SKILLEDTRADESBC

PROGRAM OUTLINE

Plumber

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PLUMBER

HARMONIZED PROGRAM OUTLINE

APPROVED BY INDUSTRY

SEPTEMBER 2017

BASED ON

RSOS 2016

Developed by
SkilledTradesBC
Province of British Columbia

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Section 1

INTRODUCTION

Plumber

Foreword

The revised Plumber Program Outline is intended as a guide for instructors, apprentices, and employers of apprentices as well as for the use of industry organizations, regulatory bodies, and provincial and federal governments. It reflects updated standards based on the new Plumber Red Seal Occupational Standard (2016) and British Columbia industry and instructor subject matter experts.

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

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

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

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

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

SAFETY ADVISORY

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

Acknowledgements

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

- Brad Heidman, UA Piping Industry College of BC
- David Dudska, Omega Mechanical
- Johnny Holm, Blue Mountain Services
- Paul Bach, PJB Mechanical
- Patrick Waunch, Rambow Mechanical
- Ray Thibault, Merit Mechanical

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

- Andrew Henderson, Pure Plumbing
- Dave Sewell, College of New Caledonia
- Ken Ford, Plumbing and Gas Inspector, City of Burnaby (Retired)
- Marty Old, Marty Old Consulting
- Mick Bryant, BC Institute of Technology

Facilitators:

- Angela Caughy
- Farrell Zecchel

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

How to Use this Document

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

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

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

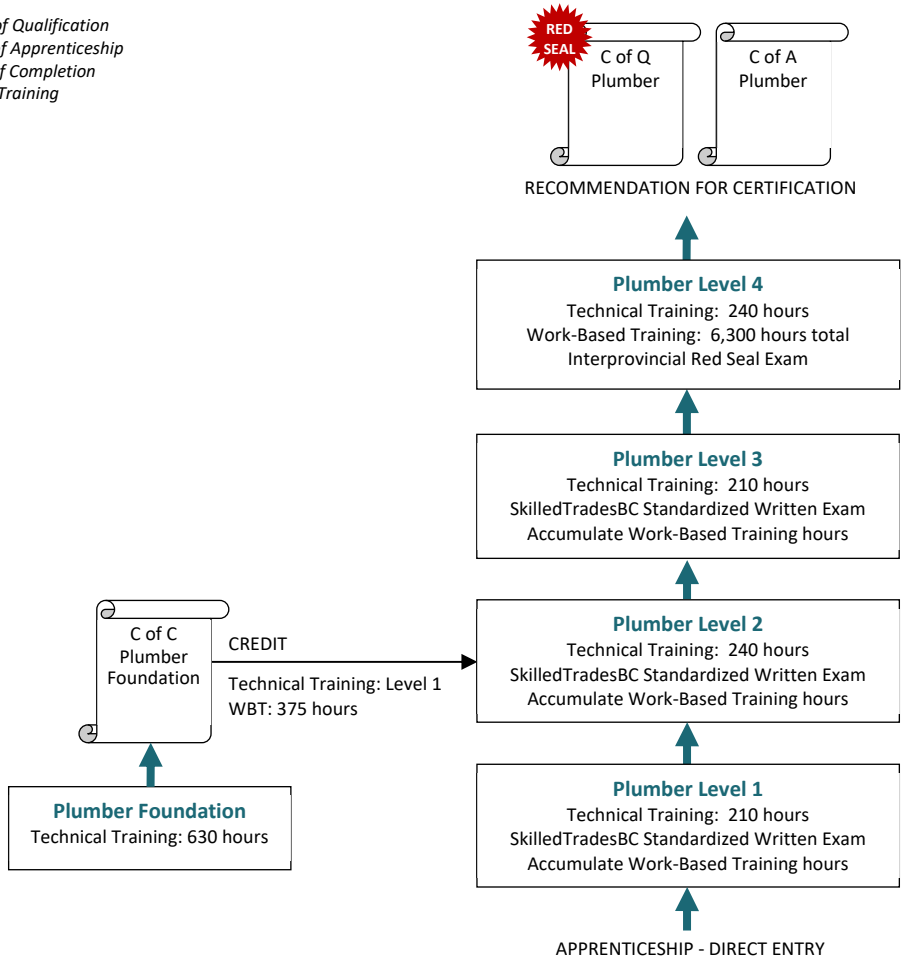
Section 2

PROGRAM OVERVIEW

Plumber

Program Credentialing Model

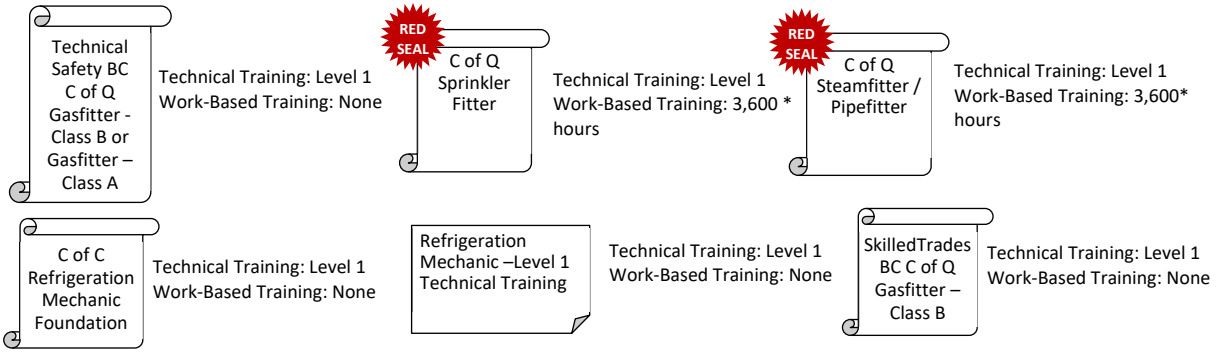
C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work-Based Training



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 up to 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

PERFORM SAFETY RELATED FUNCTIONS A	Maintains Safe Work Environment A1	Use Personal Protective Equipment (PPE) and Safety Equipment A2	Perform Lock-Out and Tag-Out Procedures A3	Practice Fire Prevention A4	
	1	1	1	1	
USE TOOLS AND EQUIPMENT B	Use Common Tools and Equipment B1	Use Access Equipment B2	Use Rigging, Hoisting, Lifting and Positioning Equipment B3	Rig Loads for Cranes B4	Use Soldering and Brazing Equipment B5	Use Oxy-Fuel Cutting Equipment B6
	1	1	1	1	1	1
	Use Welding Equipment B7	Use Technical Instruments and Testers B8				
	1	2				
PERFORM ROUTINE TRADE ACTIVITIES C	Use Mathematics and Science C1	Interpret Drawings and Specifications C2	Use Codes, Regulations and Standards C3	Use Manufacturer and Supplier Documentation C4	Perform Piping System Layout C5	
	1 2	1 2 3 4	1 2 3	2	2	

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PREPARE PIPING AND COMPONENTS D	Prepare Pipe D1	Join Tube, Tubing and Pipe D2	Install Pipe D3	Install Valves D4	Install Fittings D5	Penetrate Structures D6
	1	1	1	1	1	1
INSTALL PLUMBING FIXTURES AND APPLIANCES E	Install Fixtures E1	Install Appliances E2	Commission Fixtures and Appliances E3	Service Fixtures and Appliances E4		
	2	2	4	4		
USE COMMUNICATION TECHNIQUES F	Use Communication Techniques F1	Use Mentoring Techniques F2				
	1	4				
INSTALL SEWERS AND SEWAGE TREATMENT SYSTEMS G	Install Piping for Sewers G1	Install Manholes and Catch Basins G2	Test Manholes, Catch Basins and Piping for Sewers G3	Service Manholes, Catch Basins and Piping for Sewers G4	Install Sewage Treatment System Components G5	Test Sewage Treatment Systems and Components G6
	3	3	4	4	4	4
	Service Sewage Treatment Systems and Components G7					
	4					
INSTALL DRAINAGE, WASTE AND VENT (DWV) SYSTEMS H	Install Sanitary Drainage Systems H1	Install Storm Drainage Systems H2	Test Sanitary and Storm Drainage Systems H3	Service Sanitary and Storm Drainage Systems H4		
	2	2	2	4		
INSTALL WATER SERVICES AND DISTRIBUTION SYSTEMS I	Install Water Services I1	Install Potable Water Distribution Systems I2	Test Water Service Piping and Distribution Systems I3	Service Water Service and Distribution Systems I4	Commission Water Service and Distribution Systems I5	

