Secure storage
 - Time delivery
 - Labeling materials
 - Stock maintenance
 - Consumables
- Checklist utilization
- Cost efficiency
- Post job efficiency analysis
- Hot permits
- Hydrostatic tests
- Non-destructive tests
- Weld mapping
- Develop a plan for a complex industrial piping project based on supplied drawings and specifications, including quality control documentation

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 (GAC): **G Special Application Systems**
Competency: **G9 Install process piping systems**

Objectives

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

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

LEARNING TASKS

CONTENT

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

LEARNING TASKS

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

CONTENT

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

Achievement Criteria

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

Workplace Achievement Criteria

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

Line (GAC):	G	Special Application Systems
Competency:	G10	Install air conditioning piping systems

Objectives

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

- Describe the installation of air conditioning piping.

LEARNING TASKS

1. Describe and interpret the psychometric chart

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

2. Describe air conditioning systems

LEARNING TASKS

3. Describe the components in an air conditioning piping system

CONTENT

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

Achievement Criteria

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

Workplace Achievement Criteria

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

Line (GAC): **G Special Application Systems**
Competency: **G11 Install refrigeration piping systems**

Objectives

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

- Describe the installation process for refrigeration piping.

LEARNING TASKS

1. Describe refrigeration function and design

2. Describe refrigeration piping technology

3. Describe refrigerant piping components

CONTENT

- Definition of refrigeration
- Units of measurement (tons of refrigerant)
- Heat transfer
- Frozen hard point
- Temperature range
- Temperature/pressure relationship
- Reciprocating systems
 - Evaporator
 - Compressor
 - Condenser
- Defrost components
- Centrifugal systems
- Absorption systems
- Cooling tower systems
- Evaporative cooling systems
- Heat/cold producing components
- Refrigerant Metering Device
- Coils
- Temperature sensors and thermostats
- Gage connections
 - Schrader valve
 - High pressure line tap valve
- Refrigerant types
 - Ozone depletion
- Refrigerant cycle
- Enthalpy and temperatures
- Refrigerant safety precautions
- Leaks
 - Evaporator leaks
 - Condenser leaks
 - Refrigerant piping leaks

Achievement Criteria

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

Workplace Achievement Criteria

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

Line (GAC): **G Special Application Systems**
Competency: **G12 Install medical gas piping systems**

Objectives

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

- Describe medical gas systems.
- Install medical gas piping.

LEARNING TASKS

1. Describe medical gas systems

CONTENT

- Gas types
- Uses/purpose
- Sources of medical gas
 - Bulk
 - Cylinders
 - Compressors
- Valve and accessory placement
- Safety features
- Advantages of pipe systems versus individual cylinders
- Air supply
- Relationships
 - Owner
 - Installer
 - Third party inspectors

2. Describe the layout of medical gas piping systems

- Areas not permitted
- Service requirements for different areas
- Cross-connection
 - Hazards
 - Most common areas
- Location and limitations of cylinders and bulk supplies

3. Describe the installation of piping for medical gas systems

- Location
- 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

LEARNING TASKS

4. Describe the installation of equipment for medical gas systems

5. Install medical gas piping

CONTENT

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

Objectives

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

- Describe instrumentation piping systems.

LEARNING TASKS

1. Describe pressure related measuring instruments and components

2. Describe flow measuring devices

3. Describe temperature measuring devices

4. Describe level measuring devices

CONTENT

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

LEARNING TASKS

5. Describe density measuring devices

6. Describe valves

7. Explain the function of instrument air equipment

8. Describe instrumentation piping system components

9. Describe steam tracing systems

CONTENT

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

Achievement Criteria

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

Workplace Achievement Criteria

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

Line (GAC):	G	Special Application Systems
Competency:	G14	Describe Renewable Energy Systems

Objectives

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

- Describe geothermal piping systems.
- Describe solar heating piping systems.
- Describe heat recovery systems.

LEARNING TASKS

1. Describe geo-thermal systems, equipment and piping
2. Describe solar thermal systems
3. Describe heat recovery systems

CONTENT

- System types
 - Dry steam
 - Flash steam
 - Binary steam
- System configurations
 - Vertical closed-loop
 - Horizontal closed-loop
 - Surface water or lake loop
 - Open-loop “well water”
- System components
- System applications and limitations
- Regulatory requirements
- System types
 - DHW heating
 - Pool heating
 - Space heating supplement
 - Process water
 - Solar cooling
- System configurations
- System components
- System applications and limitations
- Regulatory requirements
- System types
- System configurations
- System components
- System applications and limitations
- Regulatory requirements

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

Objectives

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

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

LEARNING TASKS

1. Describe pressure regulators

CONTENT

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

LEARNING TASKS

2. Describe mechanical burners

3. Describe combustion analysis in appliances

4. Describe regulator venting

5. Install pressure regulators

CONTENT

- Terminology
- Characteristics
- Types
- 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 (GAC):	I	Install Natural Gas and Propane Systems
Competency:	I2	Install and service fuel gas controls and safeguards

Objectives

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

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

LEARNING TASKS

1. Describe principles of electricity

CONTENT

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

- Diagrams

LEARNING TASKS

CONTENT

2. Describe principles of magnetism and magnetic induction

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

LEARNING TASKS

3. Describe nonelectric controls

4. Describe electric control circuits

5. Describe electric control components

6. Describe control modules

CONTENT

- 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
- Transformer circuits
- Fan circuits
- Control circuits
- Safety circuits
- Pump circuits
- Heating/cooling units
- Ignition circuits
- Vent damper circuits
- Air supply circuits
- Forced vent draft
- Operating Controls
- Limit and safety controllers
- Combustion safety controllers
- Ignition systems
- Gas valves
- Ignition control modules
 - Intermittent pilot
 - Direct spark ignition
 - Hot surface ignition
- Fan timers
- Integrated appliance

