



## Program Outline

Plumber

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## **PLUMBER**

### **PROGRAM OUTLINE**

**THIS BC PROGRAM HAS BEEN HARMONIZED AND IS BASED ON 2022 RSOS**

Developed by  
SkilledTradesBC  
Province of British Columbia

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# **Section 1**

## **INTRODUCTION**

### **Plumber**

## Foreword

This revised Program Outline is intended as a guide for instructors, apprentices, and employers of apprentices as well as for the use of industry organizations, regulatory bodies, and provincial and federal governments. It reflects updated standards based on the 2022 Red Seal Occupational Standard (RSOS). It was developed by British Columbia industry and instructor subject matter experts.

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

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

Competencies are to be evaluated through written exams and practical assessments. A passing grade is achieved by getting an overall mark of 70%. See the Assessment Guidelines in Section 4 for more details.

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

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

### SAFETY ADVISORY

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

## Acknowledgements

Industry and Instructor Subject Matter Experts retained to assist in the development and review of this Program Outline:

- Eric Bradbury Pacific Vocational College
- Terence Chan Impetus Plumbing
- Steve Gilles British Columbia Institute of Technology
- Andrew Henderson Pure Mechanical Group
- Rod Lidstone Camosun College
- Pavel Pajger UA Piping Industry College of BC
- Josh Stull Camosun College
- Darren Vaux Camosun College

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

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### Previous Contributors

The Occupational Analysis Chart (OAC) (2017) was prepared with the advice and direction of industry subject matter experts convened by SkilledTradesBC. Members included:

- Brad Heidman UA Piping Industry College of BC
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- Patrick Waunch Rambow Mechanical
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- Andrew Henderson Pure Plumbing
- Dave Sewell College of New Caledonia
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- Marty Old Marty Old Consulting
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The Program Outline (2012) was prepared with the advice and direction of an industry steering committee convened initially by the Resource Training Organization (RTO). Members included:

- Steve Anderson Department of National Defense
- Danny Bradford BC Federation of Labour
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- Charlie Bowne Canadian Forces
- Glen Sanders Teck
- Rob English Canadian Maritime Engineering

## 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.

Customize the table below to meet the requirements of your program, if required.

<b>Section</b>	<b>Training Providers</b>	<b>Employers/ Sponsors</b>	<b>Apprentices</b>	<b>Challengers</b>
<b>Program Credentialing Model</b>	Communicates program length and structure, and all pathways to completion	Illustrates the length and structure of the program	Illustrates the length and structure of the program, and pathway to completion	Illustrates the challenger pathway to Certificate of Qualification
<b>OAC</b>	Communicates the competencies that industry has defined as representing the scope of the occupation	Displays the competencies that an apprentice is expected to demonstrate in order to achieve certification	Displays the competencies apprentices will achieve as a result of program completion	Displays the competencies challengers must demonstrate in order to challenge the program
<b>Training Topics and Suggested Time Allocation</b>	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Shows 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	Shows 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	Shows the relative weightings of various competencies of the occupation on which assessment is based
<b>Program Content</b>	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component	Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
<b>Assessment Guidelines</b>	Shows the general areas of competency covered in each level of technical training, the theory and practical grading weight, and the calculation method for final percentage marks	Shows the general areas of competency covered in the technical training, the grading weight for each GAC, and the percentage of that time spent on theory versus practical application	Shows the general areas of competency covered in each level of technical training, the theory and practical grading weight, and the calculation method for final percentage marks	Shows the relative weightings of various general areas of competency within the occupation on which assessment is based

<b>Section</b>	<b>Training Providers</b>	<b>Employers/ Sponsors</b>	<b>Apprentices</b>	<b>Challengers</b>
<b>Training Provider Standards</b>	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors	Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment
<b>Appendix – Glossary of Acronyms</b>			Defines program specific acronyms	

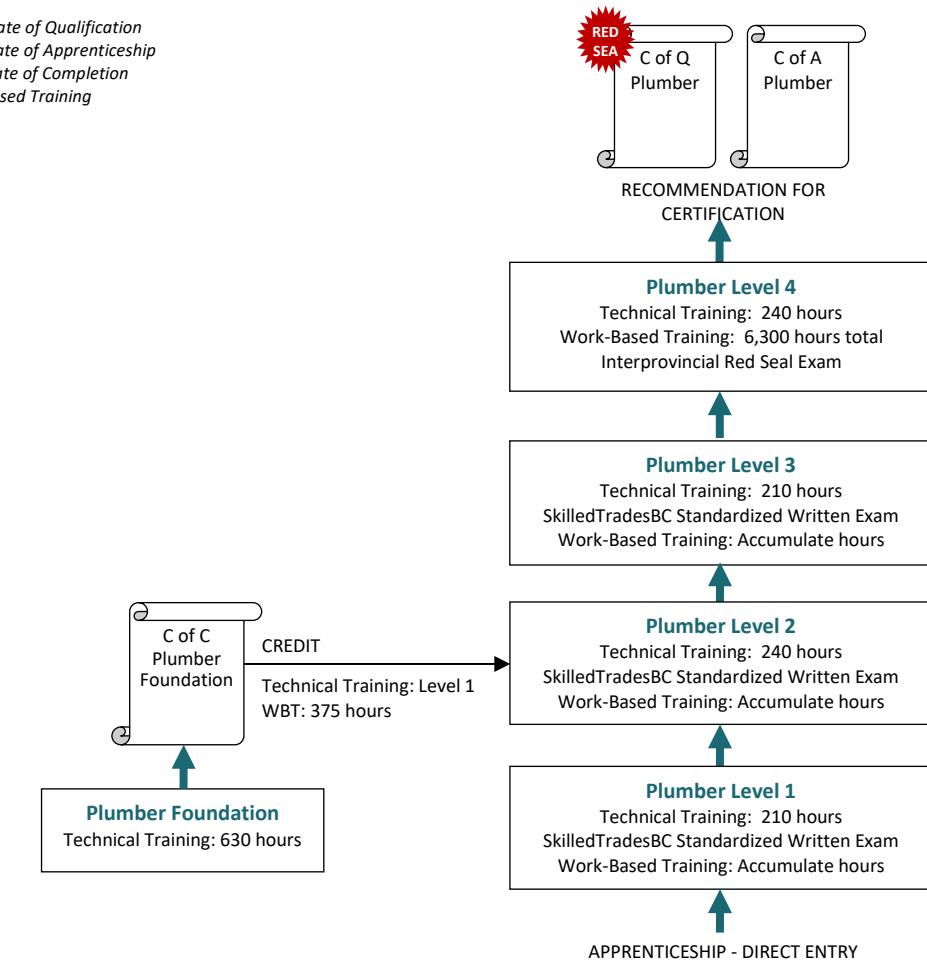
# **Section 2**

## **PROGRAM OVERVIEW**

### **Plumber**

## Program Credentialing Model

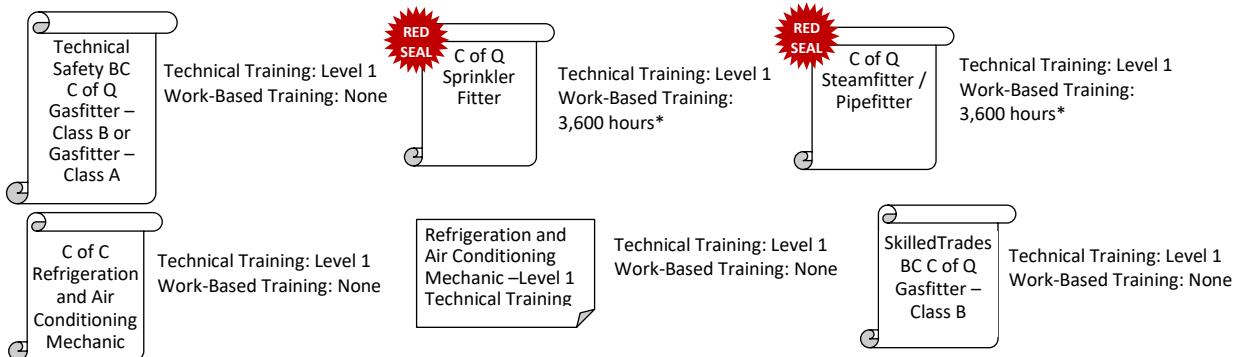
C of Q = Certificate of Qualification  
 C of A = Certificate of Apprenticeship  
 C of C = Certificate of Completion  
 WBT = Work-Based Training



### CROSS-PROGRAM CREDITS

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

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



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

## Occupational Analysis Chart

### PLUMBER

**Occupation Description:** Plumbers install, repair and maintain plumbing fixtures and systems such as water, hydronic, drain, waste and vent (DWV), low pressure steam, chemical and irrigation. They also install specialized systems such as medical gas, process piping, compressed air, water conditioners, fuel piping, sewage and water treatment, and storage and flow equipment. Plumbers interpret drawings, refer to layouts of existing services, and review applicable codes and specifications to determine work details and procedures. They locate and mark positions for fixtures, pipe connections and sleeves, and cut openings to accommodate pipe and fittings.

Regulations concerning the planning, installation, maintenance and inspection of sewage treatment systems may vary by jurisdiction. Additional certification may be required in some jurisdictions to allow plumbers to plan and perform work on these systems.

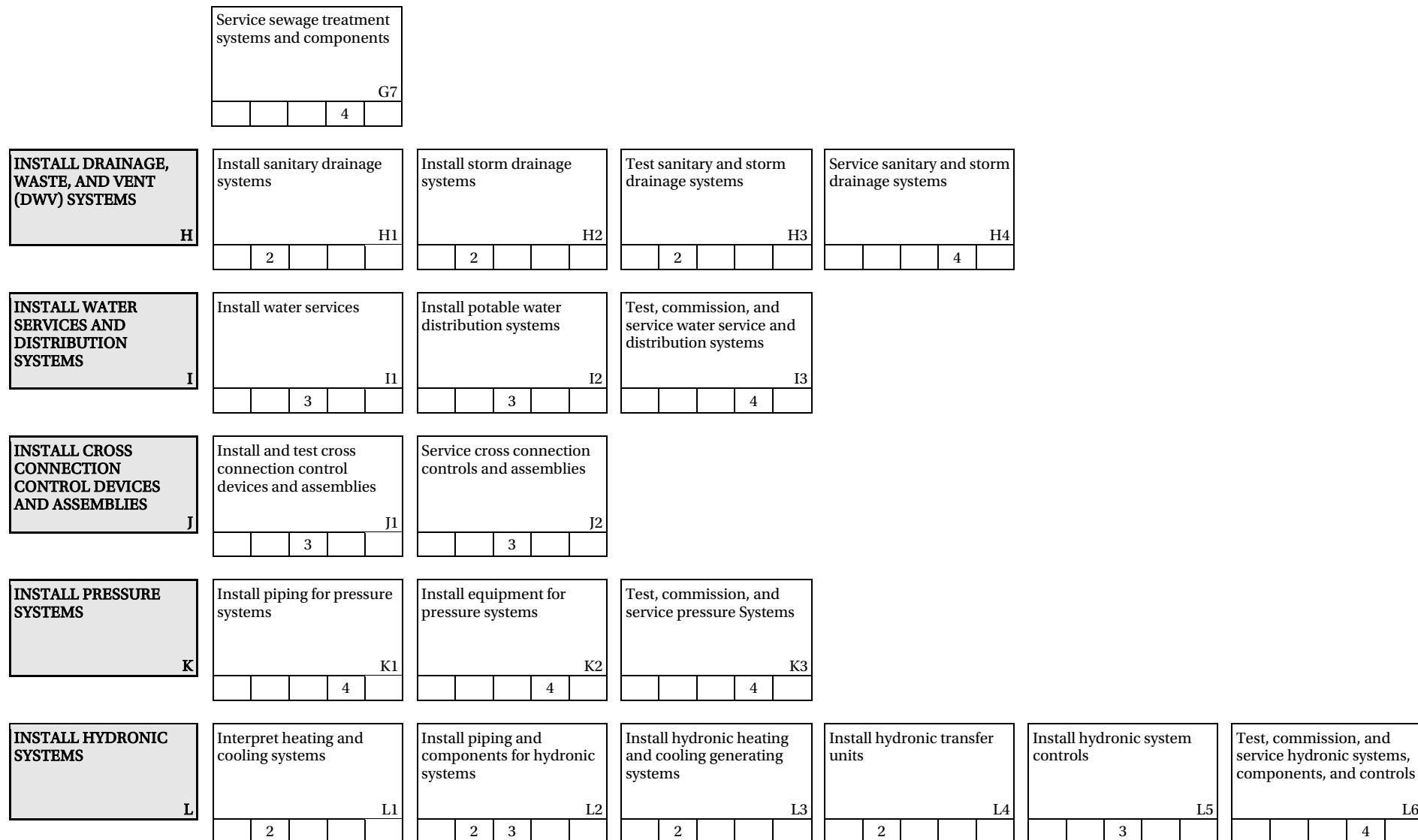
For information regarding BC regulations, please refer to [Sewerage System Regulation](#)

<b>PERFORM SAFETY RELATED FUNCTIONS</b>  <b>A</b>	Maintain safe work environment  A1	Use personal protective equipment (PPE) and safety equipment  A2	Perform Lock-Out and Tag-Out (LOTO) procedures  A3	Practice fire prevention  A4
	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<b>USE TOOLS AND EQUIPMENT</b>  <b>B</b>	Use common tools and equipment  B1	Use access equipment  B2	Use rigging, hoisting, lifting, and positioning equipment  B3	Rig loads for cranes  B4
	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	Use welding equipment  B6	Use technical instruments and testers  B7		
	1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		

## Section 2

# Program Overview

<b>PERFORM ROUTINE TRADE ACTIVITIES</b>  <b>C</b>	Use mathematics and science	Use manufacturer and supplier documentation	Use codes, regulations, and standards	Interpret drawings and specifications for piping system layout		
	C1	C2	C3	C4		
	1	2				
		2				
<b>PREPARE PIPING AND COMPONENTS</b>  <b>D</b>	Prepare pipe	Join tube, tubing, and pipe	Install pipe	Install valves	Install fittings	Penetrate structures
	D1	D2	D3	D4	D5	D6
	1					
		1				
<b>INSTALL PLUMBING FIXTURES AND APPLIANCES</b>  <b>E</b>	Install fixtures	Install appliances	Commission and service fixtures and appliances			
	E1	E2	E3			
	2			4		
		2				
<b>USE COMMUNICATION TECHNIQUES</b>  <b>F</b>	Use communication techniques	Use mentoring techniques				
	F1	F2				
	1		4			
<b>INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMS</b>  <b>G</b>	Install piping for sewers	Install maintenance holes and catch basins	Test maintenance holes, catch basins, and piping for sewers	Service maintenance holes, catch basins, and piping for sewers	Install sewage treatment systems and components	Test sewage treatment systems and components
	G1	G2	G3	G4	G5	G6
	3			4		
		3			4	



<b>INSTALL WATER TREATMENT EQUIPMENT</b>
<b>M</b>

Install water treatment equipment
<b>M1</b>

Test, commission, and service water treatment equipment
<b>M2</b>

<b>INSTALL SPECIALIZED SYSTEMS</b>
<b>N</b>

Install piping for specialized systems
<b>N1</b>

Install equipment and components for specialized systems
<b>N2</b>

Test, commission, and service specialized systems
<b>N3</b>

<b>APPLY ELECTRICAL CONCEPTS</b>
<b>O</b>

Use the principles of electricity
<b>O1</b>

Use electrical wiring diagrams and schematics
<b>O2</b>

Apply single phase motor theory
<b>O3</b>

Apply three phase motor theory
<b>O4</b>

Apply wiring practices
<b>O5</b>

Interpret the Canadian Electrical Code (CEC)
<b>O6</b>

<b>PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS</b>
<b>P</b>

Size piping and tubing systems
<b>P1</b>

Select regulators, valves and valve train components
<b>P2</b>

Select gas-fired appliances
<b>P3</b>

Select flame safeguards
<b>P4</b>

Select burners
<b>P5</b>

Plan a project
<b>P6</b>

<b>INSTALL GAS-FIRED SYSTEMS</b>
<b>Q</b>

Install piping and tubing systems
<b>Q1</b>

Install regulators, valves and valve trains
<b>Q2</b>

Install air supply systems
<b>Q3</b>

Commission fuel/air delivery systems
<b>Q4</b>

## Training Topics and Suggested Time Allocation

### PLUMBER – LEVEL 1

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line A</b>	<b>PERFORM SAFETY RELATED FUNCTIONS</b>	6%	80%	20%	100%
A1	Maintain safe work environment		✓		
A2	Use personal protective equipment (PPE) and safety equipment		✓		
A3	Perform Lock-Out and Tag-Out (LOTO) procedures		✓	✓	
A4	Practice fire prevention		✓		
<b>Line B</b>	<b>USE TOOLS AND EQUIPMENT</b>	24%	60%	40%	100%
B1	Use common tools and equipment		✓	✓	
B2	Use access equipment		✓		
B3	Use rigging, hoisting, lifting, and positioning equipment		✓	✓	
B4	Rig loads for cranes		✓		
B5	Use soldering, brazing, and oxy-fuel equipment		✓	✓	
B6	Use welding equipment		✓	✓	
<b>Line C</b>	<b>PERFORM ROUTINE TRADE ACTIVITIES</b>	43%	80%	20%	100%
C1	Use mathematics and science		✓		
C3	Use codes, regulations, and standards		✓		
C4	Interpret drawings and specifications for piping system layout		✓	✓	
<b>Line D</b>	<b>PREPARE PIPING AND COMPONENTS</b>	15%	80%	20%	100%
D1	Prepare pipe		✓		
D2	Join tube, tubing, and pipe		✓		
D3	Install pipe		✓	✓	
D4	Install valves		✓		
D5	Install fittings		✓		
D6	Penetrate structures		✓		
<b>Line F</b>	<b>USE COMMUNICATION TECHNIQUES</b>	1%	100%	0%	100%
F1	Use communication techniques		✓		
<b>Line O</b>	<b>APPLY ELECTRICAL CONCEPTS</b>	11%	100%	0%	100%
O1	Use the principles of electricity		✓		
<b>Total Percentage for Plumber Level 1</b>		100%			