**In compliance with Harmonized Sequencing, DWV has content in Level 3 in competency C2 – Drawings and Specifications*

			3					3						4					4	
INSTALL CROSS CONNECTION CONTROL DEVICES AND ASSEMBLIES **J**	Install and Test Cross Connection Control Devices and Assemblies J1					Service Cross Connection Controls and Assemblies J2														
			3					3												
INSTALL PRESSURE SYSTEMS **K**	Install Piping for Pressure Systems K1					Install Equipment for Pressure Systems K2					Test Pressure Systems K3					Service Pressure Systems K4					Commission Pressure Systems K5				
				4					4					4					4	
INSTALL HYDRONIC SYSTEMS **L**	Interpret Heating and Cooling Systems L1					Install Piping and Components for Hydronic Systems L2					Install Hydronic Heating and Cooling Generating Systems L3					Install Hydronic Transfer Units L4					Install Hydronic System Controls L5					Test Hydronic Systems, Components and Controls L6				
		2					2	3				2					2						3						4	
	Service Hydronic Systems, Components, and Controls L7					Commission Hydronic Systems, Components, and Controls L8																								
				4					4																					
INSTALL WATER TREATMENT EQUIPMENT **M**	Install Water Treatment Equipment M1					Test and Commission Water Treatment Equipment M2					Service Water Treatment Equipment M3																			
				4					4					4															
INSTALL SPECIALIZED SYSTEMS **N**	Install Piping for Specialized Systems N1					Install Equipment and Components for Specialized Systems N2					Test Specialized Systems N3					Service Specialized Systems N4					Commission Specialized Systems 5 N									
			3	4				3	4				3	4				3	4				3	4						

**Level 3 = Res. Irrigation, Green Systems & Compressed Air*

**Level 4 = Med. Gas & Process Pipe*

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APPLY ELECTRICAL CONCEPTS **O**	Use the Principles of Electricity O	Use Electrical Wiring Diagrams and Schematics O2	Apply Single Phase Motor Theory O3	Apply Three Phase Motor Theory O4	Apply Wiring Practices O5	Interpret the Canadian Electrical Code (CEC) O6
	1	3	4	4	3	4
PLAN GAS FIRED APPLIANCE SYSTEM INSTALLATIONS **P**	Size Piping and Tubing Systems P1	Select Regulators, Valves and Valve Train Components P2	Select Gas-Fired Appliances P3	Select Flame Safeguards P4	Select Burners P5	Plan a Project P6
	3	4	2	3	3	4
INSTALL GAS FIRED SYSTEMS **Q**	Install Piping and Tubing Systems Q1	Install Regulators, Valves and Valve Trains Q2	Install Air Supply Systems Q3	Commission Fuel/Air Delivery Systems Q4		
	3	4	4	4		

Training Topics and Suggested Time Allocation: Level 1

PLUMBER – LEVEL 1

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**Perform Safety Related Functions**	**6%**	**80%**	**20%**	**100%**
A1	Maintains Safe Work Environment		✓		
A2	Use Personal Protective Equipment (PPE) and Safety Equipment		✓		
A3	Perform Lock-Out and Tag-Out Procedures		✓	✓	
A4	Practice Fire Prevention		✓		
Line B	**Use Tools and Equipment**	**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 and Brazing Equipment		✓	✓	
B6	Use Oxy-Fuel Cutting Equipment		✓	✓	
B7	Use Welding Equipment		✓	✓	
Line C	**Perform Routine Trade Activities**	**43%**	**80%**	**20%**	**100%**
C1	Use Mathematics and Science		✓		
C2	Interpret Drawings and Specifications		✓	✓	
C3	Use Codes, Regulations and Standards		✓		
Line D	**Prepare Piping and Components**	**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		✓		
Line F	**Use Communication Techniques**	**1%**	**100%**	**0%**	**100%**
F1	Use Communication Techniques		✓		
Line O	**Apply Electrical Concepts**	**11%**	**100%**	**0%**	**100%**
O1	Use the Principles of Electricity		✓		
	Total Percentage for Plumber Level 1	**100%**			

Training Topics and Suggested Time Allocation: Level 2

PLUMBER – LEVEL 2

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line B	**Use Tools and Equipment**	**5%**	**80%**	**20%**	**100%**
B8	Use Technical Instruments and Testers		✓		
Line C	**Perform Routine Trade Activities**	**47%**	**80%**	**20%**	**100%**
C1	Use Mathematics and Science		✓		
C2	Interpret Drawings and Specifications		✓	✓	
C3	Use Codes, Regulations and Standards		✓	✓	
C4	Use Manufacturer and Supplier Documentation		✓		
C5	Perform Piping System Layout		✓	✓	
Line E	**Install Plumbing Fixtures and Appliances**	**8%**	**100%**	**0%**	**100%**
E1	Install Fixtures		✓		
E2	Install Appliances		✓		
Line H	**Install Drainage, Waste and Vent (DWV) Systems**	**24%**	**80%**	**20%**	**100%**
H1	Install Sanitary Drainage Systems		✓	✓	
H2	Install Storm Drainage Systems		✓		
H3	Test Sanitary and Storm Drainage Systems		✓		
Line L	**Install Hydronic Systems**	**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		✓		
Line P	**Plan Gas-Fired Appliance System Installations**	**5%**	**80%**	**20%**	**100%**
P3	Select Gas-Fired Appliances		✓		
	Total Percentage for Plumber Level 2	**100%**			

Training Topics and Suggested Time Allocation: Level 3

PLUMBER – LEVEL 3

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line C	**Perform Routine Trade Activities**	**16%**	**80%**	**20%**	**100%**
C2	Interpret Drawings and Specifications		✓	✓	
C3	Use Codes, Regulations and Standards		✓		
Line G	**Install Sewers and Sewage Treatment Systems**	**1%**	**100%**	**0%**	**100%**
G1	Install Piping for Sewers		✓		
G2	Install Manholes and Catch Basins		✓		
Line I	**Install Water Services and Distribution Systems**	**8%**	**90%**	**10%**	**100%**
I1	Install Water Services		✓		
I2	Install Potable Water Distribution Systems		✓	✓	
Line J	**Install Cross Connection Control Devices and Assemblies**	**20%**	**50%**	**50%**	**100%**
J1	Install and Test Cross Connection Control Devices and Assemblies		✓	✓	
J2	Service Cross Connection Control Devices and Assemblies		✓		
Line L	**Install Hydronic Systems**	**21%**	**70%**	**30%**	**100%**
L2	Install Piping and Components for Hydronic Systems		✓	✓	
L5	Install Hydronic System Controls		✓	✓	
Line N	**Install Specialized Systems**	**8%**	**100%**	**0%**	**100%**
N1	Install Piping for Specialized Systems		✓		
N2	Install Equipment and Components for Specialized Systems		✓		
N3	Test Specialized Systems		✓		
N4	Service Specialized Systems		✓		
N5	Commission Specialized Systems		✓		
Line O	**Apply Electrical Concepts**	**16%**	**50%**	**50%**	**100%**
O2	Use Electrical Wiring Diagrams and Schematics		✓	✓	
O5	Apply Wiring Practices		✓		
Line P	**Plan Gas-Fired Appliance System Installations**	**8%**	**100%**	**0%**	**100%**
P1	Size Piping and Tubing Systems		✓		
P4	Select Flame Safeguards		✓		
P5	Select Burners		✓		
Line Q	**Install Gas-Fired Systems**	**2%**			
Q1	Install Piping and Tubing Systems		✓		
	Total Percentage for Plumber Level 3	**100%**			

Training Topics and Suggested Time Allocation: Level 4

PLUMBER – LEVEL 4

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line C	**Perform Routine Trade Activities**	**5%**	**100%**	**0%**	**100%**
C2	Interpret Drawings and Specifications		✓		
Line E	**Install Plumbing Fixtures and Appliances**	**5%**	**100%**	**0%**	**100%**
E3	Commission Fixtures and Appliances		✓		
E4	Service Fixtures and Appliances		✓		
Line F	**Use Communication Techniques**	**1%**	**100%**	**0%**	**100%**
F2	Use Mentoring Techniques		✓		
Line G	**Install Sewers and Sewage Treatment Systems**	**7.5%**	**100%**	**0%**	**100%**
G3	Test Manholes, Catch Basins and Piping for Sewers		✓		
G4	Service Manholes, Catch Basins and Piping for Sewers		✓		
G5	Install Sewage Treatment System Components		✓		
G6	Test Sewage Treatment Systems and Components		✓		
G7	Service Sewage Treatment Systems and Components		✓		
Line H	**Install Drainage, Waste and Vent (DWV) Systems**	**3%**	**100%**	**0%**	**100%**
H4	Service Sanitary and Storm Drainage Systems		✓		
Line I	**Install Water Services and Distribution Systems**	**4.5%**	**90%**	**10%**	**100%**
I3	Test Water Service and Distribution Systems		✓		
I4	Service Water Service and Distribution Systems		✓		
I5	Commission Water Service and Distribution Systems		✓		
Line K	**Install Pressure Systems**	**9%**	**80%**	**20%**	**100%**
K1	Install Piping for Pressure Systems		✓	✓	
K2	Install Equipment for Pressure Systems		✓		
K3	Test Pressure Systems		✓		
K4	Service Pressure Systems		✓		
K5	Commission Pressure Systems		✓		
Line L	**Install Hydronic Systems**	**10%**	**70%**	**30%**	**100%**
L6	Test Hydronic Systems, Components and Controls		✓		
L7	Service Hydronic Systems, Components and Controls		✓		
L8	Commission Hydronic Systems, Components and Controls		✓		
Line M	**Install Water Treatment Equipment**	**10%**	**90%**	**10%**	**100%**
M1	Install Water Treatment Equipment		✓		
M2	Test and Commission Water Treatment Equipment		✓	✓	
M3	Service Water Treatment Equipment		✓		
Line N	**Install Specialized Systems**	**10%**	**100%**	**0%**	**100%**