LEARNING TASKS

7. Wire controls for appliances

8. Test and service controls for appliances

CONTENT

- Installation
- Limits and safety controllers
- Gas valves
- Ignition systems
- Transformers
- Matching controls to the appliance
- Wiring to manufacturer's specifications
- Flame rods
- Thermostats
 - Wiring
- 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 (GAC):	I	Install Natural Gas and Propane Systems
Competency:	I3	Install and service fuel gas equipment

Objectives

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

- Describe installation requirements for gas fired appliances.
- Install and adjust gas fired appliances.

LEARNING TASKS

1. Describe gas fired appliances
2. Describe installation requirements

CONTENT

- Types
 - Boilers
 - Instantaneous water heaters
 - Direct fired make-up air heaters
 - Direct vent appliances
 - Fireplaces
 - Furnaces
 - Infrared heaters
 - Radiant tube heaters
 - Ranges
 - Rooftop units
 - Unit heaters
 - Water heaters
 - Gas fired refrigerators
- Characteristics
- Applications
- Approval agencies
- Impact of type of building construction on installation requirements
- Altitude rating requirement
- Code and Regulation requirements
- Manufacturer's requirements
- Rating plate requirements
- Appliance sizing
- Site preparation
- Clearances
- Installer's responsibilities

LEARNING TASKS

3. Adjust and commission appliances

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

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

Objectives

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

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

LEARNING TASKS

1. Describe gas appliance venting

CONTENT

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

LEARNING TASKS

2. Describe mechanical draft appliances
3. Install venting systems for gas appliances
4. Install direct vented flues

CONTENT

- Types
- Parts
- 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

LEARNING TASKS

CONTENT

- | | |
|--|--|
| <p>5. Describe gas appliance air supply requirements</p> | <ul style="list-style-type: none"> • Purpose <ul style="list-style-type: none"> ○ Combustion air • Primary air • Secondary air • Excess air <ul style="list-style-type: none"> ○ Dilution air ○ Ventilation air • Building as a system <ul style="list-style-type: none"> ○ Negative air pressure • Openings and ducts <ul style="list-style-type: none"> ○ Terminations |
| <p>6. Determine combustion air requirements for gas appliance installations with a combined input of up to and including 400 MBH</p> | <ul style="list-style-type: none"> • Code requirements • Building envelope and construction • Category of the appliance • Draft control • Air requirement calculations <ul style="list-style-type: none"> ○ Combustion ○ Ventilation ○ Flue gas dilution • Table selection • Grills and louvers <ul style="list-style-type: none"> ○ Types ○ Sizing ○ Free area calculations • Air ducts <ul style="list-style-type: none"> ○ Length ○ Size |
| <p>7. Determine combustion air requirements for gas appliance installations with a combined input exceeding 400 MBH</p> | <ul style="list-style-type: none"> • Code requirements • Dilution air requirements • Air requirement calculations <ul style="list-style-type: none"> ○ Combustion ○ Ventilation ○ Flue gas dilution • Calculations • Grills and louvers <ul style="list-style-type: none"> ○ Types ○ Sizing ○ Free area calculations • Air ducts <ul style="list-style-type: none"> ○ Length ○ Size |

LEARNING TASKS

8. Install air supply

CONTENT

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

Achievement Criteria

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

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

Workplace Achievement Criteria

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

Line (GAC):	I	Install Natural Gas and Propane Systems
Competency:	I5	Use gas codes, regulations and standards

Objectives

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

- Identify code rules and regulations applicable to the Level B Gasfitter certification.
- Apply code rules and regulations applicable to the Level B Gasfitter certification.

LEARNING TASKS

1. Describe the B149.1 Gas Code
2. Interpret Sections of the B149.1 Gas Code
3. Use the Gas Regulations
4. Use the Canadian Electrical Code Part 1

CONTENT

- Layout
- Sections
- Contents
- Index
- Annexes
- Tables
- Definitions
- Scope
- Revisions
- Scope
- Reference publications
- Definitions
- General
- Pressure controls
- Piping and tubing systems, hose, and fittings
- Installation of specific types of appliances
- Venting systems and air supply for appliances
- Natural gas compressors and cylinders
- Gas Safety Act
- Gas Safety Regulations
- Permits
- Notification of completion
- Approvals
- Variations to the National Gas Code
- Bulletins and directives
- 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 4

TRAINING PROVIDER STANDARDS

Facility Requirements

Classroom Area (assuming class groups of 16 learners)

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

Shop Area

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

Instructor's Office Space

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

Tools and Equipment

Measuring Tools

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

Power Tools

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

Rigging and Hoisting Equipment

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

Hand Tools

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

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

Welding and Soldering Tools

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

Ladders and Platforms

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

Reference Materials

Required Reference Materials

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

Recommended Resources

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

NOTE:

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

Instructor Requirements

Occupation Qualification

The instructor must possess:

- Steamfitter/Pipefitter - Certificate of Qualification with Red Seal endorsement, plus
- Minimum 'B' Level Gas certification

Work Experience

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

Instructional Experience and Education

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

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