## Training Topics and Suggested Time Allocation

### PLUMBER - LEVEL 2

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
<b>Line B</b>	<b>USE TOOLS AND EQUIPMENT</b>	5%	80%	20%	100%
B7	Use technical instruments and testers		✓		
<b>Line C</b>	<b>PERFORM ROUTINE TRADE ACTIVITIES</b>	47%	80%	20%	100%
C1	Use mathematics and science		✓		
C2	Use manufacturer and supplier documentation		✓		
C3	Use codes, regulations, and standards		✓		
C4	Interpret drawings and specifications for piping system layout		✓	✓	
<b>Line E</b>	<b>INSTALL PLUMBING FIXTURES AND APPLIANCES</b>	8%	100%	0%	100%
E1	Install fixtures		✓		
E2	Install appliances		✓		
<b>Line H</b>	<b>INSTALL DRAINAGE, WASTE AND VENT (DWV) SYSTEMS</b>	24%	80%	20%	100%
H1	Install sanitary drainage systems		✓	✓	
H2	Install storm drainage systems		✓		
H3	Test sanitary and storm drainage systems		✓		
<b>Line L</b>	<b>INSTALL HYDRONIC SYSTEMS</b>	11%	70%	30%	100%
L1	Interpret heating and cooling systems		✓		
L2	Install piping and components for hydronic systems		✓	✓	
L3	Install hydronic heating and cooling generating systems		✓		
L4	Install hydronic transfer units		✓		
<b>Line P</b>	<b>PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS</b>	5%	80%	20%	100%
P3	Select gas-fired appliances		✓		
<b>Total Percentage for Plumber Level 2</b>		100%			

## Training Topics and Suggested Time Allocation

### PLUMBER - LEVEL 3

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line C</b>	<b>PERFORM ROUTINE TRADE ACTIVITIES</b>	16%	80%	20%	100%
C3	Use codes, regulations, and standards		✓		
C4	Interpret drawings and specifications for piping system layout		✓	✓	
<b>Line G</b>	<b>INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMS</b>	4%	100%	0%	100%
G1	Install piping for sewers		✓		
G2	Install maintenance holes and catch basins		✓		
<b>Line I</b>	<b>INSTALL WATER SERVICES AND DISTRIBUTION SYSTEMS</b>	8%	90%	10%	100%
I1	Install water services		✓		
I2	Install potable water distribution systems		✓	✓	
<b>Line J</b>	<b>INSTALL CROSS CONNECTION CONTROL DEVICES AND ASSEMBLIES</b>	20%	50%	50%	100%
J1	Install and test cross connection control devices and assemblies		✓	✓	
J2	Service cross connection control devices and assemblies		✓		
<b>Line L</b>	<b>INSTALL HYDRONIC SYSTEMS</b>	21%	70%	30%	100%
L2	Install piping and components for hydronic systems		✓	✓	
L5	Install hydronic system controls		✓	✓	
<b>Line N</b>	<b>INSTALL SPECIALIZED SYSTEMS</b>	5%	100%	0%	100%
N1	Install piping for specialized systems		✓		
N2	Install equipment and components for specialized systems		✓		
N3	Test, commission, and service specialized systems		✓		
<b>Line O</b>	<b>APPLY ELECTRICAL CONCEPTS</b>	16%	50%	50%	100%
O2	Use electrical wiring diagrams and schematics		✓	✓	
O5	Apply wiring practices		✓		
<b>Line P</b>	<b>PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS</b>	8%	100%	0%	100%
P1	Size piping and tubing systems		✓		
P4	Select flame safeguards		✓		
P5	Select burners		✓		
<b>Line Q</b>	<b>INSTALL GAS-FIRED SYSTEMS</b>	2%	100%	0%	100%
Q1	Install piping and tubing systems		✓		
<b>Total Percentage for Plumber Level 3</b>		100%			

## Training Topics and Suggested Time Allocation

## PLUMBER - LEVEL 4

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line C	<b>PERFORM ROUTINE TRADE ACTIVITIES</b>	5%	100%	0%	100%
C4	Interpret drawings and specifications for piping system layout		✓		
Line E	<b>INSTALL PLUMBING FIXTURES AND APPLIANCES</b>	5%	100%	0%	100%
E3	Commission and service fixtures and appliances		✓		
Line F	<b>USE COMMUNICATION TECHNIQUES</b>	1%	100%	0%	100%
F2	Use mentoring techniques		✓		
Line G	<b>INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMS</b>	7.5%	100%	0%	100%
G3	Test maintenance holes, catch basins, and piping for sewers		✓		
G4	Service maintenance holes, catch basins, and piping for sewers		✓		
G5	Install sewage treatment systems and components		✓		
G6	Test sewage treatment systems and components		✓		
G7	Service sewage treatment systems and components		✓		
Line H	<b>INSTALL DRAINAGE, WASTE AND VENT (DWV) SYSTEMS</b>	3%	100%	0%	100%
H4	Service sanitary and storm drainage systems		✓		
Line I	<b>INSTALL WATER SERVICES AND DISTRIBUTION SYSTEMS</b>	4.5%	90%	10%	100%
I3	Test, commission, and service water service and distribution systems		✓		
Line K	<b>INSTALL PRESSURE SYSTEMS</b>	9%	80%	20%	100%
K1	Install piping for pressure systems		✓	✓	
K2	Install equipment for pressure systems		✓		
K3	Test, commission, and service pressure systems		✓		
Line L	<b>INSTALL HYDRONIC SYSTEMS</b>	10%	70%	30%	100%
L6	Test, commission, and service hydronic systems, components, and controls		✓	✓	
Line M	<b>INSTALL WATER TREATMENT EQUIPMENT</b>	10%	90%	10%	100%
M1	Install water treatment equipment		✓		
M2	Test, commission, and service water treatment equipment		✓	✓	
Line N	<b>INSTALL SPECIALIZED SYSTEMS</b>	10%	100%	0%	100%
N1	Install piping for specialized systems		✓		
N2	Install equipment and components for specialized systems		✓		

**% of Time Allocated to:**

		<b>% of Time</b>	<b>Theory</b>	<b>Practical</b>	<b>Total</b>
N3	Test, commission, and service specialized systems		✓		
<b>Line O</b>	<b>APPLY ELECTRICAL CONCEPTS</b>	20%	100%	0%	100%
O3	Apply single phase motor theory		✓		
O4	Apply three phase motor theory		✓		
O6	Interpret the Canadian Electrical Code (CEC)		✓		
<b>Line P</b>	<b>PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS</b>	7.5%	90%	10%	100%
P2	Select regulators, valves and valve train components		✓		
P6	Plan a project		✓	✓	
<b>Line Q</b>	<b>INSTALL GAS-FIRED SYSTEMS</b>	7.5%	100%	0%	100%
Q2	Install regulators, valves and valve trains		✓		
Q3	Install air supply systems		✓		
Q4	Commission fuel/air delivery systems		✓		
<b>Total Percentage for Plumber Level 4</b>		<b>100%</b>			

# **Section 3**

## **PROGRAM CONTENT**

### **Plumber**

# **Level 1**

## **Plumber**

Line (GAC): **A PERFORM SAFETY RELATED FUNCTIONS**Competency: **A1 Maintain safe work environment****Objectives**

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

- Manage workplace hazards.
- Use WHMIS.

**LEARNING TASKS**

1. Identify workplace hazards

**CONTENT**

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

**LEARNING TASKS**

2. Describe safety hazards when working at elevations
3. Describe safety precautions when working at elevations
4. Manage workplace hazards
5. Describe how site-specific safety policies are established

**CONTENT**

- o Short term
- o Long term
- o Rigging
- o Post-tension
- Floor openings
- Weather
  - o Wind
  - o Snow
  - o Lightning
  - o Rain
- Access equipment
- Fall restraint
  - o Guard rails
  - o Safety lines
- Fall arrest
- Personal Protective Equipment (PPE)
- Workplace Hazard Materials Identification System (WHMIS)
  - o Purpose
  - o Material Safety Data Sheets (MSDS)
  - o Labels
  - o Symbols
  - o Regulations
- Transportation of Dangerous Goods (TDG)
  - o Awareness
- Occupational Health and Safety (OHS) regulation
  - o Rights and responsibilities
  - o Inspections
  - o General conditions
- WorkSafeBC standards
  - o Emergency shutoffs
- Chemical hazard response
  - o Eyewash facilities
  - o Emergency shower
- Evacuation plan
  - o Marshalling/mustering areas
  - o Emergency exits
  - o Emergency contact/phone numbers
- Standards, acts and regulations
- Hazard assessment

**LEARNING TASKS****CONTENT**

- o Safety policy
- o Site conditions
- Types of meetings
  - o Tool box
  - o Safety committee

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

### Objectives

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

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

LEARNING TASKS	CONTENT
1. Describe Personal Protective Equipment (PPE)	<ul style="list-style-type: none"><li>• Safety footwear</li><li>• Eye protection</li><li>• Ear protection</li><li>• Head protection</li><li>• Respiratory protection<ul style="list-style-type: none"><li>◦ Positive pressure</li><li>◦ Negative pressure</li><li>◦ Fit test</li></ul></li><li>• Clothing<ul style="list-style-type: none"><li>◦ High visibility workwear</li><li>◦ Gloves</li><li>◦ Fall protection</li></ul></li></ul>
2. Describe safety equipment	<ul style="list-style-type: none"><li>• Types<ul style="list-style-type: none"><li>◦ Fire extinguishers</li><li>◦ First-aid</li><li>◦ Ventilation</li><li>◦ Screens</li></ul></li><li>• Procedures</li><li>• Storage</li><li>• Limitations</li><li>• Standards, acts and regulations</li></ul>
3. Use Personal Protective Equipment (PPE)	<ul style="list-style-type: none"><li>• Purpose</li><li>• Selection</li><li>• Operating procedures</li><li>• Training requirements<ul style="list-style-type: none"><li>◦ WorkSafeBC requirements</li><li>◦ Job site requirements</li></ul></li><li>• Inspection</li><li>• Maintenance</li><li>• Storage</li></ul>

**Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS**

**Competency: A3 Perform Lock-Out and Tag-Out (LOTO) procedures**

**Objectives**

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

- Identify and use Lock-Out and Tag-Out procedures.

**LEARNING TASKS**

1. Identify energy sources

**CONTENT**

- Electricity
- Pressure
- Kinetic
- Understanding of system operation
- Components requiring lock-out
- Situations where lock-out is required
- Lock-out equipment
  - o Locks
  - o Tags
  - o Identification requirements
  - o Chains
  - o Support blocks
  - o Blind flanges
  - o Spades
  - o Spectacle blinds

2. Describe Lock-Out and Tag-Out (LOTO)

- Procedures
- Zero energy state
  - o Disconnect
  - o Depressurize
  - o Isolate
- Lock-out
- Tag-out
- Test

3. Use LOTO procedures

**Achievement Criteria**

Performance The learner will be able to perform electrical lock-out with verification.

Conditions To be assessed during technical training.

The learner will be given:

- Lock-out equipment
- Isolation devices
- Multi-meter
- Lock and key
- Tag
- Personal Protective Equipment (PPE)

Criteria The learner will be evaluated on:

- Safety

- Completion and verification of electrical lock-out procedures

**Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS**

**Competency: A4 Practice fire prevention**

**Objectives**

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

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

**LEARNING TASKS**

1. Describe the conditions necessary to support a fire

**CONTENT**

- Air
- Fuel
- Heat
- Class A
- Class B
- Class C
- Class D
- Class K
- Symbols and colours
- Hot work permit (site specific)
- Handling and storage of flammable materials
- Symbols
- Fuels
  - o Diesel
  - o Gasoline
  - o Propane
  - o Natural Gas
- Ventilation, including purging
- Lubricants
- Oily rags
- Combustible metals
- Aerosols
- Fire extinguisher
  - o Expiry date
  - o Fill level
- Warning others and fire department
- Evacuation of others
- Fire containment
- Personal method of egress
- Training
- Extinguisher selection
- P.A.S.S.

2. Describe the classes of fires according to the materials being burned

3. Apply preventative fire safety precautions

4. Describe the considerations and steps to be taken prior to fighting a fire

5. Describe the procedure for using a fire extinguisher

**LEARNING TASKS****CONTENT**

- o Pull
- o Aim
- o Squeeze
- o Sweep

Line (GAC): **B USE TOOLS AND EQUIPMENT**Competency: **B1 Use common tools and equipment****Objectives**

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

- Use hand, portable, and stationary power tools.
- Use measuring and levelling equipment.
- Inspect and maintain tools and equipment.
- Use levelling equipment to establish elevations.

**LEARNING TASKS**

1. Describe hand tools

**CONTENT**

- Wrenches
- Pliers
- Screwdrivers
- Cutting tools
- Measuring and marking tools
- Bracing and securing tools
- Hammering tools
- Levelling tools
  - Pitch levels
  - Builder's level
  - Laser levels
  - Plumb bob
- Chiseling tools
- Squaring tools
- Threading tools
- Flaring and swaging tools
- Tubing benders
- Expanding and crimping tools
- Types
  - Electric
  - Pneumatic
- Cutting tools
- Grinding and abrasive tools
- Threading tools
- Expanding and crimping tools
- Drilling, boring and coring tools
- Grooving tools
- Specialty tools
  - Fusion tools
  - Press tools
  - Extruded T

2. Describe portable power tools

**LEARNING TASKS**

3. Describe stationary power tools

**CONTENT**

- Accessories

- Cutting tools

- Grinding and abrasive tools

- Threading tools

- Drilling and boring tools

- Grooving tools

- Specialty tools

- Accessories

4. Describe pressure measuring tools

- Manometers

- Types

- Filling

- Fluids

- Mechanical gauges

- Analogue

- Digital

- Standard

- Compound

5. Use hand tools and equipment

- Parts

- Applications

- Procedures

- Safety

- Adjustment

- Inspection

- Maintenance

- Storage

6. Use levelling equipment to establish elevations

- Grade and pitch calculations

- Procedures

- Manufacturers' specifications

- Inspection

- Adjustment

- Maintenance

- Storage

**Achievement Criteria**

Performance The learner will be able to establish 10 sights.

Conditions The learner will be given:

- Sights
- Specifications
- Levelling equipment

Criteria The learner will be evaluated on:

- Accuracy

Line (GAC): **B USE TOOLS AND EQUIPMENT**Competency: **B2 Use access equipment****Objectives**

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

- Select and use ladders and elevated platforms.

**LEARNING TASKS**

1. Describe ladders and elevated platforms

**CONTENT**

- Types
  - o Ladders
  - o Platforms
  - o Lifts
  - o Aerial Work Platform (AWP)
- Applications
- Safety
  - o Fall arrest equipment
  - o Fall restraint equipment
  - o Hazard recognition
- Standards, acts, and regulations
- Site certification requirements
  - o Equipment certifications
  - o Employer responsibilities

2. Use ladders and elevated platforms

- Selection
- Operating procedures
- Limitations
- Securing
- Inspection
- Maintenance
- Storage

Line (GAC): **B USE TOOLS AND EQUIPMENT**Competency: **B3 Use rigging, hoisting, lifting, and positioning equipment****Objectives**

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

- Use hoisting, lifting, and rigging equipment.

**LEARNING TASKS**

1. Describe lifting and hoisting

**CONTENT**

- Principles
  - o Mechanical advantage
  - o Balance points
  - o Safety
  - o Estimation of weights
  - o Equipment capacities
  - o Equipment selection
  - o Lifting location
  - o Operating procedures
  - o Communication/hand signals
  - o Securing of loads
- Certification requirements
- Lift plan

2. Describe lifting and hoisting equipment

- Boom trucks
- Chain falls
- Come-alongs
- Cranes
- Mechanical lifts
- Compressed gas lifts
- Loaders
- Tirfors
- Tuggers
- Inspection
- Maintenance

3. Describe rigging equipment

- Chains
- Shackles
- Slings/chokes
- Snatch blocks
- Softeners
- Spreader bars
- Tag lines
- Turnbuckles
- Storage

**LEARNING TASKS**

4. Describe lifting and hoisting communication

**CONTENT**

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

5. Select slings

- Load
  - o Load factor labels
- Application
  - o Sling angles
  - o Sling lengths

6. Tie knots, bends, and hitches

- Types
  - o Bowline
  - o Bowline on a bight
  - o Cat's paw
  - o Clove hitch
  - o Figure eight
  - o Half hitch
  - o Reef knot
  - o Rolling hitch
  - o Sheet bend
  - o Timber hitch
  - o Trucker's hitch

7. Use hoisting, lifting and rigging equipment

- Purposes
- Limitations
- Safety
- Working load limit (WLL)
- Lift plan
- Communication/hand signals
- Securing of loads
  - o Pre-lift
  - o Post-lift
- Inspection
- Maintenance
- Storage
- Disposal

**Achievement Criteria 1**

Performance	The learner will be able to:
	<ul style="list-style-type: none"><li>• Perform a manual lift.</li><li>• Identify and use the proper type of hoisting equipment to perform a manual lift.</li></ul>
Conditions	The learner will be given:
	<ul style="list-style-type: none"><li>• Tools and equipment</li><li>• Pre-calculated lift plan</li></ul>
Criteria	The learner will be evaluated on:
	<ul style="list-style-type: none"><li>• Personal Protective Equipment (PPE) selection</li><li>• Correct body position</li><li>• Centre of gravity</li><li>• Block and store</li></ul>

**Achievement Criteria 2**

Performance	The learner will be able to:
	<ul style="list-style-type: none"><li>• Perform a hoisted lift.</li><li>• Identify and use the proper type of hoisting equipment to perform a hoisted lift.</li></ul>
Conditions	The learner will be given:
	<ul style="list-style-type: none"><li>• Tools and equipment</li><li>• Pre-calculated lift plan</li></ul>
	The learner will be evaluated on:
	<ul style="list-style-type: none"><li>• Visual check of lifting equipment</li><li>• Checking equipment capacity</li><li>• Attaching the rigging configuration</li><li>• Attaching load to the lifting hook</li><li>• Centering lifting hook above load before lifting</li><li>• Hoisting load</li><li>• Lowering load</li><li>• Securing load prior to rigging removal</li><li>• Returning rigging to designated storage place</li><li>• Using all equipment in a safe manner</li><li>• Following all site safety rules</li></ul>

Line (GAC): **B USE TOOLS AND EQUIPMENT**Competency: **B4 Rig loads for cranes****Objectives**

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

- Describe crane procedures.
- Secure loads for rigging removal.