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
N1	Install Piping for Specialized Systems		✓		
N2	Install Equipment and Components for Specialized Systems		✓		
N3	Test Specialized Systems		✓		
N4	Service Specialized Systems		✓		
N5	Commission Specialized Systems		✓		
Line O	**Apply Electrical Concepts**	**20%**	**100%**	**0%**	**100%**
O3	Apply Single Phase Motor Theory		✓		
O4	Apply Three Phase Motor Theory		✓		
O6	Interpret the Canadian Electrical Code (CEC)		✓		
Line P	**Plan Gas-Fired Appliance System Installations**	**7.5%**	**90%**	**10%**	**100%**
P2	Select Regulators, Valves and Valve Train Components		✓		
P6	Plan a Project		✓	✓	
Line Q	**Install Gas-Fired Systems**	**7.5%**	**100%**	**0%**	**100%**
Q2	Install Regulators, Valves and Valve Trains		✓		
Q3	Install Air Supply Systems		✓		
Q4	Commission Fuel/Air Delivery Systems		✓		
	Total Percentage for Plumber Level 4	**100%**			

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

LEARNING TASKS	CONTENT

	• Stressed cables
	  ○ Short term
	  ○ Long term
	  ○ Rigging
	  ○ Post-tension

2. Describe safety hazards when working at elevations	• Floor openings
	• Weather
	  ○ Wind
	  ○ Snow
	  ○ Lightning
	  ○ Rain
	• Access equipment

3. Describe safety precautions when working at elevations	• Fall restraint
	  ○ Guard rails
	  ○ Safety lines
	• Fall arrest
	• Personal Protective Equipment (PPE)

4. Manage workplace hazards	• Workplace Hazard Materials Identification System (WHMIS)
	  ○ Purpose
	  ○ Material Safety Data Sheets (MSDS)
	  ○ Labels
	  ○ Symbols
	  ○ Regulations
	• Transportation of Dangerous Goods (TDG)
	• Occupational Health and Safety (OHS) regulation
	  ○ Rights and responsibilities
	  ○ Inspections
	  ○ General conditions
	• WorkSafeBC standards
	  ○ Emergency shutoffs
	• Chemical hazard response
	  ○ Eyewash facilities
	  ○ Emergency shower
	• Evacuation plan
	  ○ Marshalling/mustering areas
	  ○ Emergency exits
	  ○ Emergency contact/phone numbers

LEARNING TASKS	CONTENT

5. Describe how site specific safety policies are established	• Standards, acts and regulations
	• Hazard assessment
	  ○ Safety policy
	  ○ Site conditions
	• Types of meetings
	  ○ Tool box
	  ○ Safety committee

Achievement Criteria (Workplace)

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

Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS

Competency: A2 Use Personal Protective Equipment (PPE) and Safety Equipment

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe Personal Protective Equipment (PPE)	• Safety footwear
	• Eye protection
	• Ear protection
	• Head protection
	• Respiratory protection
	  ○ Positive pressure
	  ○ Negative pressure
	• Clothing
	  ○ High visibility workwear
	  ○ Sun protection factor (SPF)
	  ○ Gloves
	  ○ Fall protection

2. Describe safety equipment	• Types
	  ○ Fire extinguishers
	  ○ First-aid
	  ○ Ventilation
	  ○ Screens
	• Procedures
	• Storage
	• Limitations
	• Standards, acts and regulations

3. Use Personal Protective Equipment (PPE)	• Purpose
	• Selection
	• Operating procedures
	• Training requirements
	  ○ WorkSafeBC requirements
	  ○ Job site requirements
	• Inspection
	• Maintenance
	• Storage

Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS

Competency: A3 Perform Lock-Out and Tag-Out 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	CONTENT
1. Identify energy sources	• Electricity • Pressure • Kinetic

2. Describe lock-out and tag-out	• Understanding of system operation
	• Components requiring lock-out
	• Situations where lock-out is required
	• Lock-out equipment
	  ○ Locks
	  ○ Tags
	  – Identification requirements
	  ○ Chains
	  ○ Support blocks
	  ○ Blind flanges
	  ○ Spades
	  ○ Spectacle blinds

3. Use lock-out and tag-out procedures	• Procedures
	• Zero energy state
	  ○ Disconnect
	  ○ Depressurize
	  ○ Isolate
	• Lock-out
	• Tag-out
	• Test

Achievement Criteria

Performance Conditions	The learner will be able to perform electrical lock-out with verification. 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	CONTENT
1. Describe the conditions necessary to support a fire	• Air • Fuel • Heat
2. Describe the classes of fires according to the materials being burned	• Class A • Class B • Class C • Class D • Symbols and colours

3. Apply preventative fire safety precautions	• Hot work permit (site specific)
	• Handling and storage of flammable materials
	• Symbols
	• Fuels
	  ○ Diesel
	  ○ Gasoline
	  ○ Propane
	  ○ Natural Gas
	• Ventilation, including purging
	• Lubricants
	• Oily rags
	• Combustible metals
	• Aerosols
	• Fire extinguisher
	  ○ Expiry date
	  ○ Fill level

4. Describe the considerations and steps to be taken prior to fighting a fire	• Warning others and fire department • Evacuation of others • Fire contained and not spreading • Personal method of egress • Training

5. Describe the procedure for using a fire extinguisher	• Extinguisher selection
	• P.A.S.S.
	  ○ Pull
	  ○ Aim
	  ○ Squeeze
	  ○ Sweep

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B1 Use Common Tools and Equipment

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe hand tools	• Wrenches
	• Pliers
	• Screwdrivers
	• Cutting tools
	• Measuring and marking tools
	• Bracing and securing tools
	• Hammering tools
	• Leveling 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

2. Describe portable power tools	• Types
	  ○ Electric
	  ○ Pneumatic
	• Cutting tools
	• Grinding and abrasive tools
	• Threading tools
	• Drilling, boring and coring tools
	• Grooving tools
	• Specialty tools
	  ○ Fusion tools
	  ○ Pressing tool (Pro press™)
	  ○ Extruded T (T-Drill™)
	• Accessories

LEARNING TASKS	CONTENT
3. Describe stationary power tools	• 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
	  ○ Analog
	  ○ Digital
	  ○ Standard
	  ○ Compound

5. Use hand tools and equipment	• Types • Parts • Applications • Procedures • Safety • Adjustment • Inspection • Maintenance • Storage
6. Use leveling equipment to establish elevations	• Grade and pitch calculations • Procedures • Manufacturers' specfications • Inspection • Adjustment • Maintenance • Storage

Achievement Criteria

Performance	The learner will be able to establish 10 sights.
Conditions	To be assessed during technical training. The learner will be given: • Sights • Specifications • Leveling 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	CONTENT

1. Describe ladders and elevated platforms	• Types
	  ○ Ladders
	  ○ Platforms
	  ○ Lifts
	  ○ Aerial Work Platform (AWP)
	• Applications
	• Safety
	  ○ Fall arrest equipment
	  ○ Fall restraint equipment
	  ○ Hazard recognition
	• Standards, acts and regulations
	• Site certification requirements
	  ○ Equipment certifications
	  ○ Employer responsibilities

2. Use ladders and elevated platforms	• Selection • Operating procedures • Limitations • Securing • Inspection • Maintenance • Storage

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B3 Use Rigging, Hoisting, Lifting and Positioning Equipment

Objectives

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

- Use hoisting, lifting and rigging equipment

LEARNING TASKS	CONTENT

1. Describe lifting and hoisting	• Principles
	  ○ Mechanical advantage
	  ○ Balance points
	  ○ Safety
	  ○ Estimation of weights
	  ○ Equipment capacities
	  ○ Equipment selection
	  ○ Lifting location
	  ○ Operating procedures
	  ○ Communication/hand signals
	  ○ Securing of loads
	• Certification requirements
	• Lift plan

2. Describe lifting and hoisting equipment	• Boom trucks • Chain falls • Come-alongs • Cranes • Loaders • Tirfors • Tuggers • Inspection • Maintenance
3. Describe rigging equipment	• Chains • Shackles • Slings/chokes • Snatch blocks • Softeners • Spreader bars • Tag lines • Turnbuckles • Storage • Inspection • Disposal • Maintenance

LEARNING TASKS	CONTENT
4. Describe lifting and hoisting communication	• Hand signals • Audible signals • Communication with the operator • Communication with others

5. Select slings	• Load
	  ○ Load factor labels
	• Application
	  ○ Sling angles
	  ○ Sling lengths

6. Tie knots, bends and hitches	• Types
	  ○ Bowline
	  ○ Bowline on a bight
	  ○ Cat's paw
	  ○ Clove hitch
	  ○ Figure eight
	  ○ Half hitch
	  ○ Reef knot
	  ○ Rolling hitch
	  ○ Sheet bend
	  ○ Timber hitch
	  ○ Trucker's hitch
	• Purposes
	• Limitations

7. Use hoisting, lifting and rigging equipment	• Safety
	• Working load limit (WLL)
	• Lift plan
	• Communication/hand signals
	• Securing of loads
	  ○ Pre lift
	  ○ Post lift
	• Inspection
	• Maintenance
	• Storage
	• Disposal

Achievement Criteria

Performance — The learner will be able to:

- Perform a manual lift.
- Identify and use the proper type of hoisting equipment to perform a lift.

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

- Tools and equipment
- Pre-calculated lift plan

Criteria

Manual lift - the learner will be evaluated on:

- Personal Protective Equipment (PPE) selection
- Correct body position
- Centre of gravity
- Block and store

Hoisted lift - the learner will be evaluated on:

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

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B4 Rig Loads for Cranes

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe crane procedures	• Knowledge of crane components
	• Load charts
	• Outriggers
	• Walk-around inspection
	• Hazards during rigging
	  ○ Ensuring load stability
	  ○ Cribbing
	• Limitations

2. Secure loads for rigging removal	• Guy wires • Come-alongs • Lashing • Welding • Suspending loads for subsequent placement

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B5 Use Soldering and Brazing 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	CONTENT

1. Describe the brazing process	• Principles
	• Applications
	• Filler alloys
	• Equipment
	• Safety requirements
	  ○ Fire protection equipment
	  ○ Ventilation

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 • Spark arrestors • 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
	  ○ Tip selection
	  ○ Alloy selection
	  ○ Flux selection
	  ○ Flux removal

Achievement Criteria

Performance	The learner will be able to braze and solder.
Conditions	To be assessed during technical training. The learner will be given:

- Materials
- Tools and equipment
- Specifications/drawings

Criteria The learner will be evaluated on:

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

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B6 Use Oxy-Fuel Cutting Equipment

Objectives

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

- Use Oxy-Fuel cutting equipment.

LEARNING TASKS	CONTENT
1. Describe Oxy-Fuel cutting equipment and applications	• Regulators • Flashback arrestors • Hoses • Torches • Torch attachments • Tips • Inspection • Maintenance • Storage
2. Describe fuel gas precautions and procedures	• Characteristics • Delivery systems • Cylinder handling and storage • Hazards • Fire prevention equipment • Hot work permit

3. Use Oxy-Fuel cutting equipment	• Set-up procedures
	  ○ Leak test
	• Safe operating practices
	  ○ Personal Protective Equipment (PPE)
	  ○ Flashback prevention
	  ○ Ventilation
	• Flame temperatures
	• Techniques
	• Delivery system removal and storage

Achievement Criteria

Performance	The learner will be able to cut a pipe bevel with Oxy-Fuel equipment
Conditions	To be assessed during technical training. The learner will be given: • Materials • Tools and equipment • Specifications/drawings
Criteria	The learner will be evaluated on: • Set-up/shut down • Technique • Accuracy • Appearance

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B7 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.
- Use a grinder.

LEARNING TASKS	CONTENT

1. Describe safety requirements and precautions for arc welding	• Personal Protective Equipment (PPE)
	  ○ Eye protection
	  ○ Welding helmets
	  ○ Hearing protection
	  ○ Radiation protection
	  ○ Respiratory protection
	• Electric shock
	• Fire and explosion prevention
	• Ventilation

2. Identify welding types, positions, joints and symbols	• 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

3. Describe the arc welding process and equipment	• Arc welding circuit • AC and DC power sources

LEARNING TASKS	CONTENT
	• Electrode holders • Ground clamps • Welding cables • Grinders • Consumables • Maintenance • Storage
4. Use arc welding equipment	• Set-up • Grinders • Amperage adjustment • Polarity selection • Weld faults • Distortion control • Shut down • Maintenance

Achievement Criteria

Performance	The learner will be able to bevel a pipe using grinding procedures.
Conditions	To be assessed during technical training. 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	CONTENT
1. Apply calculator functions to trade related equations	• Whole numbers • Fractions • Decimals • Percentages
2. Use formulas to calculate area	• Cross sectional area of pipe
3. Use formulas to calculate volumes	• Cylinders • Rectangular tanks
4. Use formulas to calculate capacity	• Imperial gallons • US gallons • Litres
5. Transpose formulas	• Processes

6. Perform conversions	• Length
	• Volume
	• Capacity
	• Area
	• Mass
	• Weight
	• Heat energy
	  ○ Kilowatts
	  ○ BTUh
	  ○ Gigajoules
	• Temperature
	  ○ Fahrenheit
	  ○ Centigrade
	  ○ Kelvin
	  ○ Rankine
	• Pressure
	  ○ Absolute
	  ○ Gauge

7. Calculate piping measurements	• Terms ○ Thread allowance

LEARNING TASKS	CONTENT
	○ Fitting allowance ○ End to end ○ End to centre ○ Centre to centre ○ Face to face ○ End to back ○ Back to back ○ Socket depth • Calculations • Grades • Elevations • Benchmarks
8. Use the Pythagorean theorem of right angles	• Hypotenuse • Side opposite • Side adjacent
9. Calculate offsets using the applicable trigonometric function	• Calculator methods • Table-based methods
10. Calculate the required measurements for a parallel piping offset	• Unequal spread • Equal spread • Rolling • Jumper
11. Describe the properties of matter	• Substances ○ Elements ○ Compounds ○ Mixtures • Adhesion • Cohesion • Conductivity • Density • Ductility • Elasticity • Malleability • Tensile strength • Heat properties ○ BTUs ○ Gigajoules ○ Specific Heat ○ Kilowatts
12. Use Pascal's theory of pressure and force	• Pressure ○ Pounds per square inch (psig)

LEARNING TASKS	CONTENT
	○ Pascal (Pa) ○ KiloPascal (kPa) ○ Inches of water column (in WC) ○ Inches of mercury (in Hg) ○ Ounces per square inch (OSI) ○ Bar • Total Force ○ Pounds ○ Newtons
13. Use Archimedes' principles of displacement and floatation	• Specific weight/gravity • Buoyancy
14. Define mechanical advantage as it relates to fluid power	• Hydraulics • Hydrostatics
15. Describe factors that affect fluid flow in a piping system	• Viscosity • Laminar flow • Turbulent flow • Velocity • Piping material • Fittings
16. Describe factors that affect gas volumes and pressures	• Boyle's Law • Charles Law • Combined Gas Law (Gay-Lussac's Law) • Bernoulli's principle
17. Perform gas law calculations	• Boyle's Law • Charles Law • Combined Gas Law (Gay-Lussac's Law) • Temperature ○ Kelvin ○ Rankine • Pressures ○ Absolute ○ Gauge
18. Calculate the expansion and contraction of various piping materials due to heating and cooling	• Ferrous • Non-ferrous • Thermoplastic
19. Define methods of heat transfer	• Conduction • Convection • Radiation
20. Perform heat load calculations	• Sensible

LEARNING TASKS	CONTENT
21. Describe characteristics of hydrocarbon gases	• 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: C2 Interpret Drawings and Specifications

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe drafting tools and materials	• Tools
	  ○ Compasses
	  ○ Dividers
	  ○ Drawing boards
	  ○ French curves
	  ○ Protractors
	  ○ Scale rulers
	  ○ Triangles
	  ○ T-squares
	• Erasers and shields
	• Pencils
	• Templates

2. Use scale rulers	• Dimensions
	  ○ Imperial
	  ○ Metric

3. Describe piping symbols	• Elbows • Flanges • Tees • Valves • Wyes

4. Describe characteristics of drafting lines and lettering	• Lines
	  ○ Border
	  ○ Center
	  ○ Dimension
	  ○ Extension
	  ○ Hidden
	  ○ Object
	  ○ Phantom
	• Lettering
	  ○ Hierarchy

LEARNING TASKS	CONTENT

5. Describe drawing projections	• Views
	  ○ Elevation
	  ○ Section
	  ○ Plan
	  ○ Isometric
	  ○ Orthographic
	  ○ Oblique

6. Use drawing projections	• Isometric • Orthographic • Conversion from one to the other
7. Create an isometric drawing of a basic piping arrangement	• Lettering • Line type • Relevant information ○ Detail required • Dimensioning

Achievement Criteria

Performance	The learner will be able to create an isometric drawing of a basic piping arrangement.
Conditions	To be assessed during technical training. The learner will be given: • T-squares • Orthographic drawing
Criteria	The learner will be evaluated on: • Accuracy • Neatness

Line (GAC): C PERFORM ROUTINE TRADE ACTIVITIES

Competency: C3 Use Codes, Regulations and Standards

Objectives

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

- Identify codes, standards and organizations.