**LEARNING TASKS**

1. Describe crane procedures

2. Secure loads for rigging removal

**CONTENT**

- Knowledge of crane components
- Load charts
- Outriggers
- Walk-around inspection
- Hazards during rigging
  - Ensuring load stability
  - Cribbing
- Limitations
- Guy wires
- Come-alongs
- Lashing
- Welding
- Suspending loads for subsequent placement

Line (GAC): **B USE TOOLS AND EQUIPMENT**Competency: **B5 Use soldering, brazing, and oxy-fuel equipment****Objectives**

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

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

**LEARNING TASKS**

1. Describe the brazing process

**CONTENT**

- Principles
- Applications
- Filler alloys
- Equipment
- Safety requirements
  - Fire protection equipment
  - Ventilation
  - Hot-work permit
  - Personal Protective Equipment (PPE)

2. Describe the procedures for braze welding

- Joint preparation and design
- Flux selection
- Flame for brazing
- Purging

3. Describe air-fuel and oxy-fuel equipment

- Cylinders
- Regulators
- Gauges
- Flashback arrestor
- Hoses
- Torches
- Inspection
- Maintenance
- Storage

4. Use air-fuel and oxy-fuel equipment to braze and solder

- Safety
- Flammable material recognition
- Applications
- Procedures
  - Setup
  - Take down
  - Leak test
  - Tip selection
  - Alloy selection
  - Flux selection
  - Flux removal

**LEARNING TASKS****CONTENT****Achievement Criteria**

Performance The learner will be able to braze and solder.

Conditions The learner will be given:

- Materials
- Tools and equipment
- Specifications/drawings

Criteria The learner will be evaluated on:

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

Line (GAC): **B USE TOOLS AND EQUIPMENT**Competency: **B6 Use welding equipment****Objectives**

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

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

**LEARNING TASKS**

1. Describe safety requirements and precautions for arc welding

2. Identify welding types, positions, joints and symbols

3. Describe the arc welding process and equipment

**CONTENT**

- Personal Protective Equipment (PPE)
  - Eye protection
  - Welding helmets
  - Hearing protection
  - Radiation protection
  - Respiratory protection
- Electric shock
- Fire and explosion prevention
- Ventilation
- Types
  - Bead
  - Tack
  - Fillet
  - Groove
- Positions
  - Flat (1)
  - Horizontal (2)
  - Vertical (3)
  - Overhead (4)
- Welding joints
  - Butt
  - Lap
  - Tee
  - Corner
  - Edge
- Symbols
  - Arrows
  - Weld-all-around
  - Field
  - Contour and finish
  - Location
- Arc welding circuit
- AC and DC power sources
- Electrode holders
- Ground clamps

**LEARNING TASKS****CONTENT**

- Welding cables
- Grinders
- Consumables
- Maintenance
- Storage

**Achievement Criteria**

Performance The learner will be able to bevel a pipe using grinding procedures.

Conditions The learner will be given:

- Personal Protective Equipment (PPE)
- Grinder
- Materials
- Tools

Criteria The learner will be evaluated on:

- Safety
- Fit-up
- Appearance

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**Competency: **C1 Use mathematics and science****Objectives**

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

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

**LEARNING TASKS**

1. Apply calculator functions to trade related equations

2. Use formulas to calculate area

3. Use formulas to calculate volumes

4. Use formulas to calculate capacity

5. Transpose formulas

6. Perform conversions

7. Calculate piping measurements

**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 (kW)
  - BTUh
  - Gigajoules
- Temperature
  - Fahrenheit
  - Centigrade
  - Kelvin
  - Rankine
- Pressure
  - Absolute
  - Gauge
- Terms
  - Thread allowance

**LEARNING TASKS**

8. Use the Pythagorean theorem of right angles
9. Calculate offsets using the applicable trigonometric function
10. Calculate the required measurements for a parallel piping offset
11. Describe the properties of matter
12. Use Pascal's theory of pressure and force

**CONTENT**

- o Fitting allowance
- o End-to-end
- o End to centre
- o Centre to centre
- o Face-to-face
- o End-to-back
- o Back-to-back
- o Socket depth
- Calculations
- Grades
- Elevations
- Benchmarks
- Hypotenuse
- Side opposite
- Side adjacent
- Calculator methods
- Table-based methods
- Unequal spread
- Equal spread
- Rolling
- Jumper
- Substances
  - o Elements
  - o Compounds
  - o Mixtures
- Adhesion
- Cohesion
- Conductivity
- Density
- Ductility
- Elasticity
- Malleability
- Tensile strength
- Heat properties
  - o BTUs
  - o Gigajoules
  - o Specific Heat
  - o Kilowatts (kW)
- Pressure
  - o Pounds per square inch (psig)

**LEARNING TASKS**

13. Use Archimedes' principles of displacement and floatation
14. Define mechanical advantage as it relates to fluid power
15. Describe factors that affect fluid flow in a piping system
16. Describe factors that affect gas volumes and pressures
17. Perform gas law calculations
18. Calculate the expansion and contraction of various piping materials due to heating and cooling
19. Define methods of heat transfer

**CONTENT**

- o Pascal (Pa)
- o Kilopascal (kPa)
- o Inches of water column (in. WC)
- o Inches of mercury (in. Hg)
- o Ounces per square inch (OSI)
- o Bar
- Total Force
  - o Pounds
  - o Newtons
- Specific weight/gravity
- Buoyancy
- Hydraulics
- Hydrostatics
- Viscosity
- Laminar flow
- Turbulent flow
- Velocity
- Piping material
- Fittings
- Boyle's Law
- Charles Law
- Combined Gas Law (Gay-Lussac's Law)
- Bernoulli's principle
- Boyle's Law
- Charles Law
- Combined Gas Law (Gay-Lussac's Law)
- Temperature
  - o Kelvin
  - o Rankine
- Pressures
  - o Absolute
  - o Gauge
- Ferrous
- Non-ferrous
- Thermoplastic
- Conduction
- Convection
- Radiation

**LEARNING TASKS**

- 20. Perform heat load calculations
- 21. Describe characteristics of hydrocarbon gases

**CONTENT**

- Sensible
- Latent
- Specific heat
- Chemistry
- Heat value
- Specific gravity
- Flow characteristics
- Ignition and flame temperature
- Flame speeds
- Odourant
- Limits of flammability

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**Competency: **C3 Use codes, regulations, and standards****Objectives**

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

- Identify codes, standards and organizations.

**LEARNING TASKS**

1. Identify codes, standards, and organizations

**CONTENT**

- American National Standards Institute (ANSI)
- American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- American Society of Testing and Materials (ASTM)
- American 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)
- Canadian Unified Plumbing Code (cUPC™)
- National Building Code of Canada (NBC)
- National Fire Protection Association (NFPA)
- Technical Safety BC (formerly BC Safety Authority [BCSA])
- 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)

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**Competency: **C4 Interpret drawings and specifications for piping system layout****Objectives**

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

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

**LEARNING TASKS**

1. Describe drafting tools and materials

**CONTENT**

- Tools
  - Compasses
  - Dividers
  - Drawing boards
  - French curves
  - Protractors
  - Scale rulers
  - Triangles
  - T-squares
- Erasers and shields
- Pencils
- Templates
- Dimensions
  - Imperial
  - Metric
- Elbows
- Flanges
- Tees
- Valves
- Wyes
- Lines
  - Border
  - Centre
  - Dimension
  - Extension
  - Hidden
  - Object
  - Phantom
- Lettering
  - Hierarchy

2. Use scale rulers

3. Describe piping symbols

4. Describe characteristics of drafting lines and lettering

**LEARNING TASKS**

5. Describe drawing projections
6. Use drawing projections
7. Create an isometric drawing of a basic piping arrangement

**CONTENT**

- Views
  - Elevation
  - Section
  - Plan
  - Isometric
  - Orthographic
  - Oblique
- Isometric
- Orthographic
- Conversion from one to the other
- Lettering
- Line type
- Relevant information
  - Detail required
- Dimensioning

**Achievement Criteria**

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

Conditions To be assessed during technical training.

The learner will be given:

- T-squares
- Orthographic drawing

Criteria The learner will be evaluated on:

- Accuracy
- Neatness

Line (GAC): D PREPARE PIPING AND COMPONENTS

Competency: D1 Prepare pipe

**Objectives**

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

- Describe piping and tubing.
- Prepare pipe for jointing and installation.

**LEARNING TASKS**

1. Describe piping and tubing

**CONTENT**

- Codes and regulations
  - o Authority Having Jurisdiction (AHJ)
- Manufacturers' specifications
- Schedules/Standard Dimension Ratio (SDR)
- Characteristics
- Types
  - o Steel
  - o Carbon
  - o Stainless
  - o Galvanized
  - o Copper
  - o Plastic
  - o Thermoplastic
  - o Thermoset
  - o Cast iron
  - o Aluminum
  - o Asbestos-cement
  - o Application specific
  - o Pyrex
  - o Fibre-glass
  - o Polypropylene
  - o Duriron

2. Describe methods of pipe support

- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Tools and equipment
- Types
  - o Hangers
  - o Supports
  - o Seismic
  - o Anchors
  - o Guides
  - o Slide plates

**LEARNING TASKS**

3. Describe methods of protecting piping and tubing

4. Pre-installation inspection of piping and tubing

**CONTENT**

- o Bedding media
- Compatibility with piping
- Size
- Spacing
- Elevation
- Fasteners
  - o Beam clamps
  - o Drop-in anchors
  - o Inserts
  - o Draw bolts
  - o Toggle bolts
- Structural restrictions
- Insulation thickness
- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Water treatment
  - o Softener
  - o pH
  - o Iron filters
- Frost protection
  - o Insulation
  - o Heat trace
  - o Frost boxes
  - o Circulating pumps
- Ultraviolet (UV) protection
- Corrosion protection
  - o Coatings
  - o Tape
  - o Cathodic
  - o Dielectric
  - o Sleeving
- Mechanical damage
  - o Protective plates/shield
  - o Sleeving
  - o Bollards
- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Applications
- Potential defects

**LEARNING TASKS****5. Cut piping and tubing****CONTENT**

- o Pin holes
- o Cracked fittings
- o Bent ends
- o Uneven casting
- o Damaged pipe and coatings
- o Debris
- Environmental effects
  - o Ultraviolet (UV)
  - o Thermal effects
  - o Soil conditions
- Inspection techniques
  - o Visual
  - o Threads
  - o Groove depth
  - o Sounding of cast iron pipe and fittings
  - o Tactile
- Interpretation of markings
- Safe work practices
- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Tools and equipment
  - o Cutting torch
  - o Hacksaw
  - o Bandsaw
  - o Pipe/tube cutters
  - o Reamers
  - o File
  - o Internal pipe cutters
  - o Glass pipe cutters
  - o Soil pipe cutters
  - o Snap cutters
  - o Ratchet cutters
  - o Grinder
  - o Cutting disks
  - o Hammer/chisel
- Calculations
- Inspection

**6. Bend piping and tubing**

- Safe work practices
- Codes and regulations
  - o AHJ

**LEARNING TASKS****7. Prepare piping and tubing connections****CONTENT**

- Manufacturers' specifications
- Terminology
- Tools and equipment
  - Tube benders
  - Bending springs
- Measurements
  - Angles
  - Offsets
  - Bends
- Inspection
- Safe work practices
- Codes and regulations
  - AHJ
- Manufacturers' specifications
- Tools and equipment
- Measuring
- Cutting burr removal
- Reaming
- Threading
- Sealant
- Priming
- Flaring
- Sanding/filing
- Flux
- Beveling
- Grooving
- Inspection

Line (GAC): D PREPARE PIPING AND COMPONENTS

Competency: D2 Join tube, tubing, and pipe

**Objectives**

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

- Join piping and tubing.

**LEARNING TASKS**

1. Describe piping and tubing jointing methods

**CONTENT**

- Safe work practices
- Press-fit
- Soldered
- Brazed
- Grooved
- Flanged
- Compression
  - Ferrule
  - Flared
  - CSST
- Swaged
- Corporation
- Push-fit
- Welded
  - Solvent
  - Fused
- Threaded
- Cut-grooved
- Roll-grooved
- Crimped
- Expanded
- Codes and regulations
  - AHJ
- Manufacturers' specifications
- Fittings
- Accessories
- Tools and equipment
- Assembly

2. Join piping and tubing

Line (GAC): D PREPARE PIPING AND COMPONENTS

Competency: D3 Install pipe

**Objectives**

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

- Install carbon steel piping.

**LEARNING TASKS**

1. Describe the installation of piping and tubing

**CONTENT**

- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Safe work practices
- Selection for application
  - o Structural penetration
  - o Fire rating
- Tools and equipment
- Layout

- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Selection
  - o Application
- Tools and equipment
- Piping supports
- Structure penetration

2. Install carbon steel piping

**Achievement Criteria**

Performance The learner will be able to prepare, join, and install piping of the following types:

- Plastic
- Copper
- Carbon steel

Conditions To be assessed during technical training.

The leaner will be given:

- Drawings and specifications
- Tools and equipment
- Materials

Criteria The learner will be evaluated on:

- Accuracy
- Neatness

Line (GAC): D PREPARE PIPING AND COMPONENTS

Competency: D4 Install valves

**Objectives**

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

- Describe valve types.
- Describe the installation of valves.

**LEARNING TASKS**

1. Describe valve types

2. Describe the installation of valves

**CONTENT**

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

Line (GAC): D PREPARE PIPING AND COMPONENTS

Competency: D5 Install Fittings

**Objectives**

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

- Select fittings.
- Install fittings.

**LEARNING TASKS**

1. Describe fittings

**CONTENT**

- Codes, standards and regulations
  - o AHJ
- Manufacturers' specifications
- Types
- Applications
- Limitations
- Threaded
- Compression
- Flared
- Flanged
- Crimped
- Soldered/brazed
- Mechanical (MJ)
- Solvent welded
- Polyfusion
- Sealants
  - o Thread compound
  - o Teflon tape
  - o Gaskets
  - o O-rings
  - o Hemp

2. Describe fitting connection methods

3. Install fittings

- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Accessories
- Tools and equipment
- Assembly

Line (GAC): D PREPARE PIPING AND COMPONENTS

Competency: D6 Penetrate structures

**Objectives**

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

- Describe structure penetration.

**LEARNING TASKS**

1. Describe factors affecting penetrations in structures

**CONTENT**

- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Structural integrity
- Fire separation
- Interference with other building components and systems
- Hidden components behind the surface
- Electrical wiring
- Reinforcing bars
- Piping
- Post-tension cables
- Sleeve installation
  - o Fabrication
  - o Timing (canning)
  - o Location
  - o Sizing
  - o Fastening
- Sealing
  - o Fire stopping
  - o Water-proofing
  - o Isolating groundwater
  - o Protecting pipe
  - o Preventing oxidation
- Protection during concrete pour

2. Describe methods of structure penetration

- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Fire stopping
  - o Doughnut type
  - o Gasket type
  - o Caulking
  - o Mineral wool
- Fire rating requirements

**LEARNING TASKS****CONTENT**

- Required gaps
- Fastening or wrapping fire stopping to pipes
- Sealing of vertical and horizontal penetrations
- Selection of sealants according to specifications

Line (GAC): F USE COMMUNICATION TECHNIQUES

Competency: F1 Use communication techniques

**Objectives**

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

- Describe effective communication practices.

LEARNING TASKS	CONTENT
1. Describe effective communication practices	<ul style="list-style-type: none"><li>• Liability<ul style="list-style-type: none"><li>o Gas Safety Act and safety regulations</li><li>o AHJ</li><li>o Codes and regulations</li><li>o Company requirements</li><li>o Architect</li><li>o Engineers</li><li>o Manufacturers requirements</li><li>o Fire Department per jurisdiction</li><li>o Health department</li><li>o WorkSafeBC</li><li>o Technical Safety BC (formerly BC Safety Authority)</li></ul></li><li>• Responsibilities<ul style="list-style-type: none"><li>o Employer</li><li>o Apprentice</li><li>o Client/end-user</li><li>o Installer/contractor</li><li>o Manufacturer</li><li>o Testing agencies</li></ul></li><li>• Verbal</li><li>• Non-verbal<ul style="list-style-type: none"><li>o Body language</li><li>o Signals</li></ul></li><li>• Active listening<ul style="list-style-type: none"><li>o Hearing</li><li>o Interpreting</li><li>o Reflecting</li><li>o Responding</li><li>o Paraphrasing</li></ul></li><li>• Learning styles<ul style="list-style-type: none"><li>o See (Visual)</li><li>o Hear (Audio)</li><li>o Try (Practical/Hands-on/Kinetic)</li></ul></li><li>• Workplace responsibilities</li></ul>

**LEARNING TASKS****CONTENT**

- o Personal
- o Attitude
- o Harassment
- o Discrimination
- o Supervisor
- o Human Resources (HR)
- Toolbox meetings
  - o Field Level Risk Assessment (FLRA)

Line (GAC): O **APPLY ELECTRICAL CONCEPTS**Competency: O1 **Use the principles of electricity****Objectives**

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

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

**LEARNING TASKS**

1. Describe the fundamentals of electricity

**CONTENT**

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

2. Describe electrical circuits

**LEARNING TASKS**

3. Use laws and formulas
4. Describe single-phase power characteristics
5. Describe three-phase power characteristics
6. Identify transformers

**CONTENT**

- o Closing and opening DC circuits
- AC circuits and measurements
  - o Inductance
  - o AC amperage
  - o Resistance
  - o Impedance
  - o Capacitance
  - o Power factor
- Fundamentals of magnetism
  - o Natural and artificial magnets
  - o Magnetic fields
  - o Strength of field
  - o Force on two wires
- Permeability
- Ohm's Law
- Kirchoff's Law
- Solve simple problems
- AC power distribution
  - o Generation and transmission Voltage drop
  - o Step-down transformer
- Power available
- Single-phase power supply
  - o 3-wire, dual voltage
- Circuit protection
  - o Fuses
  - o Circuit breakers
- AC power distribution
  - o Generation and transmission
  - o Voltage drop
  - o Step-down transformer
- Power available
- Three phase-power supply
  - o Delta
  - o Wye
- Type of transformers
  - o Step-up
  - o Step-down
  - o Isolation
- Primary winding
- Secondary winding

**LEARNING TASKS****CONTENT**

- Tappings

# **Level 2**

## **Plumber**

Line (GAC): **B USE TOOLS AND EQUIPMENT**Competency: **B7 Use technical instruments and testers****Objectives**