LEARNING TASKS	CONTENT
1. Identify codes, standards and organizations	• American National Standards Institute (ANSI) • American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) • American Society of Testing and Materials (ASTM) • American Water Works Association (AWWA) • National Standard of Canada (CAN) • Canadian Commission on Building and Fire Codes (CCBFC) • Canadian Gas Association (CGA) • Canadian General Standards Board (CGSB) • Canadian Standards Association (CSA) • National Building Code of Canada (NBC) • National Fire Protection Association (NFPA) • 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): 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	CONTENT

1. Describe piping and tubing	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specifications
	• Schedules/Standard Dimension Ratio (SDR)
	• Characteristics
	• Types
	  ○ Steel
	  – Carbon
	  – Stainless
	  – Galvanized
	  ○ Copper
	  ○ Plastic
	  – Thermoplastic
	  – Thermoset
	  ○ Cast iron
	  ○ Aluminum
	  ○ Asbestos-cement
	  ○ Application specific
	  – Pyrex
	  – Fibre-glass
	  – Polypropylene
	  – Duriron

2. Describe methods of pipe support	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specifications
	• Tools and equipment
	• Types
	  ○ Hangers
	  ○ Supports
	  ○ Seismic
	  ○ Anchors
	  ○ Guides
	  ○ Slide plates
	  ○ Bedding media

LEARNING TASKS	CONTENT

	• Compatibility with piping
	• Size
	• Spacing
	• Elevation
	• Fasteners
	  ○ Beam clamps
	  ○ Drop-in anchors
	  – Inserts
	  ○ Draw bolts
	  ○ Toggle bolts
	• Structural restrictions
	• Insulation thickness

3. Describe methods of protecting piping and tubing	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specfications
	• Water treatment
	  ○ Softener
	  ○ pH
	  ○ Iron filters
	• Frost protection
	  ○ Insulation
	  ○ Heat trace
	  ○ Frost boxes
	  ○ Circulating pumps
	• Ultraviolet (UV) protection
	• Corrosion protection
	  ○ Coatings
	  ○ Tape
	  ○ Cathodic
	  ○ Dielectric
	  ○ Sleeving
	• Mechanical damage
	  ○ Protective plates/shield
	  ○ Sleeving
	  ○ Bollards

4. Pre-installation inspection of piping and tubing	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specifications
	• Applications
	• Potential defects
	  ○ Pin holes
	  ○ Cracked fittings

LEARNING TASKS	CONTENT
	○ Bent ends ○ Uneven casting ○ Damaged pipe and coatings ○ Debris • Environmental effects ○ Ultraviolet (UV) ○ Thermal effects ○ Soil conditions • Inspection techniques ○ Visual – Threads – Groove depth ○ Sounding of cast iron pipe and fittings ○ Tactile • Interpretation of markings
5. Cut piping and tubing	• Safe work practices • Codes and regulations ○ AHJ • Manufacturers' specifications • Tools and equipment ○ Cutting torch ○ Hacksaw ○ Bandsaw ○ Pipe/tube cutters ○ Reamers ○ File ○ Internal pipe cutters ○ Glass pipe cutters ○ Soil pipe cutters – Snap cutters – Ratchet cutters ○ Grinder – Cutting disks ○ Hammer/chisel • Calculations • Inspection
6. Bend piping and tubing	• Safe work practices • Codes and regulations ○ AHJ • Manufacturers' specifications • Terminology

LEARNING TASKS	CONTENT

7. Prepare piping and tubing connections	• 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	CONTENT

1. Describe piping and tubing jointing methods	• Safe work practices
	• Press-fit
	• Soldered
	• Brazed
	• Grooved
	• Flanged
	• Compression
	  ○ Ferule
	  ○ Flared
	  ○ CSST
	• Swaged
	• Corporation
	• Push-fit
	• Welded
	  ○ Solvent
	  ○ Fused
	• Threaded
	• Cut-grooved
	• Roll-grooved
	• Crimped
	• Expanded

2. Join piping and tubing	• Codes and regulations ○ AHJ • Manufacturers' specifications • Fittings • Accessories • Tools and equipment • Assembly

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	CONTENT
1. Describe the installation of piping and tubing	• Codes and regulations ○ AHJ • Manufacturers' specifications • Safe work practices • Selection for application • Tools and equipment • Layout

2. Install carbon steel piping	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specifications
	• Selection
	  ○ Application
	• Tools and equipment
	• Piping supports
	• Structure penetration

Achievement Criteria (to be combined with D1, D2 & D5)

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	CONTENT

1. Describe valve types	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specifications
	• Seating design
	• Types
	  ○ Butterfly
	  ○ Plug
	  ○ Ball
	  ○ Gate
	  ○ Globe
	  – Needle
	  ○ Check
	  ○ Pressure Reducing (PRV)
	  ○ Mechanical Safety Devices
	  – Pressure Relief
	  – Temperature and Pressure Relief
	  – Pop Safety (PSV)
	  – Safety Relief (SRV)
	  – Vacuum relief
	  – Ratings
	• Application
	• Materials
	• Limitations
	  ○ Temperature
	  ○ Pressure

2. Describe the installation of valves	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specifications
	• Selection
	  ○ Applications
	  ○ 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	CONTENT
1. Describe fittings	• Codes, standards and regulations ○ AHJ • Manufacturers' specifications • Types • Applications • Limitations

2. Describe fitting connection methods	• Threaded
	• Compression
	• Flared
	• Flanged
	• Crimped
	• Soldered/brazed
	• Mechanical
	• Solvent welded
	• Polyfusion
	• Sealants
	  ○ Thread compound
	  ○ Teflon tape
	  ○ Gaskets
	  ○ O-rings
	  ○ Hemp

3. Install fittings	• Codes and regulations ○ AHJ • Manufacturers' specifications • Accessories • Tools and equipment • Assembly

Achievement Criteria (to be combined with D1, D2 & D3)

Performance	The learner will be able to install fittings.
Conditions	To be assessed during technical training. The learner will be given:

- Drawings and specifications
- Tools and equipment
- Fittings and materials

Criteria The learner will be evaluated on:

- Neatness
- Accuracy

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	CONTENT

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

2. Describe methods of structure penetration	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specfications
	• Fire stopping
	  ○ Doughnut type
	  ○ Gasket type
	  ○ Caulking
	  ○ Mineral wool
	• Fire rating requirements
	• Required gaps

LEARNING TASKS	CONTENT
	• 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

1. Describe effective communication practices

CONTENT

- Liability
  - Sources of information
    - Gas Act and Safety Regulations
    - AHJ
    - Codes and regulations
    - Company requirements
    - Architect
    - Engineers
    - Manufacturers requirements
    - Fire Department per jurisdiction
    - Health department
    - WorkSafeBC
    - Technical Safety BC *(formerly BC Safety Authority)*
  - Responsibilities
    - Employer
    - Apprentice
    - Client/end-user
    - Installer/contractor
    - Manufacturer
    - Testing agencies
- Verbal
- Non-verbal
  - Body language
  - Signals
- Active listening
  - Hearing
  - Interpreting
  - Reflecting
  - Responding
  - Paraphrasing
- Learning styles
  - See
  - Hear
  - Try

LEARNING TASKS	CONTENT

	• Workplace responsibilities
	  ○ Personal
	  – Attitude
	  – Harassment
	  – Discrimination
	  ○ Supervisor
	  ○ Human Resources (HR)
	• Toolbox meetings
	  ○ 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 simple problems using Ohm's and Kirchhoff's Laws.
- Describe single phase and three phase power supplies.
- Identify transformers.

LEARNING TASKS	CONTENT

1. Describe the fundamentals of electricity	• Basic principles
	  ○ Atomic theory
	  ○ Electron flow
	  ○ Conductors - insulators
	  ○ Kinds of electricity
	  – AC current
	  – DC current
	  – Static electricity
	  ○ Cathodic protection
	  – Anode
	  – Cathode
	• Properties of wire
	  ○ Resistance
	  ○ Calculating resistance
	• Codes and regulations
	  ○ Effect of temperature
	  ○ Types of wires and cables
	• Electrical sources
	  ○ AC
	  – Single phase
	  – Three phase
	  ○ DC

2. Describe electrical circuits	• Parts of a circuit
	  ○ Source
	  ○ Switch
	  ○ Load
	• DC circuits and measurements
	  ○ Ohm's Law
	  ○ Measurement of voltage and amperage
	  ○ Resistors in parallel and series
	  ○ Power and energy

LEARNING TASKS	CONTENT
	○ Closing and opening DC circuits • AC circuits and measurements ○ Inductance ○ AC amperage ○ Resistance ○ Impedance ○ Capacitance ○ Power factor • Fundamentals of magnetism ○ Natural and artificial magnets ○ Magnetic fields ○ Strength of field ○ Force on two wires • Permeablility
3. Use laws and formulas	• Ohm's Law • Kirchoff's Law • Solve simple problems
4. Describe single phase power characteristics	• AC power distribution ○ Generation and transmission Voltage drop ○ Step-down transformer • Power available • Single phase power supply ○ 3-wire, dual voltage • Circuit protection ○ Fuses ○ Circuit breakers
5. Describe three phase power characteristics	• AC power distribution ○ Generation and transmission ○ Voltage drop ○ Step-down transformer • Power available • Three phase power supply ○ Delta ○ Wye
6. Identify transformers	• Type of transformers ○ Step-up ○ Step-down ○ Isolation • Primary winding • Secondary winding • Tappings

Level 2

Plumber

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B8 Use Technical Instruments and Testers

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe pressure measuring tools	• Manometers
	  ○ Types
	  – Digital
	  – Slack tubed
	  – Incline
	  ○ Filing
	  ○ Fluids
	  ○ Calibration
	  ○ Differential
	• Mechanical gauges
	  ○ Bourdon tube
	  ○ Compound
	  – Magnehelic gauge
	  ○ Differential gauge

2. Use manometers and mechanical gauges	• Gas pressures
	  ○ Standing line pressures
	  ○ Operating line pressures
	  ○ Gauge pressures
	  ○ Absolute pressures
	  ○ Conversion between different pressures
	• Diagnostics
	  ○ Pressure tests
	  ○ Leak detection

3. Interpret pressure readings	• Code B149.1
	• Manufacturer's specifications
	• Diagnostics
	  ○ Pressure tests
	  ○ Leak detection
	• Tightness of closure

4. Describe temperature measuring instruments	• Thermometer

LEARNING TASKS	CONTENT
	• Pyrometer • Thermocouple • Thermistor • Scales
5. Use temperature measuring instruments	• Calibration • Check readings • Applications

6. Describe electrical testing meters	• Types
	  ○ Multi-meter
	  ○ Ammeter
	  ○ Ohm-meter
	  ○ Volt-meter
	  ○ Micro-ammeter
	  ○ Milli-ammeter

7. Use electrical test meters	• Check voltage • Check current • Check resistance • Check for continuity

8. Use combustible gas indicator (CGI)	• 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	CONTENT
1. Describe the chemistry of combustion	• 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
	  ○ Combustion
	  ○ Primary
	  ○ Secondary
	  ○ Excess
	  ○ Dilution
	  ○ Total
	• Products of combustion
	  ○ CO_2
	  ○ H_2O
	  ○ O_2
	  ○ N_2

3. Describe draft	• Natural draft
	  ○ Buoyancy
	  ○ Temperature
	  ○ Height
	• Terms
	  ○ Stack effect
	  ○ Stack draft
	  ○ Natural draft
	  ○ Chimney effect
	• Mechanical draft

4. Describe the building as a system	• Negative air pressure • Exhaust equipment

LEARNING TASKS	CONTENT

	• Air supply equipment
	• Building envelope
	• Building ventilation
	  ○ Air exchange equipment
	• Regional location
	• Type of building
	• Code requirements
	  ○ B149.1
	  ○ Building Code

Line (GAC): C PERFORM ROUTINE TRADE ACTIVITIES

Competency: C2 Interpret Drawings and Specifications

Objectives

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

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

LEARNING TASKS	CONTENT

1. Identify types of drawings	• Types
	  ○ Architectural
	  ○ Structural
	  ○ Mechanical
	  ○ Electrical
	  ○ Shop
	• Specification sheets
	• Parts
	  ○ Plan
	  – Plot
	  – Foundation
	  – Floor
	  ○ Elevation
	  ○ Sections
	  ○ Details
	  ○ Title block
	  ○ Revisions
	  ○ Schedules
	  ○ Legends
	• Information contained
	  ○ Building dimensions
	  ○ Construction type
	  ○ Room layout
	  ○ Fixture locations
	  ○ Finish details
	• Symbols
	• Conventions

2. Create isometric drawings of a piping system	• Detail required • Dimensioning • Relevant information • Lettering • Line type • Pipe sizing

LEARNING TASKS	CONTENT
3. Plan residential take-offs	• Terminology • Lists, calculations and formulas • Site considerations

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.
Conditions	To be assessed during technical training. The learner will be given: • Floor plan and specifications • Drawing equipment
Criteria	The learner will be evaluated on: • Accuracy • Neatness

Line (GAC): C PERFORM ROUTINE TRADE ACTIVITIES

Competency: C3 Use Codes, Regulations and Standards

Objectives

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

- Interpret codes and standards for the National Plumbing Code (NPC).
- Interpret codes and standards for the B149.1 Gas Code series.

LEARNING TASKS	CONTENT
1. Describe the application of codes and standards	• Design • Planning • Installation • Maintenance • Decommissioning
2. Identify environmental agencies associated with sewage disposal	• BC Health Department • WorkSafeBC • BC Water and Waste Association (BCWWA) • BC Onsite Sewage Association (BCOSSA) • Authority having jurisdiction (AHJ)
3. Describe the National Plumbing Code (NPC)	• Layout • Sections • Contents • Index • Appendices • Tables • Definitions • Scope • Revisions
4. Interpret the National Plumbing Code (NPC)	• Scope • Reference publications • Definitions • General • Appendices
5. Describe the B149 Gas Code series	• B149.1, B149.2, B149.3 • Layout • Sections • Contents • Index • Annexes

LEARNING TASKS	CONTENT
	• Tables • Definitions • Scope • Revisions
6. Interpret Sections of the B149.1 Gas Code	• Scope • Reference publications • Definitions • General • Piping and tubing systems, hose, and fittings • Annexes A & B

Achievement Criteria

Performance	The learner will be able to interpret codes and standards for sizing exercises.
Conditions	To be assessed during technical training. The learner will be given: • Codes • Standards • Projects
Criteria	The learner will be evaluated on: • Accuracy • Code compliance

Line (GAC): C PERFORM ROUTINE TRADE ACTIVITIES

Competency: C4 Use Manufacturer and Supplier Documentation

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe manufacturer and supplier documentation	• Types
	  ○ Tool and equipment documentation
	  ○ Material Safety and Data Sheets (MSDS)
	  ○ System component documentation
	  ○ Proprietary product documentation
	  ○ Certification agencies
	• Information
	  ○ Installation instructions and requirements
	  ○ Operation and maintenance manuals
	  ○ Product specifications
	  ○ Warranty information
	  ○ Appliance rating plates

2. Source manufacturer documentation	• Manufacturer web-sites • Search engines • Archival sources • On-site documentation • Contact manufacturer • Local agencies

Line (GAC): C PERFORM ROUTINE TRADE ACTIVITIES

Competency: C5 Perform Piping System Layout

Objectives

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

- Layout piping systems.

LEARNING TASKS	CONTENT

1. Describe piping system layout	• Safe work hazards
	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specfications
	• Routing
	• Penetrations
	• Site conditions
	• Materials
	• Components
	• Supports
	• Tools and equipment
	• Interference with other systems
	  ○ Electrical
	  ○ Ventilation
	  ○ Sprinkler

2. Layout piping systems	• Measure • Calculate • Tools and equipment

Achievement Criteria

Performance	The learner will be able to layout a piping system.
Conditions	To be assessed during technical training. The learner will be given: • Drawing and specifications • Tools and equipment
Criteria	The learner will be evaluated on: • Accuracy • Neatness

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	CONTENT

1. Describe fixtures and trim	• Types
	• Applications
	  ○ Residential
	  ○ Commercial
	  ○ Institutional
	  ○ Materials and finishes
	• Purpose

2. Describe the installation of fixtures and trim	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specfications
	• Layout
	• Tools and equipment
	• Supports
	  ○ Carriers
	  ○ Blocking
	  ○ Wall hangers
	• Fasteners
	• Caulking
	• Barrier-free requirements and regulations
	• Rough-ins
	  ○ Clearance
	  ○ Mounting
	  – Heights
	• Assembly
	• Adjustments
	• Protection
	• Leveling
	• Connection to water distribution systems and drainage
	• Coordination of connection of power

Line (GAC): E INSTALL PLUMBING FIXTURES AND APPLIANCES

Competency: E2 Install Appliances

Objectives

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

- Describe the installation of appliances.

LEARNING TASKS	CONTENT

1. Describe appliances	• Types
	• Applications
	  ○ Residential
	  ○ Commercial
	  ○ Institutional
	  ○ Materials and finishes
	• Purpose

2. Describe the installation of appliances	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specfications
	• Layout
	• Protection during installation
	• Tools and equipment
	• Supports
	• Rough-ins
	  ○ Clearance
	  ○ Mounting
	  – 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	CONTENT

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

5. Describe requirements of a trade-waste system	• Sealing of penetrations
	• Application
	• Interceptors
	  ○ Types
	  ○ Applications
	  ○ Regulations
	  ○ Venting
	  ○ Manufactures 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 — To be assessed during technical training.
The learner will be given:

- Specifications
- Schedule
- Drawings

Criteria — The learner will be evaluated on:

- Code complianance
- Efficiency
- Accuracy

Achievement Criteria 2

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

Conditions — To be assessed during technical training.
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	CONTENT

1. Describe storm drainage systems	• 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

LEARNING TASKS	CONTENT
5. Describe the placement and operation of sumps and catch basins	• Sealing of penetrations • National Plumbing Code ○ AHJ • Pumps • Confined space requirements
6. Describe sub-soil drainage systems	• Purpose • Material • Perforation orientation • Backwater valve • Surcharge requirements • Curtain drain • Backfilling • Location
7. Describe site retention systems	• Overflow to municipal • Green technology

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	CONTENT
1. Identify code requirements affecting the testing of sanitary and storm drainage systems	• National Plumbing Code ○ AHJ • Safety • Equipment • Procedure • Duration • Inspection • Documentation
2. Describe the testing of sanitary and storm drainage systems	

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	CONTENT

1. Describe the operation of residential forced air systems	• Purpose
	• Components
	• Ducting configurations
	  ○ Supply air
	  ○ Return air
	  ○ Zoning
	• Controls
	• Balancing

2. Describe the operation of residential hydronic heating systems	• Codes and regulations
	  ○ AHJ
	• Purpose
	• Volumetric thermal expansion
	  ○ Expansion coefficients
	  ○ Temperature
	  – ΔT
	  ○ Volume
	• Fluid fundamentals
	  ○ Volumetric coefficient differences
	  ○ Linear and volumetric expansion
	  ○ Viscosity
	• Components
	  ○ Valves
	  – Mixing
	  – Zone
	  ○ Closed loops circulators
	  ○ Gauges and thermometers
	  ○ Heat transfer units
	  – Fan coil units
	  – Radiators
	  – Radiant panels