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

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

**LEARNING TASKS**

1. Describe pressure measuring tools

**CONTENT**

- Manometers
  - o Types
  - o Digital
  - o Slack tubed
  - o Incline
  - o Filing
  - o Fluids
  - o Calibration
  - o Differential
- Mechanical gauges
  - o Bourdon tube
  - o Compound
  - o Magnehelic gauge
  - o Differential gauge
- Gas pressures
  - o Standing line pressures
  - o Operating line pressures
  - o Gauge pressures
  - o Absolute pressures
  - o Conversion between different pressures
- Diagnostics
  - o Pressure tests
  - o Leak detection
- Code CSA B149.1
- Manufacturers' specifications
- Diagnostics
  - o Pressure tests
  - o Leak detection
- Tightness of closure
- Thermometer
- Pyrometer

2. Use manometers and mechanical gauges

3. Interpret pressure readings

4. Describe temperature measuring instruments

**LEARNING TASKS**

5. Use temperature measuring instruments
6. Describe electrical testing meters
7. Use electrical test meters
8. Use combustible gas indicator (CGI)

**CONTENT**

- Thermocouple
- Thermistor
- Scales
- Calibration
- Check readings
- Applications
- Types
  - Multimeter
  - Ammeter
  - Ohm-meter
  - Voltmeter
  - Microammeter
  - Milliammeter
- Check voltage
- Check current
- Check resistance
- Check for continuity
- Types
  - Electronic
  - Laser
  - Draeger
  - Flame ionization
- Applications

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**Competency: **C1 Use mathematics and science****Objectives**

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

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

**LEARNING TASKS**

1. Describe the chemistry of combustion

**CONTENT**

- Requirements for combustion
- Products of combustion
- Stoichiometric combustion
- Complete combustion
- Incomplete combustion
- Combustion yield formula

2. Calculate air requirements and products of combustion

- Air requirements
  - o Combustion
  - o Primary
  - o Secondary
  - o Excess
  - o Dilution
  - o Total
- Products of combustion
  - o  $\text{CO}_2$
  - o  $\text{H}_2\text{O}$
  - o  $\text{O}_2$
  - o  $\text{N}_2$

3. Describe draft

- Natural draft
  - o Buoyancy
  - o Temperature
  - o Height

- Terms
  - o Stack effect
  - o Stack draft
  - o Natural draft
  - o Chimney effect
- Mechanical draft

4. Describe the building as a system

- Negative air pressure
- Exhaust equipment
- Air supply equipment

**LEARNING TASKS****CONTENT**

- Building envelope
- Building ventilation
  - Air exchange equipment
- Regional location
- Type of building
- Code requirements
  - CSA B149.1
  - Building Code

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**Competency: **C2 Use manufacturer and supplier documentation****Objectives**

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

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

**LEARNING TASKS**

1. Describe manufacturer and supplier documentation
2. Source manufacturer documentation

**CONTENT**

- Types
  - o Tool and equipment documentation
  - o Safety and Data Sheets (SDS)
  - o System component documentation
  - o Proprietary product documentation
  - o Certification agencies
- Information
  - o Installation instructions and requirements
  - o Operation and maintenance manuals
  - o Product specifications
  - o Warranty information
  - o Appliance rating plates
- Manufacturer websites
- Search engines
- Archival sources
- On-site documentation
- Contact manufacturer
- Local agencies

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

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

- Interpret codes and standards for the National Plumbing Code (NPC).
- Interpret codes and standards for the CSA B149 Gas Code series.

LEARNING TASKS	CONTENT
1. Describe the application of codes and standards	<ul style="list-style-type: none"><li>• Design</li><li>• Planning</li><li>• Installation</li><li>• Maintenance</li><li>• Decommissioning</li></ul>
2. Identify environmental agencies associated with sewage disposal	<ul style="list-style-type: none"><li>• BC Health Department</li><li>• WorkSafeBC</li><li>• BC Water and Waste Association (BCWWA)</li><li>• BC Onsite Sewage Association (BCOSSA)</li><li>• Authority having jurisdiction (AHJ)</li></ul>
3. Describe the National Plumbing Code (NPC)	<ul style="list-style-type: none"><li>• Layout</li><li>• Sections</li><li>• Contents</li><li>• Index</li><li>• Appendices</li><li>• Tables</li><li>• Definitions</li><li>• Scope</li><li>• Revisions</li></ul>
4. Interpret the National Plumbing Code (NPC)	<ul style="list-style-type: none"><li>• Scope</li><li>• Reference publications</li><li>• Definitions</li><li>• General</li><li>• Appendices</li></ul>
5. Describe the CSA B149 Gas Code series	<ul style="list-style-type: none"><li>• CSA B149.1, CSA B149.2, CSA B149.3</li><li>• Layout</li><li>• Sections</li><li>• Contents</li><li>• Index</li><li>• Annexes</li></ul>

**LEARNING TASKS**

6. Interpret Sections of the B149.1 Gas Code

**CONTENT**

- Tables
- Definitions
- Scope
- Revisions
- Scope
- Reference publications
- Definitions
- General
- Piping and tubing systems, hose, and fittings
- Annexes A & B

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**Competency: **C4 Interpret drawings and specifications for piping system layout****Objectives**

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

- Identify types of drawings.
- Create a drainage, waste and vent (DWV) isometric projection to code requirements.
- Plan residential take-offs.

**LEARNING TASKS**

1. Identify types of drawings

**CONTENT**

- Types
  - o Architectural
  - o Structural
  - o Mechanical
  - o Electrical
  - o Shop
- Specification sheets
- Parts
  - o Plan
  - o Plot
  - o Foundation
  - o Floor
  - o Elevation
  - o Sections
  - o Details
  - o Title block
  - o Revisions
  - o Schedules
  - o Legends
- Information contained
  - o Building dimensions
  - o Construction type
  - o Room layout
  - o Fixture locations
  - o Finish details
- Symbols
- Conventions
- Safe work hazards
- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Routing
- Penetrations

2. Describe piping system layout

**LEARNING TASKS**

3. Create isometric drawings of a piping system

**CONTENT**

- Site conditions
- Materials
- Components
- Supports
- Tools and equipment
- Interference with other systems
  - Electrical
  - Ventilation
- Sprinkler
- Detail required
- Dimensioning
- Relevant information
- Lettering
- Line type
- Pipe sizing
- Terminology
- Lists, calculations and formulas
- Site considerations
- Measure
- Calculate
- Tools and equipment

4. Plan residential take-offs

5. Lay out piping systems

**Achievement Criteria**

Performance The learner will be able to:

- Create a drainage, waste and vent (DWV) isometric projection to code requirements
- Plan a residential take-off
- Lay out a piping system

Conditions The learner will be given:

- Drawing and specifications
- Tools and equipment
- Codes
- Standards

Criteria The learner will be evaluated on:

- Accuracy
- Neatness
- Code compliance

Line (GAC): E INSTALL PLUMBING FIXTURES AND APPLIANCES

Competency: E1 Install fixtures

**Objectives**

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

- Describe the installation of fixtures and trim.

**LEARNING TASKS**

1. Describe fixtures and trim
2. Describe the installation of fixtures and trim

**CONTENT**

- Types
- Applications
  - o Residential
  - o Commercial
  - o Institutional
  - o Materials and finishes
- Purpose
- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Layout
- Tools and equipment
- Supports
  - o Carriers
  - o Blocking
  - o Wall hangers
- Fasteners
- Caulking
- Barrier-free (accessibility) requirements and regulations
- Rough-ins
  - o Clearance
  - o Mounting
  - o Heights
- Assembly
- Adjustments
- Protection
- Levelling
- Connection to water distribution systems and drainage
- Coordination of connection of power

Line (GAC): **E** INSTALL PLUMBING FIXTURES AND APPLIANCESCompetency: **E2** Install appliances**Objectives**

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

- Describe the installation of appliances.

**LEARNING TASKS**

1. Describe appliances

2. Describe the installation of appliances

**CONTENT**

- Types
- Applications
  - o Residential
  - o Commercial
  - o Institutional
  - o Materials and finishes
- Purpose
- Codes and regulations
  - o AHJ
- Manufacturers' specifications
- Layout
- Protection during installation
- Tools and equipment
- Supports
- Rough-ins
  - o Clearance
  - o Mounting
  - o Heights
- Assembly
- Connection to water distribution systems and drainage
- Application of sealants
- Adjustment of settings
- Coordination of connection of power

Line (GAC): H INSTALL DRAINAGE, WASTE, AND VENT (DWV) SYSTEMS

Competency: H1 Install sanitary drainage systems

**Objectives**

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

- Interpret the National Plumbing Code (NPC) for DWV systems.
- Plan the layout of a commercial or institutional DWV system.
- Install piping and components for interior DWV systems.

**LEARNING TASKS**

1. Describe drainage, waste and vent (DWV) systems

**CONTENT**

- Terminology
  - National Plumbing Code (NPC)
- Parts of a drainage, waste and vent (DWV) system
  - Function
  - Applications
  - Components

2. Interpret Code requirements for parts of an interior drainage, waste and vent (DWV) system

- Types of piping
- Size
- Grades
- Fittings
  - Orientation
  - Prohibitions
- Traps
- Cleanouts
- Venting
- Hangers and supports
  - Spacing
  - Seismic
- Jointing practices

3. Plan the layout of an interior drainage, waste and vent (DWV) system

- Design
- Location of structure penetrations
- Routing
- Pipe supports

4. Install drainage, waste and vent (DWV) systems

- Safety
- Tools and equipment
- Determination of grades
- Installation of components
- Location of cleanouts
- Testing
- Inspection

**LEARNING TASKS**

5. Describe requirements of a trade-waste system

**CONTENT**

- Sealing of penetrations
- Application
- Interceptors
  - Types
  - Applications
  - Regulations
  - Venting
  - Manufacturers specifications
  - AHJ

**Achievement Criteria 1**

Performance The learner will be able to plan the layout of a commercial or institutional drainage, waste and vent (DWV) system.

Conditions The learner will be given:

- Specifications
- Schedule
- Drawings

Criteria The learner will be evaluated on:

- Code compliance
- Efficiency
- Accuracy

**Achievement Criteria 2**

Performance The learner will be able to install the drain, waste and vent (DWV) for a bathroom group.

Conditions The learner will be given:

- Specifications
- Tools and materials

Criteria The learner will be evaluated on:

- Accuracy
- Grade
- Piping support
- Code requirements
- Testing requirements

Line (GAC): H INSTALL DRAINAGE, WASTE, AND VENT (DWV) SYSTEMS

Competency: H2 Install storm drainage systems

**Objectives**

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

- Interpret code requirements for parts of storm drainage systems.
- Plan the layout of a storm drainage system.
- Describe the installation storm drainage systems.

**LEARNING TASKS**

1. Describe storm drainage systems

**CONTENT**

- Terminology
  - National Plumbing Code (NPC)
- Parts of a storm drainage system
  - Function
  - Applications
  - Components

2. Interpret code requirements for parts of storm drainage systems

- Types of piping
- Size
- Grades
- Fittings
  - Orientation
  - Prohibitions
- Traps
- Cleanouts
- Venting
- Hangers and supports
  - Spacing
  - Seismic
- Jointing practices
- Insulation

3. Plan the layout of a storm drainage system

- Location of structure penetrations
- Routing
- Pipe supports

4. Describe the installation of storm drainage systems

- Safety
- Tools and equipment
- Determination of grades
- Installation of components
- Location of cleanouts
- Testing
- Inspection
- Sealing of penetrations

**LEARNING TASKS**

5. Describe the placement and operation of sumps and catch basins
6. Describe subsoil drainage systems
7. Describe site-retention systems

**CONTENT**

- National Plumbing Code
  - AHJ
- Pumps
  - Operation
  - Safety
  - Alarms
  - Duplex
- Confined space requirements
- Purpose
- Material
- Perforation orientation
- Backwater valve
- Surcharge requirements
- Perimeter drain
- Backfilling
- Location
- Overflow to municipal
- Green technology
  - Grey water
  - Storage
  - Rainwater reclamation

**Line (GAC): H INSTALL DRAINAGE, WASTE, AND VENT (DWV) SYSTEMS**

**Competency: H3 Test sanitary and storm drainage systems**

### **Objectives**

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

- Describe the testing of sanitary and storm drainage systems.

#### **LEARNING TASKS**

1. Identify code requirements affecting the testing of sanitary and storm drainage systems
2. Describe the testing of sanitary and storm drainage systems

#### **CONTENT**

- National Plumbing Code
  - o AHJ
- Safety
- Equipment
- Procedure
- Duration
- Inspection
- Documentation

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L1 Interpret heating and cooling systems

**Objectives**

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

- Describe the operation of residential forced air systems.
- Describe the operation of hydronic heating systems.
- Calculate volumetric thermal expansion.
- Describe low pressure steam piping systems.

**LEARNING TASKS**

1. Describe the operation of residential forced-air systems

2. Describe the operation of residential hydronic heating systems

**CONTENT**

- Purpose
- Components
- Ducting configurations
  - o Supply air
  - o Return air
  - o Zoning
- Controls
- Balancing
- Codes and regulations
  - o AHJ
- Purpose
- Volumetric thermal expansion
  - o Expansion coefficients
  - o Temperature
  - o  $\Delta T$
  - o Volume
- Fluid fundamentals
  - o Volumetric coefficient differences
  - o Linear and volumetric expansion
  - o Viscosity
- Components
  - o Valves
    - Isolation
    - Service
    - Mixing
    - Zone
  - o Closed loops circulators
  - o Gauges and thermometers
  - o Heat transfer units
  - o Fan coil units
  - o Radiators

**LEARNING TASKS****CONTENT**

- o Radiant panels
- o Unit heaters
- o Termination heat pumps
- o In-floor heating
- o Force flow units
- o Perimeter radiation
- o Expansion tank
- o Air separator/eliminator
- o Zone headers
- o Air vents
- o Feed water
- o Water treatment
- o Backflow preventor
- Piping system configurations
  - o Zoning
  - o Hydraulic separation
    - Closely-spaced tees
    - Low-loss header
  - o Primary/secondary piping
  - o Supply water
  - o Return water
  - o Balancing
  - o High temperature
  - o Low temperature
  - o Mixing
- Process Flow Diagrams (PFD)
- Controls
- Heat transfer units
- Safety considerations
- Design
  - o Drawings and specifications
  - o Zoning
  - o Point of no pressure change
- Pipe sizing
- Heating generating equipment
  - o Boilers
  - o High mass
  - o Low mass
  - o Biomass
  - o Heat pumps
  - o Heat exchangers
  - o Solar panels
- Cooling generating equipment

**LEARNING TASKS**

3. Calculate volumetric thermal expansion

4. Describe low pressure steam piping systems

**CONTENT**

- o Cooling towers
- o Heat pumps
- o Fluid coolers
- o Chillers
- o Dirt elimination devices
- Auxiliary equipment
  - o Indirect fired hot water tanks
  - o Heat exchangers
  - o Make-up tanks
- Controls
- Fluids
  - o Water
  - o Chemical
  - o Brine solutions
- Additives
  - o Treatment chemicals
  - o Rust inhibitors
  - o Glycol
- Protection
  - o Piping
  - o Components
- Expansion coefficients
- Temperature
  - o  $\Delta T$
- Volume
- Types
  - o Counter flow
  - o One-pipe
  - o Two-pipe
  - o Two-pipe gravity return
  - o Subatmospheric
- Steam heating systems symbols
- Components

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L2 Install piping and components for hydronic systems

### Objectives

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

- Install piping for a hydronic system.

#### LEARNING TASKS

1. Install piping and components for hydronic systems

#### CONTENT

- Pipe routing
- High and low points
- Tools and equipment
- Jointing methods
- Grade/pitch
- Supports
- Expansion/Contraction
- Restraints
- Assembly

### Achievement Criteria

Performance The learner will be able to install piping for a hydronic system.

Conditions The learner will be given:

- Drawings and specifications
- Tools and materials

Criteria The learner will be evaluated on:

- Safety
- Accuracy
- Function

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L3 Install hydronic heating and cooling generating systems

**Objectives**

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

- Describe the installation of hydronic heat generating systems.
- Describe the installation of hydronic cooling generating systems.

**LEARNING TASKS**

1. Describe the installation of hydronic heat generating systems

**CONTENT**

- Codes and regulations
  - o AHJ
  - o Manufacturers' specifications
- Tools and equipment
- Heat source
- Components
- Circulating pumps
  - o ECM
  - o Variable Frequency Drive (VFD)
- Venting
- Fuel sources
- Layout
- Supports
- Restraints
  - o Vibration
  - o Seismic
- Trim
- Connections
  - o Pipe
  - o Flue
  - o Power
  - o Drainage
  - o Neutralizer

2. Describe the installation of hydronic cooling generating systems

- Codes and regulations
  - o AHJ
  - o Manufacturers' specifications
- Tools and equipment
- Cooling source
- Components
- Circulating pumps
  - o ECM
  - o VFD
- Venting

**LEARNING TASKS****CONTENT**

- Energy sources
- Layout
- Supports
- Restraints
  - Vibration
  - Seismic
- Trim
- Connections
  - Pipe
  - Condensate
  - Flue
  - Power
  - Drainage
  - Neutralizer

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L4 Install hydronic transfer units

**Objectives**

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

- Describe hydronic transfer units.
- Describe the installation of hydronic transfer units.

**LEARNING TASKS**

1. Describe hydronic transfer units

2. Describe the installation of hydronic transfer units

**CONTENT**

- Types
  - Convector
  - Forced convection
  - Radiant panels
  - Radiant/Convector (RC)
- Applications
  - Commercial
  - Residential
- Location
- Operating temperatures
- Codes and regulations
  - AHJ
  - Manufacturers' specifications
- Drawings and specifications
- Tools and equipment
- Jointing methods
- Supports
- Restraints
- Trim
- Connections
  - Pipe
  - Condensate
  - Power
- Protection
  - Mechanical damage
  - Seismic
  - Expansion/contraction

Line (GAC): P PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS

Competency: P3 Select gas-fired appliances

**Objectives**

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

- Describe gas-fired appliances.

**LEARNING TASKS**

1. Describe gas-fired appliances

**CONTENT**

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

# **Level 3**

## **Plumber**

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**Competency: **C3 Use codes, regulations, and standards****Objectives**

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

- Interpret the National Plumbing Code (NPC) Section 6 and related Appendix.
- Describe gas regulations.