LEARNING TASKS	CONTENT

- Unit heaters
- Termination heat pumps
- In-floor heating
- Force flow units
- Perimeter radiation

- Expansion tank
- Air separator/eliminator
- Zone headers
- Air vents
- Feed water
- Water treatment
- Backflow preventor

- Piping system configurations
  - Zoning
  - Supply water
  - Return water
  - Balancing
  - High-temperature
  - Low-temperature
  - Mixing
- Process Flow Diagrams (PFD)
- Controls
- Heat transfer units
- Safety considerations
- Design
  - Drawings and specifications
  - Zoning
  - Point of no pressure change
- Pipe sizing
- Heating generating equipment
  - Boilers
    - High mass
    - Low mass
    - Bio-mass
  - Heat pumps
  - Heat exchangers
  - Solar panels
- Cooling generating equipment
  - Cooling towers
  - Heat pumps
  - Fluid coolers
  - Chillers

LEARNING TASKS	CONTENT
	○ Dirt elimination devices • Auxiliary equipment ○ Indirect fired hot water tanks ○ Heat exchangers ○ Make-up tanks • Controls • Fluids ○ Water ○ Chemical ○ Brine solutions • Additives ○ Treatment chemicals ○ Rust inhibitors ○ Glycol • Protection ○ Piping ○ Components
3. Calculate volumetric thermal expansion	• Expansion coefficients • Temperature ○ ΔT • Volume
4. Describe low pressure steam piping systems	• Types ○ Counter flow ○ One-pipe ○ Two-pipe ○ Two-pipe gravity return ○ Sub-atmospheric • 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	CONTENT
1. Install piping and components for hydronic systems	• Pipe routing • High and low points • Tools and equipment • Jointing methods • Grade/pitch • Supports • Restraints • Assembly

Achievement Criteria

Performance	The learner will be able to install piping for a hydronic system.
Conditions	To be assessed during technical training. The learner will be given: • Drawings and specifications • Tools and materials
Criteria	The learner will 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	CONTENT

1. Describe the installation of hydronic heat generating systems	• Codes and regulations
	  ○ AHJ
	  ○ Manufacturers' specifications
	• Tools and equipment
	• Heat source
	• Components
	• Circulating pumps
	• Venting
	• Fuel sources
	• Layout
	• Supports
	• Restraints
	  ○ Vibration
	  ○ Seismic
	• Trim
	• Connections
	  ○ Pipe
	  ○ Flue
	  ○ Power
	  ○ Drainage
	  ○ Neutralizer

2. Describe the installation of hydronic cooling generating systems	• Codes and regulations
	  ○ AHJ
	  ○ Manufacturers' specifications
	• Tools and equipment
	• Cooling source
	• Components
	• Circulating pumps
	• Venting
	• Energy sources
	• Layout
	• Supports
	• Restraints

LEARNING TASKS	CONTENT
	○ 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	CONTENT

1. Describe hydronic transfer units	• Types
	  ○ Convectors
	  ○ Forced convection
	  ○ Radiant panels
	  ○ Radiant/Convector (RC)
	• Applications
	  ○ Commercial
	  ○ Residential

2. Describe the installation of hydronic transfer units	• Location
	• Operating temperatures
	• Codes and regulations
	  ○ AHJ
	  ○ Manufacturers' specfications
	• 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
  - Boilers
    - Hot water
    - Steam
    - High mass
    - Low mass
  - Direct fired make-up air heaters
  - Direct vent appliances
  - Decorative appliances
    - Fireplace
    - Fire pit
  - Furnaces
  - Radiant heaters
    - Low intensity
    - High intensity
  - Ranges and/or Commercial cooking equipment
  - Rooftop units
  - Unit heaters
  - Water heaters
    - Tankless
    - Storage type
  - Gas fired refrigerators
- Characteristics
  - Appliance design
  - Direct-fired
  - Indirect-fired
- Applications
- Approval agencies

Level 3

Plumber

Line (GAC): C PERFORM ROUTINE TRADE ACTIVITIES

Competency: C2 Interpret Drawings and Specifications

Objectives

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

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

LEARNING TASKS	CONTENT
1. Design a drainage, waste and vent (DWV) system	• Soil and waste pipes • Vents
2. Design a water distribution system	• Service • Distribution • Supply
3. Design a fuel gas distribution system	• 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,
- water distribution system;
- 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

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.
- Use gas regulations.

LEARNING TASKS	CONTENT

1. Describe the National Plumbing Code (NPC) Section 6	• Water distribution systems
	  ○ Layout
	  ○ Sections
	  ○ Contents
	  ○ Index
	  ○ Appendices
	  ○ Tables
	  ○ Definitions
	  ○ Scope
	  ○ Revisions

2. Interpret the National Plumbing Code (NPC) Section 6	• Water distribution systems
	  ○ Scope
	  ○ Reference publications
	  ○ Definitions
	  ○ General
	  ○ Appendices

3. Use 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 Completetion • Approvals • Variations to the National Gas Code • Bulletins, Directives and Safety Orders

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	CONTENT

1. Describe sewers	• Types
	  ○ Storm
	  ○ Sanitary
	  ○ Combined
	• Hazards
	  ○ Trenching
	  ○ Confined spaces
	  ○ Pinch points
	  ○ Hoists
	  ○ Air quality
	• Components
	• Applications
	• Operations

2. Size pipe for sewers	• Hydraulic load
	  ○ Fixture units
	  ○ Litres per 15 minutes
	• Codes
	  ○ Sizing tables
	• Grades

3. Describe the installation of piping for sewers	• Pipe
	  ○ Types
	  ○ Sizing
	  ○ Routing
	• Codes and regulations
	• Drawings and specifications
	  ○ Engineering specifications
	• Tools and equipment
	• Fixtures
	• Materials
	• Components
	• Benchmark
	• Grade and elevation
	• Layout
	• Trenching/backfilling
	• Support
	• Protection
	• Backflow prevention

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

Competency: G2 Install Manholes and Catch Basins

Objectives

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

- Describe the installation of manholes and catch basins.

LEARNING TASKS	CONTENT

1. Describe manholes	• Types
	  ○ Indoor
	  ○ Outdoor
	  ○ Storm
	  ○ Sanitary
	• Applications

2. Describe catch basins	• Types
	  ○ Lawn
	  ○ Driveway
	  ○ Patio
	• Characteristics
	• Applications

3. Describe the installation of manholes	• Codes and regulations
	  ○ AHJ
	  ○ Applications
	  ○ Opening size
	  ○ Rungs/ladder placement
	  ○ Venting
	  ○ Lid seals
	• Location/layout
	• Grouting
	• Grade
	• Elevations
	• Tools and equipment
	• Materials
	• Channeling
	• Penetrations
	• Protection
	  ○ Specifications
	• Supports

4. Describe the installation of catch basins	• Codes and regulations ○ AHJ • Location/layout • Grade

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	CONTENT
1. Describe water services	• Terminology • Types • Characteristics • Applications • Components • Equipment • Codes and regulations ○ AHJ • Protection methods • Connections • Irrigation

2. Describe sizing for water service piping	• Flow requirements
	• Calculations
	  ○ Hazen-Williams formula
	• Codes and regulations
	  ○ Water service tables
	  ○ AHJ
	• Drawings and specifications
	• System factors
	  ○ Number of fixtures
	  ○ Pipe length required
	  ○ Fitting allowances
	  ○ Remote outlet
	  ○ Elevations
	  ○ System pressure
	  ○ Flow
	  ○ Velocity

3. Describe the installation of piping for water services	• Tools and equipment ○ Hot tapping

LEARNING TASKS	CONTENT
	• Materials • Fittings • Components • Supports • Restraints • Codes and regulations ○ 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	CONTENT

1. Describe potable water service and distribution systems	• Types
	  ○ Public
	  ○ Private
	  ○ Residential
	  ○ Industrial, Commercial, Institutional (ICI)
	• Terminology
	• Characterisitcs
	• Applications
	  ○ Pressure systems
	• Codes and regulations
	  ○ AHJ
	• Expansion joints
	• Equipment
	  ○ Pumps
	  ○ Valves
	  – Pressure reducing
	  – Tempering
	  ○ Tanks
	  – Hot water
	  – Pressure
	  ○ Cross connection devices
	  ○ Water treatment
	• Assemblies
	• Fixtures
	• Accessories
	• Cross connection
	• Pressure systems
	• Heat tracing

2. Interpret code requirements for parts of a potable water service and distribution system	• Types of piping

LEARNING TASKS	CONTENT

	• Size
	• Fittings
	  ○ Orientation
	  ○ Prohibitions
	• Hangers and supports
	  ○ Spacing
	  ○ Seismic
	• Jointing practices

3. Plan the layout of a potable water service and distribution systems	• Design • Location of structure penetrations • Routing • Pipe supports