**LEARNING TASKS**

1. Describe the National Plumbing Code (NPC)  
Section 6

**CONTENT**

- Water distribution systems
  - o Layout
  - o Sections
  - o Contents
  - o Index
  - o Appendices
  - o Tables
  - o Definitions
  - o Scope
  - o Revisions
- Water distribution systems
  - o Scope
  - o Reference publications
  - o Definitions
  - o General
  - o Appendices
- Role of Technical Safety BC (formerly BC Safety Authority [BCSA])
- Safety Standards Act
- Safety Standards General Regulations
- Gas Safety Regulations
- Permits
- Notification of Completion
- Approvals
- Variations to the National Gas Code
- Bulletins, Directives and Safety Orders

2. Interpret the National Plumbing Code (NPC)  
Section 6

- Water distribution systems
  - o Scope
  - o Reference publications
  - o Definitions
  - o General
  - o Appendices
- Role of Technical Safety BC (formerly BC Safety Authority [BCSA])
- Safety Standards Act
- Safety Standards General Regulations
- Gas Safety Regulations
- Permits
- Notification of Completion
- Approvals
- Variations to the National Gas Code
- Bulletins, Directives and Safety Orders

3. Describe gas regulations

- Role of Technical Safety BC (formerly BC Safety Authority [BCSA])
- Safety Standards Act
- Safety Standards General Regulations
- Gas Safety Regulations
- Permits
- Notification of Completion
- Approvals
- Variations to the National Gas Code
- Bulletins, Directives and Safety Orders

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**

Competency: **C4 Interpret drawings and specifications for piping system layout**

### Objectives

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

- Design drainage, waste and vent (DWV), water distribution and fuel gas distribution systems.

#### LEARNING TASKS

1. Design a drainage, waste and vent (DWV) system
2. Design a water distribution system
3. Design a fuel gas distribution system

#### CONTENT

- Soil and waste pipes
- Vents
- Service
- Distribution
- Supply
- 2 psig system
- Low pressure system

### Achievement Criteria

Performance The learner will be able to:

- Design a commercial or institutional drainage, waste and vent (DWV) system
- Design a water distribution system
- Design a fuel-gas distribution system

Conditions To be assessed during technical training.

The learner will be given:

- Floor plan and specifications
- Drafting paper

Criteria The learner will be evaluated on:

- Accuracy
- Neatness
- Code compliance

**Line (GAC): G INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMS**

**Competency: G1 Install piping for sewers**

**Objectives**

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

- Size pipe for sewers.
- Describe the installation of piping for sewers.

**LEARNING TASKS**

1. Describe sewers

**CONTENT**

- Types
  - o Storm
  - o Sanitary
  - o Combined
- Hazards
  - o Trenching
  - o Confined spaces
  - o Pinch points
  - o Hoists
  - o Air quality
- Components
- Applications
- Operations
- Hydraulic load
  - o Fixture units
  - o Litres per 15 minutes
- Codes
  - o Sizing tables
- Grades
- Pipe
  - o Types
  - o Sizing
  - o Routing
- Codes and regulations
  - o AHJ
- Drawings and specifications
  - o Engineering specifications
- Tools and equipment
- Fixtures
- Materials
- Components
- Benchmark
- Grade and elevation
- Layout

2. Size pipe for sewers

3. Describe the installation of piping for sewers

**LEARNING TASKS****CONTENT**

- Trenching/backfilling
- Support
- Protection
- Backflow prevention

Line (GAC): **G** INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMSCompetency: **G2** Install maintenance holes and catch basins**Objectives**

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

- Describe the installation of maintenance holes and catch basins.

**LEARNING TASKS**

1. Describe maintenance holes

**CONTENT**

- Types
  - o Indoor
  - o Outdoor
  - o Storm
  - o Sanitary
- Applications
- Types
  - o Lawn
  - o Driveway
  - o Patio
- Characteristics
- Applications
- Codes and regulations
  - o AHJ
  - o Applications
  - o Opening size
  - o Rungs/ladder placement
  - o Venting
  - o Lid seals
- Location/layout
- Grouting
- Grade
- Elevations
- Tools and equipment
- Materials
- Channelling
- Penetrations
- Protection
  - o Specifications
- Supports
- Codes and regulations
  - o AHJ
- Location/layout
- Grade

2. Describe catch basins

3. Describe the installation of maintenance holes

4. Describe the installation of catch basins

**LEARNING TASKS****CONTENT**

- Elevations
- Tools and equipment
- Materials
- Penetration seals
- Protection

Line (GAC): I INSTALL WATER SERVICES AND DISTRIBUTION SYSTEMS

Competency: I1 Install water services

**Objectives**

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

- Describe sizing for water service piping.
- Describe the installation water services.

**LEARNING TASKS**

1. Describe water services

**CONTENT**

- Terminology
- Types
- Characteristics
- Applications
- Components
- Equipment
- Codes and regulations
  - AHJ
- Protection methods
- Connections
- Irrigation

2. Describe sizing for water service piping

- Flow requirements
- Calculations
- Codes and regulations
  - Water service tables
  - AHJ
- Drawings and specifications
- System factors
  - Number of fixtures
  - Friction loss
  - Remote outlet
  - Elevations
  - System pressure
  - Flow
  - Velocity

3. Describe the installation of piping for water services

- Tools and equipment
  - Hot tapping
- Materials
- Fittings
- Components
- Supports
- Restraints
- Codes and regulations

**LEARNING TASKS****CONTENT**

- o AHJ
  - Drawings and specifications
  - Bedding and backfill
  - Elevations
  - Heat tracing
  - Insulation
  - Testing
  - Inspection

Line (GAC): I INSTALL WATER SERVICE AND DISTRIBUTION SYSTEMS

Competency: I2 Install potable water distribution systems

**Objectives**

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

- Interpret the National Plumbing Code (NPC) Section 6: Potable water systems.
- Size pipe for potable water service and distribution systems.
- Describe the installation of piping for potable water service and distribution systems.

**LEARNING TASKS**

1. Describe potable water service and distribution systems

**CONTENT**

- Types
  - o Public
  - o Private
  - o Residential
  - o Industrial, Commercial, Institutional (ICI)
- Terminology
- Characterisitscs
- Applications
  - o Pressure systems
- Codes and regulations
  - o AHJ
- Expansion joints
- Equipment
  - o Pumps
    - Booster
    - Re-circulation
  - o Valves
    - Pressure reducing
    - Isolation
    - Tempering
    - Automatic water connections
  - o Tanks
    - Hot water
    - Pressure
  - o Cross connection devices
  - o Water treatment
- Assemblies
- Fixtures
- Accessories
- Cross connection
- Pressure systems

**LEARNING TASKS**

<b>LEARNING TASKS</b>	<b>CONTENT</b>
	<ul style="list-style-type: none"> <li>• Heat tracing</li> </ul>
2. Interpret code requirements for parts of a potable water service and distribution system	<ul style="list-style-type: none"> <li>• Types of piping</li> <li>• Size</li> <li>• Fittings           <ul style="list-style-type: none"> <li>o Orientation</li> <li>o Prohibitions</li> </ul> </li> <li>• Hangers and supports           <ul style="list-style-type: none"> <li>o Spacing</li> <li>o Seismic</li> </ul> </li> <li>• Jointing practices</li> </ul>
3. Plan the layout of a potable water service and distribution systems	<ul style="list-style-type: none"> <li>• Design</li> <li>• Location of structure penetrations</li> <li>• Routing</li> <li>• Pipe supports</li> </ul>
4. Size pipe for potable water service and distribution systems	<ul style="list-style-type: none"> <li>• Codes and regulations           <ul style="list-style-type: none"> <li>o Tables               <ul style="list-style-type: none"> <li>– Simplified</li> <li>– Small building</li> <li>– Average pressure loss</li> </ul> </li> <li>o AHJ</li> </ul> </li> <li>• Drawings and specifications           <ul style="list-style-type: none"> <li>o Pressure requirements</li> </ul> </li> <li>• Calculations           <ul style="list-style-type: none"> <li>o Elevations/head loss</li> <li>o Friction loss</li> </ul> </li> <li>• System factors           <ul style="list-style-type: none"> <li>o Number of water service fixture units</li> <li>o Developed pipe length</li> <li>o Friction loss</li> <li>o Remote outlet</li> <li>o Available pressure</li> </ul> </li> </ul>
5. Describe the installation of piping for potable water service and distribution systems	<ul style="list-style-type: none"> <li>• Codes and regulations           <ul style="list-style-type: none"> <li>o AHJ</li> </ul> </li> <li>• Drawings and specifications           <ul style="list-style-type: none"> <li>o Layout               <ul style="list-style-type: none"> <li>– Routing</li> </ul> </li> </ul> </li> <li>• Site requirements</li> <li>• Tools and equipment</li> <li>• Sleeves</li> </ul>

**LEARNING TASKS****CONTENT**

- Supports
- Components
  - Piping
  - Fittings
  - Valves
  - Shock arrestors
  - Recirculating lines
  - Fire stopping
  - Cross connection control valves
  - Expansion tanks
- Protection
- Jointing
- Pipe identification

**Achievement Criteria**

Performance	The learner will be able to size a commercial potable water service and distribution system using the methods described in the National Plumbing Code (NPC).
Conditions	The learner will be given: <ul style="list-style-type: none"><li>• National Plumbing Code (NPC)</li><li>• Diagram of a potable water service and distribution system</li></ul>
Criteria	The learner will be evaluated on: <ul style="list-style-type: none"><li>• Accuracy</li><li>• Code compliance</li></ul>

**Line (GAC):** J **INSTALL CROSS CONNECTION CONTROL DEVICES AND ASSEMBLIES**

**Competency:** J1 **Install and test cross connection control devices and assemblies**

### Objectives

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

- Describe the installation of cross connection control devices and assemblies.
- Test cross connection control assemblies.

### LEARNING TASKS

1. Describe cross connection control

### CONTENT

- Hazards
  - o Minor, moderate, severe
- Assemblies
  - o Reduced pressure backflow preventer assembly (RPBA)
  - o Double check valve assembly (DCVA)
  - o Pressure Vacuum Breaker Assembly (PVBA)
  - o Air gap
- Devices
  - o Dual check valve
  - o Dual check valve backflow preventer with atmospheric port
  - o Dual check valve backflow preventer with vent
  - o Atmospheric vacuum breaker
  - o Hose connection vacuum breaker
  - o Laboratory faucet type vacuum breaker
- Inspection
- Methods
- Maintenance
  - o Calibration
  - o Annual verification
- Codes, regulations and permits
  - o AHJ
  - o NPC, Section 7: Non-Potable Water Systems
- Certification
- Hazard assessment
  - o Minor, moderate, severe
- Installation requirements
  - o Height

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

**LEARNING TASKS**

## 3. Test cross connection control assemblies

**CONTENT**

- o Location
- o Accessibility
- Codes, regulations and permits
  - o BCWWA
  - o AHJ
  - o National Plumbing Code (NPC)
- Tools and equipment
- Connections
- Pressures
- Inspection
- Testing
- Safe work practices
- Types
  - o Reduced Pressure Backflow Assembly (RPBA)
  - o Double-check Valve Assembly (DCVA)
  - o Pressure Vacuum Breaker Assembly (PVBA)
- Test procedures
- Purpose
- Minimum requirements
- Test frequency
- Documentation

**Achievement Criteria:**

Performance	The learner will be able to test cross-connection assemblies required for certification.
Conditions	To be assessed during technical training. The learner will be given: <ul style="list-style-type: none"><li>• Assemblies</li><li>• Test equipment</li><li>• Documentation</li></ul>
Criteria	The learner will be evaluated on: <ul style="list-style-type: none"><li>• Current accepted certification test procedures and equipment</li></ul>

**Line (GAC): J    INSTALL CROSS CONNECTION CONTROL DEVICES AND ASSEMBLIES**

**Competency: J2    Service cross connection controls and assemblies**

### **Objectives**

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

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

#### **LEARNING TASKS**

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

#### **CONTENT**

- Troubleshoot
  - o Isolation
  - o Assemblies
  - o Reduced pressure backflow preventer assembly (RPBA)
  - o Double check valve assembly (DCVA)
    - Pressure Vacuum Breaker Assembly (PVBA)
  - o Visual Inspection
  - o Verify component
- Repair or replace
  - o Safe work practices
  - o Tools and equipment
  - o Retest
  - o Return to service
  - o Documentation
  - o Codes, regulations and permits
  - o AHJ
  - o Inspection

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L2 Install piping and components for hydronic systems

**Objectives**

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

- Size piping and components for hydronic systems.
- Design a residential hot water radiant floor heating system.
- Describe sizing of piping and components for low-pressure steam systems.

**LEARNING TASKS**

1. Size piping and components for hydronic systems

**CONTENT**

- Load requirements
- Heat loss/gain calculations
- Codes and regulations
  - AHJ
- Manufacturers' specifications
- Drawings and specifications
- Expansion devices
  - Bladder
  - Diaphragm
  - Conventional air cushion
  - Open tank
- Circuit balancing valves
- Heating and cooling compatibility

2. Describe sizing of piping and components for low-pressure steam systems

- Load requirements
- Codes and regulations
  - AHJ
  - CSA B214
  - ASHRAE
- Components
- Pipe
  - Procedures
- Expansion/contraction

**Achievement Criteria**

Performance The learner will be able to design a residential hot water radiant floor heating system.

Conditions The learner will be given:

- Residential layout
- Design criteria
- Design materials

Criteria The learner will be evaluated on:

- Accuracy

- Procedure

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L5 Install hydronic system controls

**Objectives**

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

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

**LEARNING TASKS**

1. Describe switches

**CONTENT**

- Manual
- Temperature actuated
- Pressure actuated
- Liquid level actuated
- Flow
- Proximity/End

2. Describe relays

- Operation
- Ratings
- Contacts
  - Normally open
  - Normally closed

3. Select relays

- 120 volt coils
- 24 volt coils
- Ratings

4. Install relays

- Wiring base connections
- Symbols
- Terminal identification on wiring diagram
- Enclosures

5. Describe the principles of electrical controls

- Test equipment
- Circuit diagrams
- Symbols
- Electronic
- Electro-mechanical

6. Describe control systems for hydronic systems

- Types
- Boilers
- Zoning
  - Location of controls and sensors
- Priority systems
- Reset
  - Heat curves

**LEARNING TASKS****CONTENT**

- Circulators
- Multi-temperature systems
  - Control valves
  - Mixing
  - Diverting
  - Injection
- Purpose/operation

**Achievement Criteria**

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

Conditions To be assessed during technical training.

The learner will be given:

- Ladder diagram
- Double-pole, single-throw relay
- Power supply
- Switch
- Pump simulator (Load)
- Transformer

Criteria The learner will be evaluated on:

- Accuracy to the diagram
- Wiring techniques

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N1 Install piping for specialized systems

**Objectives**

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

- Describe irrigation systems.
- Describe compressed air systems.
- Describe green energy systems.
- Describe the installation of piping for compressed air systems.

**LEARNING TASKS**

1. Describe residential irrigation systems

**CONTENT**

- Safe work practices
- Types
  - o Residential
  - o Commercial
  - o Agricultural
- Codes and regulations
  - o AHJ
  - o National Plumbing Code of Canada (NPCC)
  - o BCWWA
- Design criteria
- Pipe types
- Cross-connection hazards
- Trenching
- Coordination with underground utilities
- Tools and equipment
- Service testing

2. Describe compressed air systems

- Safe work practices
- Hazards
- Pipe types
- Codes and regulations
  - o AHJ
  - o Vessel-specific
  - o ASME
- Piping arrangements
  - o Straight line
  - o Loop
- Tools and equipment
- Jointing methods
- Draining of moisture
- Compressors

**LEARNING TASKS**

3. Describe green energy systems

**CONTENT**

- o Types
- o Operation
- Safety devices
- Types
  - o Geothermal
  - o Solar thermal
  - o Grey water re-use
  - o Rainwater collection
- Codes and regulations
  - o AHJ
  - o LEED
  - o BCWWA
- Hazards
  - o Cross connection control issues
- Piping configurations
- Components
- Controls
- Applications
- Operation
- Sizing
  - o Measurements
  - o Calculations
  - o Manufacturer's documentation
  - o Engineered drawings
- Codes and regulations
  - o AHJ
  - o Vessel-specific
  - o ASME
- Pipe routing/configurations
- Tools and equipment
- Assembly
- Jointing methods
- Pitch and grade
- Supports
- Allowances
- Protection
  - o Mechanical damage
  - o Seismic activity
  - o Environmental conditions
- Structure penetration

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N2 Install equipment and components for specialized systems

**Objectives**

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

- Describe the installation of equipment for irrigation systems.
- Describe the installation of equipment for compressed air systems.
- Describe the installation of equipment for green energy systems.

**LEARNING TASKS**

1. Describe the installation of equipment for irrigation systems

**CONTENT**

- Safe work practices
- Codes and regulations
  - o AHJ
  - o National Plumbing Code of Canada (NPCC)
  - o BCWWA
- Equipment types
  - o Sprinkler heads
  - o Valve boxes
  - o Timers
  - o Pumps
  - o Solenoid valves
- Winterization considerations
  - o Grades
  - o Drainage points
  - o Purge points
- Tools and equipment
- Sprinkler head selection
- Equipment adjustment
  - o Patterns
- Timers
- Safe work practices
- Codes and regulations
  - o AHJ
  - o Vessel-specific
  - o ASME
- Components
  - o Air driers
  - o Flex-connectors
  - o Auto drains
  - o Pressure regulators
  - o Filters
- Compressors

2. Describe the installation of equipment for compressed air systems

**LEARNING TASKS**

3. Describe the installation of equipment for green energy systems

**CONTENT**

- Tools and equipment
- Vibration isolation
- Connection of equipment to piping
- Safe work practices
- Codes and regulations
  - AHJ
  - LEED
  - BCWWA
- Location
- High and low points
- Tools and equipment
- Pumps
- Cross connection
- Supports
- Fasteners
- Installation method
  - Manual
  - Mechanical
- Clearances
- Alignment and levelling
- Anchoring
- Controls

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N3 Test, commission, and service specialized systems

**Objectives**

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

- Describe the testing of irrigation, compressed air, and green energy systems.
- Describe the commissioning of irrigation, compressed air, and green energy systems.
- Describe the servicing of irrigation, compressed air, and green energy systems.

**LEARNING TASKS**

1. Describe the testing of specialized systems

**CONTENT**

- Safe work practices
  - o Lock-Out/Tag-Out (LOTO)
- Codes and regulations
  - o AHJ
- Visual pre-check
- Types
- Applications
- Tools and equipment
- Test medium
  - o Hydrostatic
  - o Compressed gases
- Components
- Procedures
  - o Filling
  - o Draining
  - o Purging
- Return to service
- Inspection
- Documentation

2. Describe the commissioning of specialized systems

- Safe work practices
- Codes, regulations and permits
  - o AHJ
  - o Manufacturer's documentation
- Sensory inspection
- Hazards
- Purging/venting
- Flushing
- Chemical treatment
  - o Disinfecting and sampling
- Commissioning equipment
- Electrical supply and connections
- Water supply

**LEARNING TASKS**

<b>LEARNING TASKS</b>	<b>CONTENT</b>
	<ul style="list-style-type: none"><li>• Load</li><li>• Codes</li><li>• Valves test</li><li>• Leak test</li><li>• Hydrostatic test</li></ul>
3. Describe maintenance procedures for specialized systems	<ul style="list-style-type: none"><li>• Schedules</li><li>• Sensory inspection</li><li>• Lubrication</li><li>• Chemicals</li><li>• Fluids</li><li>• Components</li><li>• Wear</li></ul>
4. Describe troubleshooting and repair procedures for specialized systems	<ul style="list-style-type: none"><li>• Safe work practices</li><li>• LOTO</li><li>• Verify reported problem</li><li>• Inspection/testing<ul style="list-style-type: none"><li>◦ Sensory</li><li>◦ Diagnostic</li><li>◦ Monitoring</li></ul></li><li>• Tools and equipment</li><li>• Isolate components</li><li>• Conditions for repair/replacement<ul style="list-style-type: none"><li>◦ Temperature</li><li>◦ Leaks</li><li>◦ Corrosion</li><li>◦ Control malfunction</li><li>◦ Vibration</li><li>◦ Irregular movement</li></ul></li><li>• Procedures<ul style="list-style-type: none"><li>◦ Isolation</li><li>◦ Inspection</li><li>◦ Cleaning</li><li>◦ Verify</li><li>◦ LOTO</li><li>◦ Flushing</li></ul></li><li>• Components<ul style="list-style-type: none"><li>◦ Gauges</li><li>◦ Controls</li><li>◦ Relief valves</li><li>◦ Flow control valves</li><li>◦ Reducing valves</li></ul></li></ul>

**LEARNING TASKS****CONTENT**

- Faults
  - Flow
  - Pressure
  - Velocity
- Causes
- Repair/replace components
- Return to service
- Documentation

Line (GAC): O **APPLY ELECTRICAL CONCEPTS**Competency: O2 **Use electrical wiring diagrams and schematics****Objectives**

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

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

**LEARNING TASKS**

1. Identify electrical diagrams

2. Sketch a circuit

3. Analyze simple circuits

4. Describe appliance circuits

**CONTENT**

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

**LEARNING TASKS**

5. Sketch a ladder diagram

**CONTENT**

- Pump/fan
- Control
- Sequence of operation
- Components
  - Line voltage
  - Control voltage
  - Function
  - Source
  - Switch
  - Load
  - Conductors

**Achievement Criteria**

Performance The learner will be able to sketch a:

- Series circuit
- Parallel circuit
- Ladder diagram

Conditions To be assessed during technical training.

The learner will be given:

- Drawings and specifications
- Sketching equipment

Criteria The learner will be evaluated on:

- Accuracy
- Neatness

Line (GAC): O **APPLY ELECTRICAL CONCEPTS**Competency: O5 **Apply wiring practices****Objectives**

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

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

**LEARNING TASKS**

1. Describe conductor components

**CONTENT**

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

2. Describe conductor installation

3. Describe conductor termination

Line (GAC): P PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS

Competency: P1 Size piping and tubing systems

**Objectives**

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

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

**LEARNING TASKS**

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

2. Describe natural gas fuel distribution systems

3. Describe piping, tubing, and hoses

**CONTENT**

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

**LEARNING TASKS****4. Size piping and tubing systems****CONTENT**

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

Line (GAC): **P** PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONSCompetency: **P4** Select flame safeguards**Objectives**

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

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

**LEARNING TASKS**

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

**CONTENT**

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

Line (GAC): P PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS

Competency: P5 Select burners

**Objectives**

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

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

**LEARNING TASKS**

1. Describe burners

**CONTENT**

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

2. Describe atmospheric burners

**LEARNING TASKS**

## 3. Describe burner orifices

**CONTENT**

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

Line (GAC): Q INSTALL GAS-FIRED SYSTEMS

Competency: Q1 Install piping and tubing systems

**Objectives**

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

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

**LEARNING TASKS**

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

**CONTENT**

- Code and regulations
  - o AHJ
- Manufacturers' specifications
- Types
- Methods
- Identification
- Procedures
- Fittings
- Valves
- Prohibited practice
- Location limitations
- Structural penetrations
  - o Fire stopping
- Drip or dirt pockets
- Between buildings
- Concealment
  - o Protection plates
  - o In concrete
- Protective coatings
- Underground
- Support
- Tools
- Connectors

# **Level 4**

## **Plumber**

Line (GAC): **C PERFORM ROUTINE TRADE ACTIVITIES**Competency: **C4 Interpret drawings and specifications for piping system layout****Objectives**

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

- Describe contractual documents and record management.

**LEARNING TASKS**

1. Describe contractual documents

**CONTENT**

- Purpose
- Types
  - o Agreements
  - o General conditions
  - o Drawings
  - o Specifications
  - o Master format
  - o Divisions
- General requirements
- Responsibilities and obligations
  - o Permits and requirements
  - o Guarantees/warranties
  - o Liability
  - o Tests and inspections
  - o Workmanship
- Change orders
- Paper-based filing
- Electronic filing
- Service reports
- Invoices
- Time sheets
- Purchase orders
- Vehicle logs
- Maintenance logs
- Inventory
- Permits
- Statements of completion

2. Describe record management

Line (GAC): E INSTALL PLUMBING FIXTURES AND APPLIANCES

Competency: E3 Commission and service fixtures and appliances

**Objectives**

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

- Describe the commissioning of fixtures and appliances.
- Describe the servicing of fixtures, trim and appliances.

**LEARNING TASKS**

1. Describe the commissioning of fixtures and appliances
2. Describe the servicing of fixtures, trim and appliances

**CONTENT**

- Tools and equipment
- System check/test
- Manufacturers' specifications
- Inspection
- Adjustments
- Documentation
- Inform end-user of operation
- Interpret client information
- Inspection
- Tools and equipment
- System check/test
- Manufacturers' specifications
- Isolation
- Clean/repair/replace
- Adjustments
- Return to service
- Verify operation
- Documentation

Line (GAC): **F USE COMMUNICATION TECHNIQUES**Competency: **F2 Use mentoring techniques****Objectives**

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

- Use mentoring techniques.

**LEARNING TASKS**

1. Describe effective mentoring techniques

**CONTENT**

- Verbal
  - o Tone
- Non-verbal
  - o Body language
  - o Signals/Cues
- Active listening
  - o Hearing
  - o Interpreting
  - o Reflectin/Mirroring
  - o Responding
  - o Paraphrasing/Summarizing
- Personal responsibilities
  - o Attitude
  - o Harassment
  - o Descrimination
  - o Audience-specific language

2. Describe learning strategies

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

Line (GAC): **G** INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMSCompetency: **G3** Test maintenance holes, catch basins, and piping for sewers**Objectives**

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

- Describe the testing of maintenance holes, catch basins, and piping for sewers.

**LEARNING TASKS**

1. Describe the testing of maintenance holes, catch basins, and piping for sewers

**CONTENT**

- Types
  - o Sensory
  - o Hydrostatic
  - o Smoke and air
  - o Mandrel
- Equipment
  - o Balloons
  - o Inflatable test balls
  - o Test plugs
  - o Mandrel
- Faults
  - o Cracks
  - o Corrosion
  - o Inadequate flow
  - o Piping failure
- Specifications, codes, and regulations
- Leak checks
- Return to service
- Documentation

Line (GAC): **G** INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMSCompetency: **G4** Service maintenance holes, catch basins, and piping for sewers**Objectives**

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

- Describe the servicing of maintenance holes, catch basins, and piping for sewers.

LEARNING TASKS	CONTENT
1. Describe maintenance procedures for maintenance holes, catch basins, and piping for sewers	<ul style="list-style-type: none"><li>• Inspection<ul style="list-style-type: none"><li>◦ Schedules</li></ul></li><li>• Testing<ul style="list-style-type: none"><li>◦ Smoke</li><li>◦ Cameras</li></ul></li><li>• Component verification</li><li>• Specifications, codes, and regulations</li><li>• Tools and equipment<ul style="list-style-type: none"><li>◦ Snakes</li><li>◦ Jetters</li><li>◦ Cameras</li><li>◦ Vacuum trucks</li></ul></li><li>• Isolation</li><li>• Return to service</li><li>• Documentation</li></ul>
2. Describe troubleshooting procedures for maintenance holes, catch basins, and piping for sewers	<ul style="list-style-type: none"><li>• Verify reported problem</li><li>• Safe work practices<ul style="list-style-type: none"><li>◦ Confined space</li><li>◦ Point of access</li><li>◦ Shoring</li></ul></li><li>• Inspection</li><li>• Component verification</li></ul>
3. Describe repair procedures maintenance holes, catch basins, and piping for sewers	<ul style="list-style-type: none"><li>• Tools and equipment</li><li>• Isolation</li><li>• Repair or replace components</li><li>• Testing</li><li>• Return to service</li><li>• Documentation</li></ul>

Line (GAC): **G** INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMSCompetency: **G5** Install sewage treatment systems and components**Objectives**

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

- Describe the installation of sewage treatment systems and components.

**LEARNING TASKS**

1. Describe private sewage disposal systems

**CONTENT**

- Purpose
- Operation
- Septic tank process
  - o Conditions
- Disposal field process
  - o Conditions
- Tanks
  - o Holding
  - o Septic
- Chambers
  - o Pump
  - o Siphon
- Codes and regulations
  - o B.C. Health Act
  - o Health Act Sewage Disposal Regulation
  - o On-site Sewage System Management
- Absorption field
- Limiting factors
  - o Soil conditions
    - Type
    - Structure
    - Percolation rates
  - o Property boundaries
  - o Water table elevation
  - o Proximity to potable water sources and courses
- Alternatives
  - o Lagoons
  - o Mounds
- Packaged sewage treatment plants
- Sewage volume calculations
- Pump sizing
- Plan preparation and submittal

**LEARNING TASKS**

2. Describe municipal sewage disposal systems and sewage treatment plants
3. Describe private sewage treatment system installation

**CONTENT**

- Purpose
- B.C. Health Act
- Codes and regulations
  - AHJ
- Site plan
- Permits
- Percolation tests
  - Procedure
  - Mandatory inspection of test
  - Maximum rate
- Components
  - Pumps
    - Float-switch settings
    - Control panel
    - Duplex
  - Controls
  - Distribution piping
  - Septic tanks
    - Location
    - Sizing
    - Elevation
  - Fields
    - Location
    - Sizing
    - Elevation
  - Distribution boxes
  - Bell and siphon
  - Tanks
    - Septic
    - Aeration
    - Holding
    - Pumping
- Soil conditions
- Bed preparation for tanks
- Lifting and hoisting
- Setting elevations
- Tools and equipment
- Positioning of components
- Application of gaskets and fittings

Line (GAC): **G** INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMS

Competency: **G6** Test sewage treatment systems and components

### Objectives

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

- Describe the testing of sewage treatments systems and components.

### LEARNING TASKS

1. Describe the testing of sewage treatment systems and components

### CONTENT

- Testing equipment
  - o Inflatable test balls
  - o Test plugs
  - o Compressed air
- System check
  - o Leaks
  - o Inadequate grade
- Specifications
- Pressure test
- Codes and regulations
- Sensory inspection
- Safe work practices

Line (GAC): **G** INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMSCompetency: **G7** Service sewage treatment systems and components**Objectives**

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

- Describe the servicing of sewage treatment systems and components.

**LEARNING TASKS**

1. Describe the maintenance of sewage treatment systems and components

**CONTENT**

- Schedules
- Pumping
- Inspection
- Component verification
- Specifications
- Tools and equipment
- Documentation
- Inspection
- Safe work practices
  - o Confined space
  - o Point of access
- Verification of reported problems
  - o Cause
  - o Result
- Faults
- Component verification
- Tools and equipment
- Isolation
- Return to service
- Documentation
- Safe work practices
  - o Confined space
  - o Point of access
- Tools and equipment
- Isolation
- Repair or replace components
- Testing
- Return to service
- Documentation

2. Describe troubleshooting procedures for sewage treatment systems and components

3. Describe the repair of sewage treatment systems and components

Line (GAC): **H** INSTALL DRAINAGE, WASTE, AND VENT (DWV) SYSTEMSCompetency: **H4** Service sanitary and storm drainage systems**Objectives**

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

- Describe the servicing of drainage, waste and vent (DWV) systems.

**LEARNING TASKS**

1. Describe the maintenance of drainage, waste and vent (DWV) systems
  - Manufacturer's literature
  - Pumps
  - Controls
  - Backwater valves
  - Baffles
  - Filters
  - Flow control devices
  - Strainer baskets
  - Interceptors
  - Drain cleaning equipment
    - Video inspection
      - Pipe locators
    - Drain augers
    - Water blasters
    - Steam cleaning
    - Shop vacuum

2. Describe troubleshooting and repair of drainage, waste and vent (DWV) systems
  - Inspection
  - Verification of reported problem
    - Cause
    - Result
  - Faults
    - Tree roots
    - Settling
    - Physical damage
    - Fats, oils, and grease
    - Pipe failure
    - Human error
  - Safe work practices
    - Confined space
    - Point of access
  - Test
  - Return to service

Line (GAC): I INSTALL WATER SERVICES AND DISTRIBUTION SYSTEMS

Competency: I3 Test, commission, and service water service and distribution systems

**Objectives**

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

- Describe the testing of water service and distribution systems.
- Describe the commissioning of water service and distribution systems.
- Describe the servicing of water service and distribution systems.

**LEARNING TASKS**

1. Describe the testing of water service and distribution systems

**CONTENT**

- Safe work practices
- Types
  - o Hydrostatic
  - o Compressed gas
- Tools and equipment
  - o Gauges
  - o Pumps
  - o Compressor
- Code and regulations
  - o AHJ
- Components
  - o Water meters
  - o Isolation valves
  - o Cross connection control devices
  - o Check valves
  - o Expansion devices
  - o Pumps
  - o Post-indicator valves
  - o Fire hydrants
- Inspection
- Documentation

2. Describe the commissioning of water service and distribution systems

- Pre-check
- Hazards
- Safe work practices
- Chemical treatment
- Purging
  - o Air
  - o Chemical
  - o Test water
- Flushing
- Commissioning equipment
- Start-up

**LEARNING TASKS**

3. Describe the maintenance of water service and distribution systems
  
4. Describe the troubleshooting and repair of water service and distribution systems

**CONTENT**

- o Permits
- o AHJ
- o Electrical supply and connections
  - Hot water tanks
  - Water treatment equipment
  - Pumps
  - Heat tracing
  - Water meters
- o Codes and regulations
- o AHJ
- o Manufacturer's documentation
- o Valves test
  - Cross connection control assemblies
- Pressure reducing valve (PRV) set points
- Maintenance schedules
- Inspection
- Component verification
- Specifications, codes, regulations
  - o AHJ
- Tools and equipment
- Isolation
- Testing
- Return to service
- Documentation
- Troubleshoot
  - o Verify reported problem
  - o Inspection
  - o Component verification
  - o Isolation
- Repair
  - o Safe work practices
    - Confined space
    - Point of access
    - Shoring
  - o Tools and equipment
  - o Isolation
  - o Repair or replace components
  - o Testing
  - o Return to service
  - o Documentation

Line (GAC): **K** INSTALL PRESSURE SYSTEMS

Competency: **K1** Install piping for pressure systems

### Objectives

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

- Size pressure systems and select a pump.
- Describe the installation of piping for pressure systems.

### LEARNING TASKS

1. Describe pressure systems

### CONTENT

- Types
  - o Shallow well
  - o Deep well
  - o Boosted system
- Terminology
- Purpose
- Requirements
  - o Pressure
  - o Demand
- Head pressure
- Friction loss
- Pumps
  - o Location
  - o Voltage and horsepower requirements
  - o Submersible
  - o Reciprocating
  - o Centrifugal
    - Jet
      - Shallow well
      - Deep well
    - o Installation procedures
- Torque arrestors
- Vibration isolation
- Connection methods
  - o Pitless adapter
  - o Well seals
- Components
  - o Drive point (screened)
  - o Check valves
  - o Strainers
  - o Ejectors
  - o Foot valves
  - o Venturi

**LEARNING TASKS****2. Size pressure systems****CONTENT**

- o Flow control valve
- o Pump support
  - Safety cable
- Heat tracing
- Pressure tanks
- Electrical
  - o Pumps
  - o Wiring
  - o Pressure switches
  - o Control panels
  - o Variable frequency drives (VFD)
  - o Electronically commutated motors (ECM)
- Calculations
  - o Peak flow demand
  - o Elevations and distances
  - o Total dynamic head
- Codes and regulations
  - o AHJ
- Drawings and specifications
  - o Manufacturers documentation
- Components
- Equipment
- Water source factors
  - o Well report
  - o Drawdown
    - Cone of depression
  - o Yield
  - o Depth
- Pump selection
- Layout/routing
  - o Environmental
  - o Site conditions
- Safe work practices
- Materials
- Components
- Tools and equipment
- Codes and regulations
  - o AHJ
- Drawings and specifications
- Connections

**LEARNING TASKS****CONTENT**

- Protection

**Achievement Criteria**

Performance The learner will be able to size a pressure system and select a pump.

Conditions The learner will be given:

- Drawing and specifications
- Pump performance curve
- Manufacturer's literature

Criteria The learner will be evaluated on:

- Accuracy

Line (GAC): **K** INSTALL PRESSURE SYSTEMS

Competency: **K2** Install equipment for pressure systems

### Objectives

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

- Describe the installation of equipment for pressure systems.

### LEARNING TASKS

1. Describe the installation of equipment for pressure systems

### CONTENT

- Safe work practices
- Codes and regulations
  - o AHJ
  - o Manufacturers' specifications
- Drawings and specifications
- Components
  - o Pressure tank
    - Diaphragm
    - Bladder
    - Steel (Air-over-water)
  - o Air volume control
  - o Pressure relief valve
  - o Pitless adapters
  - o Cables for removal
  - o Well seals
  - o Torque arrestor
  - o Electrical
  - o Pressure switch
  - o Load sensor
  - o Pump control
  - o Variable frequency drives (VFD)
  - o Electrically commutated motors (ECM)
- Tools and equipment
- Assembly
- Connection
  - o Power
  - o Controls
  - o Water
- Protection methods
  - o Pitless adapters
  - o Pump house
  - o Heat tracing

Line (GAC): K INSTALL PRESSURE SYSTEMS

Competency: K3 Test, commission, and service pressure systems

**Objectives**

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

- Describe the testing of pressure systems.
- Describe the commissioning of pressure systems.
- Describe the servicing of pressure systems.

**LEARNING TASKS**

1. Describe the testing of pressure systems

**CONTENT**

- Safe work practices
- Tools and equipment
- Types
  - Hydrostatic
  - Compressed gas
- Purging
- Apply test
- Procedures
  - Filling
  - Draining
- Faults
  - Electrical
  - Leaks
- Lock-out/tag-out (LOTO)
- Return to service
- Sensory inspection
- Documentation
- Commissioning equipment
- Visual inspection
- Hazards
- Purging
- Flushing
- Chemical treatment
  - Disinfecting and sampling
- Codes, regulations and permits
  - AHJ
- Manufacturer's documentation
- Electrical supply and connections
- Water supply
- Start-up
- Leak test

2. Describe commissioning and repair procedures for pressure systems

**LEARNING TASKS**

3. Describe maintenance procedures for pressure systems

**CONTENT**

- Documentation
- Client equipment education
- Schedules
- Sensory inspection
- Lubrication
- Chemicals
- Fluids
- Components
  - Pressure tanks
  - Pressure switch
  - Check valve
  - Pressure relief valve
  - Sensor lines
- Faults
  - Wear
  - Leaks
  - Noise
  - Corrosion
  - Electrical
- Safe work practices
- Tools and equipment
- Verify reported problem
- Inspection/testing
  - Sensory
  - Diagnostic
  - Monitoring
- Lock-out/tag-out
- Isolate components
- Conditions for repair/replacement
  - Wear
  - Leaks
  - Noise
  - Corrosion
  - Electrical faults
- Repair/replace components
- Test
- Return to service
- Documentation
- Safe work practices
- Tools and equipment
- Verify reported problem

4. Describe troubleshooting and repair procedures for pressure systems

**LEARNING TASKS****CONTENT**

- Inspection/testing
  - Sensory
  - Diagnostic
  - Monitoring
- Lock-out/tag-out
- Isolate components
- Conditions for repair/replacement
  - Wear
  - Leaks
  - Noise
  - Corrosion
  - Electrical faults
- Repair/replace components
- Test
- Return to service
- Documentation

**Line (GAC):** L **INSTALL HYDRONIC SYSTEMS**  
**Competency:** L6 **Test, commission, and service hydronic systems, components, and controls**

### Objectives

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

- Describe testing procedures for hydronic systems, components and controls.
- Use commissioning procedures for hydronic systems, components and controls.
- Describe servicing procedures for hydronic systems, components and controls.

### LEARNING TASKS

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

### CONTENT

Safe work practices

- o Lock-out/tag-out (LOTO)

- Codes and regulations
  - o AHJ
  - o Manufacturer's specifications
- Visual pre-check
- Sensory inspection
- Types
  - o Visual pre-check
  - o Sensory
  - o Pressure
  - o Thermal
- Tools and equipment
- Test medium
  - o Fluid
  - o Compressed air
  - o Inert gases
- Components
- Procedures
  - o Filling
  - o Draining
  - o Purging
- Return to service
- Documentation
- Design requirements
  - o Safety features
    - Limits
  - o Temperature drop
  - o System balancing
    - Flow rates (zones)
  - o Air flow (forced convector)
  - o Flow directions
  - o Control sequence

2. Apply commissioning procedures for hydronic systems, components, and controls

**LEARNING TASKS**

3. Describe the maintenance of hydronic systems, components and controls
4. Describe troubleshooting and repair procedures hydronic systems, components and controls

**CONTENT**

- Sensor checks
- o Piping configuration
- o Air removal
- o Cross connection controls
- o Make-up water line
- Manufacturers' specifications
- Schedules
- Sensory inspection
- Lubrication
- Fluids
- Components
  - o Wear
  - o Noise
- Leaks
- Client consultation
- Inspection/testing
  - o Sensory
  - o Diagnostic
  - o Monitoring
- LOTO
- Isolate components
- Conditions for repair/replacement
  - o Thermal anomalies
  - o Leaks
  - o Corrosion
  - o Control malfunction
  - o Vibration
  - o Irregular flow
  - o Air lock
- Tools and equipment
- Repair/replace components
- Return to service
- Documentation

**Achievement Criteria**

**Performance** The learner will be able to commission a circulator, expansion tank, and manifolds for an in-floor hydronic system.

**Conditions** The learner will be given:

- Drawings and specifications
- Tools and materials
- Piping arrangement

**Criteria** The learner will be evaluated on:

- Safety
- Accuracy
- Function

Line (GAC): M INSTALL WATER TREATMENT SYSTEMS

Competency: M1 Install water treatment equipment

**Objectives**

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

- Describe the sizing and installation of water treatment equipment.

**LEARNING TASKS**

1. Describe water treatment equipment

**CONTENT**

- Water quality
  - o Hardness
  - o Minerals
    - Iron
    - Calcium
    - Magnesium
    - Arsenic
  - o Hydrogen Sulfide (H<sub>2</sub>S)
  - o Methane
  - o Trihalomethane (THM)
  - o Contamination/pollution
  - o pH
  - o Taste/odour
  - o Turbidity
- Types
  - o Softeners (de-ionizer)
  - o Filters
    - Mechanical removal (screen)
    - Adsorption
  - o Potable water treatment
- Ionic exchange
  - o Water softeners
  - o Iron
  - o Tannins
- Neutralizing
- Reverse osmosis systems (RO)
- Ultra-violet (UV) disinfection
- Chemical feed
  - o Chlorination
  - o pH adjustment
- Distillation
- Characteristics
  - o Heat
  - o Pressure
- Operation

**LEARNING TASKS**

2. Describe the sizing of water treatment equipment
3. Describe the installation of water treatment equipment

**CONTENT**

- Water samples
  - Collection
  - Testing
  - Analysis
- Water demand
- Selection
  - Test results
  - Specifications
  - Space constraints
- Safe work practices
- Tools and equipment
- Cross connection requirements
- Installation sequence
- Appropriate drainage
- Codes and regulations
  - AHJ
  - Health codes (if applicable)
- Specifications and site conditions
- Assembly
- Levelling
- Restraints
- Connections
- Protection
  - Mechanical damage
  - Seismic activity
  - Environmental conditions

Line (GAC): M INSTALL WATER TREATMENT SYSTEMS

Competency: M2 Test, commission, and service water treatment equipment

**Objectives**

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

- Test and commission water treatment equipment.
- Describe the servicing of water treatment equipment.

**LEARNING TASKS**

1. Test and commission of water treatment equipment

**CONTENT**

- Safe work practices
- Testing equipment
  - o pH kits
  - o mineral kits
- Drawings and specifications
- Codes and regulations
  - o AHJ
  - o Manufacturers requirements
- Faults
  - o Leaks
  - o Inadequate operation
  - o Cracks
  - o Improper selection/sequence
- Inspection
- System verification
- Post-test
- Water samples
  - o Collection
  - o Testing
  - o Analysis
- Adjustments
- Commissioning equipment
- Service/regeneration intervals
- Client equipment operation eductaion
- Sensory inspection
- Replace Consumables
  - o Filters
  - o Regeneration materials
  - o Ultra-violet (UV) lamps
  - o Limestone chips
  - o Reverse-osmosis (RO) membrane
- Components
  - o Scale removal (distillers)

2. Describe maintenance procedures for water treatment equipment

**LEARNING TASKS**

3. Describe troubleshooting and repair procedures for water treatment equipment

**CONTENT**

- Cleaning
- Safe work practices
- Verify reported problem
- Tools and equipment
- Inspection/testing
  - Sensory
  - Diagnostic
  - Monitoring
- LOTO
- Isolate components
- Conditions for repair/replacement
  - Temperature
  - Leaks
  - Corrosion
  - Control malfunction
  - Vibration
  - Irregular movement
- Repair/replace components
- Return to service
- Documentation

**Achievement Criteria**

Performance The learner will be able to test a water sample.

Conditions The learner will be given:

- Water sample test kit
- Water samples

Criteria The learner will be evaluated on:

- Accuracy

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N1 Install piping for specialized systems

**Objectives**

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

- Describe the installation of medical gas piping systems.
- Describe process piping systems.

**LEARNING TASKS**

1. Describe medical gas systems

**CONTENT**

- Gas types
- Uses/purpose
- Sources of medical gas
  - o Storage
    - Bulk tanks
    - Cryogenic
    - Cylinders
  - o Compressors
- Accessory placement
- Equipment
  - o Vacuum pumps
  - o Air compressors
  - o Reserve systems
  - o Valves
  - o Alarms
- Safety features
- Relationships
  - o Owner
  - o Installer
  - o Third-party inspectors
- Layout
  - o Areas not permitted
  - o Service requirements for different areas
  - o Cross connection
  - o Location
  - o Limitations
- Safe work practices
- Codes and regulations
  - o AHJ
  - o CSA Z7396
- Tools and equipment
- Pipe types
- Hangers and supports

2. Describe the installation of medical gas piping systems

**LEARNING TASKS**

## 3. Describe process piping systems

**CONTENT**

- Jointing
- Cleaning and storing
- Material handling
- Cutting, fitting, brazing
- De-greasing
- Capping
- Certification requirements
  - CSA Z7396
- Purging
- Pressure testing
- Safe work practices
- System types and application
- Design criteria
  - AHJ
  - Engineered drawings
  - Code and regulations
- Piping materials
  - Application-specific
- Damage protection
  - Mechanical
  - Chemical
- Temperature
- Safe work practices
- Design criteria
- Components
  - Manometers
  - Fans
  - Tags
  - Termintation kit
  - Pipe and fittings
  - Condensation drains
  - Controls
- Testing
- Documentation

## 4. Describe radon mitigation systems

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N2 Install equipment and components for specialized systems

**Objectives**

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

- Describe the installation of medical gas equipment.

**LEARNING TASKS**

1. Describe the installation of medical gas equipment

**CONTENT**

- Codes and regulations
  - o AHJ
  - o CSA Z7396
- Equipment
  - o Vacuum pumps
  - o Air compressors
  - o Bulk systems
  - o Reserve systems
- Characteristics and requirements of equipment
  - o Zone valves
  - o Alarms
  - o Manifolds
    - Automatic changeover
- Accessories
  - o Pressure reducing valves
  - o Pressure relief valves
  - o Dew-point sensors
- Diameter Index Safety System (DISS)
- Pin Index Safety System (PISS)
- Tools and equipment
- Equipment pipe connection
- Pressure-testing equipment
- Alarm points

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N3 Test, commission, and service specialized systems

**Objectives**

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

- Describe testing for medical gas systems.
- Describe commissioning of medical gas systems.
- Describe maintenance procedures for medical gas systems.
- Describe troubleshooting and repair procedures for medical gas systems.

**LEARNING TASKS**

1. Describe testing for medical gas systems

**CONTENT**

- Types
  - o Cross connection
  - o Pressure
  - o Destructive
  - o Purity
  - o Flow
  - o Alarm
- Equipment
- Test medium
- Components
- Procedures
- Testing agencies
  - o Third-Party
- Lock-out/tag-out (LOTO)
- Return to service
- Documentation
- Codes and regulations
  - o AHJ
  - o CSA Z7396
- Manufacturer's documentation
- Permits
- Visual pre-check
- Safe work practices
- Purging
- Equipment
- Electrical supply and connections
- Tests
  - o Valves
  - o Leak
  - o Alarms
- Documentation

2. Describe the commissioning of medical gas systems

**LEARNING TASKS**

3. Describe maintenance procedures for medical gas systems
4. Describe troubleshooting and repair procedures for medical gas systems

**CONTENT**

- Codes and regulations
  - AHJ
  - CSA Z7396
- Schedules
- Sensory inspection
- Components
  - Lubrication
- Codes and regulations
  - AHJ
- Interpretation of operator information
- Inspection/testing
  - Sensory
  - Diagnostic
  - Monitoring
- Safe work practices
  - LOTO
- Tools and equipment
- Component isolation
- Conditions for repair/replacement
  - Temperature
  - Leaks
  - Corrosion
  - Control malfunction
  - Vibration
- Procedures
  - Cleaning
  - Open system protection and identification
- Component repair/replacement
- Return to service
- Documentation

Line (GAC): O **APPLY ELECTRICAL CONCEPTS**Competency: O3 **Apply single-phase motor theory****Objectives**

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

- Describe single-phase motors.

**LEARNING TASKS**

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

**CONTENT**

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

Line (GAC):      **O    APPLY ELECTRICAL CONCEPTS**

Competency:      **O4    Apply three phase motor theory**

### **Objectives**

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

- Describe three phase motors.

#### **LEARNING TASKS**

1.    Describe three phase motors

#### **CONTENT**

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

Line (GAC):      **O    Apply Electrical Concepts**

Competency:       **O6   Interpret the Canadian Electrical Code (CEC)**

### **Objectives**

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

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

### **LEARNING TASKS**

1. Describe the Canadian Electrical Code Part 1
2. Interpret the Electrical Safety Regulations
3. Size conductors
4. Describe wiring installation
5. Describe grounding and bonding techniques

### **CONTENT**

- Section
  - o 0,2,4,8,10,12
  - o Appendix B
  - o Appendix D
- Technical Safety BC (formerly BC Safety Authority [BCSA])
- Section 4 CEC
- Section 12 CEC
- Section 10 CEC

Line (GAC): P PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS

Competency: P2 Select regulators, valves, and valve train components

**Objectives**

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

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

**LEARNING TASKS**

1. Describe manual valves

**CONTENT**

- Types
  - o Plug valves
  - o Butterfly
  - o Ball valves
  - o Needle valves
- Construction
- Operation
- Pressure markings and ratings
- Maintenance

2. Describe automatic gas valves

- Electric
  - o Solenoid
  - o Diaphragm
  - o Combination
  - o Single stage
  - o Two stage
  - o Modulating
  - o Pilot safety
  - o Safety shut off
- Non-electric
  - o Rod and tube
  - o Hydraulic

3. Describe pressure regulators

- Types
  - o Appliances
  - o Line pressure
  - o Service
  - o Direct operated
- Operating elements
  - o Loading
  - o Measuring
  - o Restricting
- Pressure adjustment
  - o Gas line
  - o Manifold
- Parts

**LEARNING TASKS**

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

5. Describe the operation of a gas valve train

**CONTENT**

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

Line (GAC): P PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS

Competency: P6 Plan a project

**Objectives**

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

- Plan a residential piping installation.

**LEARNING TASKS**

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

**CONTENT**

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

**Achievement Criteria:**

Performance The learner will be able to:

- Plan a layout of a residential piping installation
- Sketch an isometric piping drawing
- Size the piping system
- Generate a tools and material list

Conditions The learner will be given:

- Residential floor plan with meter and appliance location
- Appliance model number

- Piping material
- Sketching equipment
- Delivery pressure

Criteria      The learner will be evaluated on:

- Material take-off
  - Accuracy
- Isometric drawing
  - Neatness
  - Accuracy
- Code compliance
  - Sizing
  - Hanger spacing
  - Valves
  - Drip legs
  - Swing joints
  - Pipe identification

Line (GAC): **Q** **INSTALL GAS-FIRED SYSTEMS**

Competency: **Q2** **Install regulators, valves and valve trains**

### Objectives

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

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

#### LEARNING TASKS

1. Describe the installation of manual shut-off valves
2. Describe the installation of pressure regulators

#### CONTENT

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

Line (GAC): **Q** **INSTALL GAS-FIRED SYSTEMS**Competency: **Q3** **Install air supply systems****Objectives**

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

- Describe installation of passive air supply systems.

**LEARNING TASKS**

1. Describe installation of passive air supply

**CONTENT**

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

Line (GAC): **Q** INSTALL GAS-FIRED SYSTEMSCompetency: **Q4** Commission fuel/air delivery systems**Objectives**

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

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

**LEARNING TASKS**

1. Describe piping and tubing testing requirements

**CONTENT**

- B149.1
- Pressure
- Duration
- Equipment
- Air
  - o Tools
  - o Equipment
  - o Spools
  - o System isolation
  - o Lock-out
- Inert gases
  - o Tools
  - o Equipment
  - o Spools
  - o System isolation
  - o Lock-out
  - o Calculations
- Leak (integrity) testing
  - o Soap test
  - o After appliance connection
- Valve tightness of closure testing
- Code requirements
  - o Locations
  - o Equipment
  - o Duration

2. Describe piping and tubing pressure testing procedures

3. Describe purging procedures for piping and tubing under 4 inch diameter

# **Section 4**

## **ASSESSMENT GUIDELINES**

**Assessment Guidelines – Level 1**
**Level 1 Grading Sheet: Subject Competency and Weightings**

PROGRAM: IN-SCHOOL TRAINING:		PLUMBER LEVEL 1	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	PERFORM SAFETY RELATED FUNCTIONS	15%	10%
B	USE TOOLS AND EQUIPMENT	10%	30%
C	PERFORM ROUTINE TRADE ACTIVITIES	40%	10%
D	PREPARE PIPING AND COMPONENTS	15%	50%
F	USE COMMUNICATION TECHNIQUES	5%	0%
O	APPLY ELECTRICAL CONCEPTS	15%	0%
	Total	100%	100%
In-school theory/practical subject competency weighting		70%	30%
Final in-school percentage score		IN-SCHOOL %	

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

**Assessment Guidelines – Level 2**
**Level 2 Grading Sheet: Subject Competency and Weightings**

PROGRAM: IN-SCHOOL TRAINING:		PLUMBER LEVEL 2	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
B	USE TOOLS AND EQUIPMENT	5%	0%
C	PERFORM ROUTINE TRADE ACTIVITIES	25%	40%
E	INSTALL PLUMBING FIXTURES AND APPLIANCES	15%	0%
H	INSTALL DRAINAGE, WASTE, AND VENT (DWV) SYSTEMS	30%	40%
L	INSTALL HYDRONIC SYSTEMS	15%	20%
P	PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS	10%	0%
	Total	100%	100%
In-school theory/practical subject competency weighting		75%	25%
Final in-school percentage score		IN-SCHOOL %	

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

**Assessment Guidelines – Level 3**
**Level 3 Grading Sheet: Subject Competency and Weightings**

PROGRAM: IN-SCHOOL TRAINING:		PLUMBER LEVEL 3	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
C	PERFORM ROUTINE TRADE ACTIVITIES	10%	20%
G	INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMS	5%	0%
I	INSTALL WATER SERVICES AND DISTRIBUTION SYSTEMS	15%	15%
J	INSTALL CROSS CONNECTION CONTROL DEVICES AND ASSEMBLIES	20%	35%
L	INSTALL HYDRONIC SYSTEMS	25%	20%
N	INSTALL SPECIALIZED SYSTEMS	5%	0%
O	APPLY ELECTRICAL CONCEPTS	5%	10%
P	PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS	10%	0%
Q	INSTALL GAS-FIRED SYSTEMS	5%	0%
	Total	100%	100%
In-school theory/practical subject competency weighting		80%	20%
Final in-school percentage score		IN-SCHOOL %	

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

## Assessment Guidelines – Level 4

### Level 4 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:		PLUMBER LEVEL 4	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
C	PERFORM ROUTINE TRADE ACTIVITIES	4%	0%
E	INSTALL PLUMBING FIXTURES AND APPLIANCES	4%	0%
F	USE COMMUNICATION TECHNIQUES	4%	0%
G	INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMS	10%	0%
H	INSTALL DRAINAGE, WASTE, AND VENT (DWV) SYSTEMS	4%	0%
I	INSTALL WATER SERVICES AND DISTRIBUTION SYSTEMS	4%	0%
K	INSTALL PRESSURE SYSTEMS	12%	25%
L	INSTALL HYDRONIC SYSTEMS	5%	25%
M	INSTALL WATER TREATMENT EQUIPMENT	12%	10%
N	INSTALL SPECIALIZED SYSTEMS	8%	0%
O	APPLY ELECTRICAL CONCEPTS	11%	0%
P	PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS	11%	40%
Q	INSTALL GAS-FIRED SYSTEMS	11%	0%
Total		100%	100%
In-school theory/practical subject competency weighting		85%	15%
Final in-school percentage score  Apprentices must achieve a minimum 70% as the final in-school percentage score to be eligible to write the Interprovincial Red Seal exam.		IN-SCHOOL %	

All apprentices who complete Level 4 of the Plumber program with a FINAL level mark of 70% or greater will write the Interprovincial Red Seal examination as their final assessment.

SkilledTradesBC will enter the apprentices Plumber Red Seal Interprovincial examination mark in SkilledTradesBC Portal. A minimum mark of 70% on the examination is required for a pass.

## **Section 5**

# **TRAINING PROVIDER STANDARDS**

## Facility Requirements

### Classroom Area

- 350 square feet of floor space (22 square feet per learner)
- Compliance with the local and National Fire Code of Canada and occupational safety requirements
- Meets applicable municipal zoning bylaws for technical instruction and education facilities
- Comfortable seating and tables suitable for learning
- Overhead and multimedia projectors and screen
- Whiteboard with marking pens and erasers
- Windows with shades or blinds
- Heating/air conditioning
- Lighting controls (windows and fixtures) for screen viewing
- Acoustics that allow audibility of the instructor

### Shop Area

- Minimum 3,000 square feet of shop area including a tool crib and work stations
- 10 foot ceiling height for shop and lab areas
- Adequate heating, lighting and ventilation
- Refuse and recycling bins
- First-aid equipment
- Shops will be equipped to support the practical lab exercises as outlined in this program outline

### Lab Requirements

- See shop area requirements

### Student Facilities

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

### Instructor's Office Space

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

## Tools and Equipment

### Shop (Facility) Tools and Equipment

#### *Hand Tools*

Angle finder	PEX tools
Bench, power vise (power driver pliers)	Pliers (lineman, locking, needle nose, water pump, groove, lock)
Bending tools (hand and hydraulic)	Plumb bob
Bolt cutter	Pry bars
Bolt die	Pumps (hand-operated: cistern, diaphragm, transfer)
Bolt tap	Ratchet
Brushes (utility, wire)	Saws (dry wall, hand, hack, hole, portable band, large band)
Bucket pump	Scratch awl
C-clamp	Screwdrivers (complete set)
Caulking gun	Shear
Centre punch	Shrink-fit device
Chain pipe tongs	Shovel
Chalk line	Socket set (imperial and metric)
Cold chisels	Spacing tool
Contour markers	Squares (regular, T, tri)
Drafting accessories	Strapping device
Files	Stud finder
Flaring tool	Stud punch
Flashlight	Swaging tool
Freeze pack	Tin snips
Gasket cutter	Tip cleaner
Hammers (ball-peen, chipping, sledge, soft-face, claw, rubber mallet, sledge)	Tube cleaner
Hand beveller	Tube benders
Hand groover	Vise-grip pliers
Hand threader	Wheel and bearing pullers
Hex keys	Wrap-around
Hole punch	Wrenches (adjustable/crescent, basin, chain, combination (open/closed end), faucet seat, hammer, non-spark, pin, pipe, spud, strap, torque)
Knife	
Marking tool	
Pick	
Pin punch	
Pinch bars	
Pipe cutters (single-wheel, multi-wheel)	
Pipe reamer (spiral, fluted)	
Pipe tap	
Pipe threader	
Pipe vises (chain and jokes, tri-stand and bench)	

#### *Power Tools*

Air compressor (and accessories)	Hydraulic jacks
Beveling tools (hand and electric drive)	Hydraulic torque wrench
Compaction equipment	Impact driver
Concrete cutter	Inspection cameras
Coring machines	Mini-grinder
Cryogenic equipment	Portable end-prep milling (pneumatic, electric)
Die grinder	Powder-actuated tools
Drain cleaning equipment	Pumps (booster, hydrostatic)
Drills (electric, pneumatic, hammer, bench or stand press, mag)	Rotary hammer
	Saws (band, chain, chop, circular, cut-off, jig)

Facing tool  
Generator  
Grinders (electric or pneumatic) angle, bench, die pedestal  
Grooving machine  
Heat gun  
Heat lamp  
Hydraulic flange spreaders

power hole, reciprocating, sabre)  
Steamer  
Task lighting equipment  
Telescopic boom  
Threading machine

***Welding, Cutting and Jointing Equipment***

Compressed gas cylinders (purge, shield cutting)  
Copper tube cutter  
Files  
Flaring tools  
Flashback arrestor  
Fusion tools  
Fusion welding equipment  
Gas powered cut-off  
Grooving machine  
Hand-operated oiler  
Hot air gun  
Hot tap equipment  
Hydraulic pipe cutter  
Mechanical crimper  
PEX crimper  
PEX pipe expander (manual and power)  
Pipe cutter  
Pipe groover  
Pipe reamer

Pipe roller  
Pipe stand  
Plastic tube cutters (set)  
Propane tiger torches (preheating)  
Ratchet cutter  
Regulator  
Snap cutter  
Striker  
Specialized assembly tools and equipment  
T-extracting tool  
Torches (oxy-fuel cutting, heating and welding)  
Tube bender  
Tube cutter  
Welding machines (SMAW)

***Measuring Tools***

Ampere probe  
Calculator  
Calipers  
Centre finder  
Chart recorders  
Dead weights  
Feeler gauge  
Gauges (temperature, pressure, liquid, vacuum, specialty)  
Geometry set  
Hydrostatic test pump  
Infrared temperature sensor

Levels (laser, standard, builder's (transit), digital (smart))  
Magnehelic gauge  
Measuring tape  
Manometers (incline, digital and u-tube)  
Micrometer  
Multimeter  
Plumb bob  
Rulers  
Squares (24 in. combination, flange straightedge)  
String line  
Thermometer

***Rigging and Hoisting Equipment***

Access equipment (Ladders, man/material lift (manual and power), scaffolding, scissor lift, stair cart)  
Beam clamps  
Beam trolleys  
Bridles  
Cable clips  
Cable puller  
Chain block hoist (endless chain)

Grip hoist (Tirfor®)  
Hooks  
Jacks (hydraulic, ram and piston)  
Plate clamp  
Rope (nylon, synthetic)  
Rubber  
Shackles  
Skid steer loader  
Slings (nylon, wire rope, wire mesh) and chokers

Chain puller	Snatch block
Come-along	Softeners
D-ring	Spreader bar
Dolly	Tag line
Equalizer beam	Tuggers (power)
Eye bolts	Winches
Forklift , telescopic forklift	

***Ladders and Platforms (Access Equipment)***

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

***Personal Protective and Safety Equipment***

Air quality tester	Hard hat
Arc flash protection	Health care and infectious control equipment
Barricades and caution tape	Hearing protection
Confined space equipment	Knee pads
Dust mask	Lock-out/tag out devices
Eye wash kit	Reflective vests
Face shield	Respiratory mask
Fire blanket	Rubber boots (CSA)
Fire extinguisher	Safety boots (CSA)
Fire resistant clothing	Safety glasses/goggles (CSA)
First aid kit	Safety harness, lanyard, and life line (CSA)
Gloves (industrial rubber, leather)	Welding helmet
Ground fault circuit interrupter	

***Testing, Measuring and Communication Equipment***

Ampere probe	Infrared temperature sensor
Calculator	Manometers (incline and digital)
Calipers	Markers
Centre finder	Micrometer
Chart recorders	Multimeter
Communication devices	Nitrogen bottles and regulators
Computer	Pipe locator
Crimp gauge	Refractometer
Dead weights	Scanning equipment
Draft gauge	Squares (24 in. combination, flange straightedge)
Drafting equipment	String line
Electronic leak detector	Test strips and kits
Feeler gauge	Thermal imager
Gauges (differential pressure and sight tube, temperature, pressure, liquid, vacuum, specialty)	Thermometer
GPS	
Groove depth tape	
Hand pump and accessories	

**Student Tools (supplied by student)*****Required***

- Calculator
- Safety boots
- Hard hat
- Safety glasses

***Recommended***

- N/A

## Reference Materials

### Required Reference Materials

- IPT's Pipe Trades Handbook, ISBN 978-0-920855-18-8
- WorkSafeBC Regulations (online), [www.worksafebc.com](http://www.worksafebc.com)
- Student Materials Package [www.crownpub.bc.ca](http://www.crownpub.bc.ca)
- CAN/ CSA B149.1 (current version)
- CAN/ CSA C22.1 (current version)
- Technical Safety BC (formerly BCSA) Safety Standards General Regulation
- Technical Safety BC (formerly BCSA) Gas Safety Regulation, (online), [www.technicalssafetybc.ca](http://www.technicalssafetybc.ca)
- Canadian Electrical Code (current version)
- Safety Standards Act

### Recommended Resources

- CSA Gas Trade Training Modules
- Low Pressure Boilers, Frederick M. Steingrass, Daryl R. Walker, American Technical Publishers, ISBN 978-0-8269-4365-1
- High Pressure Boilers, Frederick M. Steingrass, Harold J. Frost, Daryl R. Walker, American Technical Publishers, ISBN 978-0-8269-4315-6
- IPT's Guide to Blueprint Interpretation, ISBN: 978-0-920855-42-3
- CAN/ CSA B.214 Installation of Hydronic Heating Systems
- Modern Hydronic Heating – John Seigenthaler, ISBN-13- 978-1428335158
- Fundamentals of Gas Utilization – John Dutton, ISBN 978-0919852358
- Design of Fluid Systems – Spirax Sarco
- Electricity and Controls for HVAC-R – Herman/Sparkman, ISBN-13-978-1133278207

### Suggested Websites

- Technical Safety BC (formerly known as BC Safety Authority), [www.technicalssafetybc.ca](http://www.technicalssafetybc.ca)
- TECA, Thermal Environmental Comfort Association, [www.teca.ca](http://www.teca.ca)
- SkilledTradesBC, Industry Training Authority, [www.skilledtradesbc.ca](http://www.skilledtradesbc.ca)
- CSA, [www.csagroup.org](http://www.csagroup.org)
- Red Seal, [www.red-seal.ca](http://www.red-seal.ca)
- WorkSafeBC, [www.worksafebc.com](http://www.worksafebc.com)

#### NOTE:

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

## Instructor Requirements

### Occupation Qualification

The instructor must possess:

Plumber – Certificate of Qualification with Red Seal endorsement.

Additionally, all Plumber instructors delivering Red Seal Gasfitter - Class B content must possess **one** of the following:

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

### Work Experience

A minimum of 5 years experience working in the industry as a Plumber journeyperson after Red Seal certification.

### Instructional Experience and Education

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

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

# **Appendices**

## Appendix A Acronyms

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

<b>NBC</b>	National Building Code
<b>NEMA</b>	National Electrical Manufacturer's Association
<b>NFPA</b>	National Fire Protection Association
<b>NSPS</b>	New Source Performance Standards
<b>NRR</b>	Noise reduction rating number
<b>OHS</b>	Occupational Health and Safety
<b>OS&amp;Y</b>	Outside stem and yoke (valve)
<b>PLC</b>	Programmable logic controller
<b>PPE</b>	Personal protective equipment
<b>PRV</b>	Pressure reducing valve
<b>PTFI</b>	Pilot trial for ignition
<b>PVC</b>	Polyvinyl chloride
<b>RPM</b>	Revolutions per minute
<b>RTD</b>	Resistance temperature detector
<b>SCR</b>	Selective catalytic reduction
<b>TDG</b>	Transportation of dangerous goods
<b>TXV</b>	Thermostatic expansion valve
<b>UL</b>	Underwriters Laboratories
<b>ULC</b>	Underwriters Laboratories of Canada
<b>UST</b>	Underground storage tank
<b>VFD</b>	Variable frequency drive
<b>VSD</b>	Variable speed drive
<b>WHMIS</b>	Workplace Hazardous Materials Information System

## Appendix B

### Summary of Achievement Criteria

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

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

The following tables summarize the practical assessments for each level. **For details, please refer to the Achievement Criteria following the competency in the Program Content section.**

PLUMBER – LEVEL 1 SUMMARY OF ACHIEVEMENT CRITERIA	
SUBJECT COMPETENCY	ACHIEVEMENT CRITERIA TASK
A3 Perform Lock-Out and Tag-Out procedures	The learner will be able to perform electrical lock-out with verification.
B1 Use common tools and equipment	The learner will be able to establish 10 sights.
B3 Use rigging, hoisting, lifting, and positioning equipment	<p>The learner will be able to perform a manual lift.</p> <p>The learner will be able to identify and use the proper type of hoisting equipment to perform a lift.</p>
B5 Use soldering, brazing, and oxy-fuel equipment	The learner will be able to braze and solder.
B6 Use welding equipment	The learner will be able to bevel a pipe using grinding procedures.
C4 Interpret drawings and specifications for piping system layout	The learner will be able to create an isometric drawing of a basic piping arrangement.
D3 Install pipe	<p>The learner will be able to prepare, join, and install piping of the following types:</p> <ul style="list-style-type: none"> <li>• Plastic</li> <li>• Copper</li> <li>• Carbon steel</li> </ul>

**PLUMBER – LEVEL 2  
SUMMARY OF ACHIEVEMENT CRITERIA**

SUBJECT COMPETENCY		ACHIEVEMENT CRITERIA TASK
C4	Interpret drawings and specifications for piping system layout	<p>The learner will be able to:</p> <ul style="list-style-type: none"> <li>• Create a drainage, waste and vent (DWV) isometric projection to code requirements</li> <li>• Plan a residential take-off</li> <li>• Lay out a piping system</li> </ul>
H1	Install sanitary drainage systems	<p>The learner will be able to plan the layout of a commercial or institutional drainage, waste and vent (DWV) system.</p> <p>The learner will be able to install the drain, waste, and vent (DWV) for a bathroom group.</p>
L2	Install piping and components for a hydronic system	The learner will be able to install piping for a hydronic system.

**PLUMBER – LEVEL 3  
SUMMARY OF ACHIEVEMENT CRITERIA**

SUBJECT COMPETENCY		ACHIEVEMENT CRITERIA TASK
C4	Interpret drawings and specifications for piping system layout	<p>The learner will be able to:</p> <ul style="list-style-type: none"> <li>• Design a commercial or institutional drainage, waste and vent (DWV) system</li> <li>• Design a water distribution system</li> <li>• Design a fuel-gas distribution system</li> </ul>
I2	Install potable water distribution systems	The learner will be able to size a commercial potable water service and distribution system using the methods described in the National Plumbing Code (NPC).
J1	Install and test cross-connection control devices and assemblies	The learner will be able to test cross-connection assemblies required for certification.
L2	Install piping and components for a hydronic system	The learner will be able to design a residential hot water, radiant floor heating system.
L5	Install hydronic system controls	The learner will be able to install/wire a relay.
O2	Use electrical wiring diagrams and schematics	<p>The learner will be able to sketch a:</p> <ul style="list-style-type: none"> <li>• Series circuit</li> <li>• Parallel circuit</li> <li>• Ladder diagram</li> </ul>

**PLUMBER – LEVEL 4  
SUMMARY OF ACHIEVEMENT CRITERIA**

SUBJECT COMPETENCY	ACHIEVEMENT CRITERIA TASK
K1      Install piping for pressure systems	The learner will be able to size a pressure system and select a pump.
L6      Test, commission, and service hydronic systems, components and controls	The learner will be able to commission a circulator, expansion tank, and manifolds for an in-floor hydronic system.
M2      Test and commission water treatment equipment	The learner will be able to test a water sample.
P6      Plan a project	<p>The learner will be able to:</p> <ul style="list-style-type: none"> <li>• Plan a layout of a residential piping installation</li> <li>• Sketch an isometric piping drawing</li> <li>• Size the piping system</li> <li>• Generate a tools and material list</li> </ul>

## Appendix C Technical Safety BC Requirements

(in support of Gasfitter – Class B training)

### Gasfitter – Class B Exam administered by Technical Safety BC:

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

### Tools and Equipment

*(to be used in coordination with the program Tools and Equipment list in this Program Outline)*

#### Level One (Class B) Apprenticeship

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