4. Size pipe for potable water service and distribution systems	• Codes and regulations
	  ○ Tables
	  ○ AHJ
	• Drawings and specifcations
	  ○ Pressure requirements
	• Calculations
	  ○ Elevations/Head loss
	  ○ Friction loss
	• System factors
	  ○ Number of water service fixture units
	  ○ Developed pipe length
	  ○ Fixture allowance
	  ○ Friction loss
	  ○ Remote outlet
	  ○ Available pressure

5. Describe the installation of piping for potable water service and distribution systems	• Codes and regulations
	  ○ AHJ
	• Drawings and specifications
	  ○ Layout
	  – Routing
	• Site requirements
	• Tools and equipment
	• Sleeves
	• Supports
	• Components
	  ○ Piping
	  ○ Fittings
	  ○ Valves
	  ○ Shock arrestors

LEARNING TASKS	CONTENT
	○ 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	To be assessed during technical training. The learner will be given: • National Plumbing Code (NPC) • Diagram of a potable water service and distribution system.
Criteria	The learner will be evaluated on: • Accuracy

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	CONTENT

1. Describe cross connection control	• Hazards
	  ○ Minor, moderate, severe
	• Assemblies
	  ○ Reduced pressure backflow preventer assembly (RPBA)
	  ○ Double check valve assembly (DCVA)
	  ○ Pressure Vacuum Breaker Assembly (PVBA)
	  ○ Air gap
	• Devices
	  ○ Dual check Valve
	  ○ Dual check Valve Backflow Preventer with Atmospheric Port
	  ○ Dual check Valve Backflow Preventer with Vent
	  ○ Atmospheric Vacuum Breaker
	  ○ Hose Connection Vacuum Breaker
	  ○ Labroratory Faucet Type Vacuum Breaker
	• Inspection
	• Methods
	• Maintenance
	  ○ Calibration
	  ○ Annual verification
	• Codes, regulations and permits
	  ○ AHJ
	  ○ NPC, Section 7, Non-Potable Water Systems
	• Certification

2. Describe the installation of cross connection control devices and assemblies	• Hazard assessment ○ Minor, moderate, severe • Installation requirements

LEARNING TASKS	CONTENT
3. Test cross connection control assemblies	○ Height ○ Location ○ Accessibility • Codes, regulations and permits ○ BCWWA ○ AHJ ○ National Plumbing Code (NPC) • Tools and equipment • Connections • Pressures • Inspection • Testing • Safe work practices • Types ○ Reduced Pressure Backflow Assembly (RPBA) ○ Double-check Valve Assembly (DCVA) ○ Pressure Vacuum Breaker Assembly (PVBA) • Test procedures • Purpose • Minimum requirements • Test frequency • Documentation

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:

- Assemblies
- Test equipment
- Documentation

Criteria — The learner will be evaluated on:

- Current accepted certification test procedures and equipment

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	CONTENT

1. Describe the troubleshooting and repair of cross connection control assemblies	• Troubleshoot
	  ○ Isolation
	  ○ Assemblies
	  – Reduced pressure backflow preventer assembly (RPBA)
	  – Double check valve assembly (DCVA)
	  – Pressure Vacuum Breaker Assembly (PVBA)
	  ○ Visual Inspection
	  ○ Verify component
	• Repair or replace
	  ○ Safe work practices
	  ○ Tools and equipment
	  ○ Retest
	  ○ Return to service
	  ○ Documentation
	  ○ Codes, regulations and permits
	  – AHJ
	  – 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.

LEARNING TASKS	CONTENT

1. Size piping and components for hydronic systems	• Load requirements
	• Heat loss/gain calculations
	• Codes and regulations
	  ○ AHJ
	• Manufacturers' specfications
	• Drawings and specifications
	• Expansion devices
	  ○ Bladder
	  ○ Diaphragm
	  ○ Conventional air cushion
	  ○ Open tank
	• Circuit balancing valves
	• Heating and cooling compatibility

Achievement Criteria

Performance	The learner will be able to design a residential hot water radiant floor heating system.
Conditions	To be assessed during technical training. The learner will be given: • Residential layout • Design criteria • Design materials
Criteria	The learner will be evaluated on: • Accuracy

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	CONTENT
1. Describe switches	• 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

LEARNING TASKS	CONTENT
	○ Heat curves • Circulators • Multi-temperature systems ○ Control valves – Mixing – Diverting – Injection • Purpose/Operation

Achievement Criteria

Performance	The learner will be able to install/wire a relay.
Conditions	To be assessed during technical training. The learner will be given: • Ladder diagram • Double pole, single throw relay • Power supply • Switch • Light bulbs • Transformer
Criteria	The learner will be evaluated on: • Accuracy to the diagram • Wiring techniques • Neatness

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, compressed air and green systems.
- Describe the installation of piping for compressed air systems.

LEARNING TASKS	CONTENT

1. Describe residential irrigation systems	• Safe work practices
	• Types
	  ○ Residential
	  ○ Commercial
	  ○ Agricultural
	• Codes and regulations
	  ○ AHJ
	• 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
	  ○ Vessels specific
	  ○ AHJ
	• Piping arrangements
	  ○ Straight line
	  ○ Loop
	• Tools and equipment
	• Jointing methods
	• Draining of moisture
	• Compressors
	  ○ Types
	  ○ Operation
	• Safety devices

3. Describe green systems	• Types ○ Geo-thermal

LEARNING TASKS	CONTENT
	○ Solar thermal ○ Grey water reuse ○ Rainwater collection • Codes and regulations ○ AHJ • Hazards ○ Cross connection control issues • Piping configurations • Components • Controls • Applications • Operation
4. Describe piping installation for compressed air systems	• Sizing ○ Measurements ○ Calculations ○ Manufacturer's documentation ○ Engineered drawings • Codes and regulations ○ AHJ • Pipe routing/configurations • Tools and equipment • Assembly • Jointing methods • Pitch and grade • Supports • Allowances • Protection ○ Mechanical damage ○ Seismic activity ○ Environmental conditions • Structure penetration

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N2 Install Equipment for Specialized Systems

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe the installation of equipment for irrigation systems	• Safe work practices
	• Codes and regulations
	  ○ AHJ
	• Equipment types
	  ○ Sprinkler heads
	  ○ Valve boxes
	  ○ Timers
	  ○ Pumps
	  ○ Solenoid valves
	• Winterization consideration
	  ○ Grades
	  ○ Drainage points
	  ○ Purge points
	• Tools and equipment
	• Sprinkler head selection
	• Equipment adjustment
	  ○ Patterns
	• Timers

2. Describe the installation of equipment for compressed air systems	• Safe work practices
	• Codes and regulations
	  ○ AHJ
	• Components
	  ○ Air driers
	  ○ Flex-connectors
	  ○ Auto drains
	  ○ Pressure regulators
	  ○ Filters
	• Compressors
	• Tools and equipment
	• Vibration isolation
	• Connection of equipment to piping

3. Describe the installation of equipment for green systems	• Safe work practices • Codes and regulations ○ AHJ • Location

LEARNING TASKS	CONTENT

	• High and low points
	• Tools and equipment
	• Pumps
	• Cross connection
	• Supports
	• Fasteners
	• Installation method
	  ○ Manual
	  ○ Mechanical
	• Clearances
	• Alignment and leveling
	• Anchoring
	• Controls

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N3 Test Specialized Systems

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe the testing of specialized systems	• Safe work practices
	  ○ Lock-out/tag-out
	• Codes and regulations
	  ○ AHJ
	• Visual pre-check
	• Types
	• Applications
	• Tools and equipment
	• Test medium
	  ○ Fluid
	  ○ Compressed air
	  ○ Inert gases
	• Components
	• Procedures
	  ○ Filling
	  ○ Draining
	  ○ Purging
	• Return to service
	• Inspection
	• Documentation

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N4 Service Specialized Systems

Objectives

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

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

LEARNING TASKS	CONTENT
1. Describe maintenance procedures for specialized systems	• Schedules • Sensory inspection • Lubrication • Chemicals • Fluids • Components • Wear

2. Describe troubleshooting and repair procedures for specialized systems	• Safe work practices
	• Lock-out/tag-out
	• Verify reported problem
	• Inspection/testing
	  ○ Sensory
	  ○ Diagnostic
	  ○ Monitoring
	• Tools and equipment
	• Isolate components
	• Conditions for repair/replacement
	  ○ Temperature
	  ○ Leaks
	  ○ Corrosion
	  ○ Control malfunction
	  ○ Vibration
	  ○ Irregular movement
	• Procedures
	  ○ Cleaning a system before, during, and after assembly
	  ○ Blanking off all piping, tubing, and hoses when a system is opened
	  ○ Flushing procedures for contaminants
	  ○ Isolating equipment before testing the system
	  – Gauges
	  – Controls
	  – Relief valves
	  – Flow control valves

LEARNING TASKS	CONTENT
	– Reducing valves • Faults ○ Flow ○ Pressure ○ Velocity • Causes • Repair/replace components • Return to service • Documentation

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N5 Commission Specialized Systems

Objectives

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

- Describe the commissioning of irrigation, compressed air and green systems:

LEARNING TASKS	CONTENT

1. Describe the commissioning of specialized systems	• Safe work practices
	• Codes, regulations and permits
	  ○ AHJ
	  ○ Manufacturer's documentation
	• Sensory inspection
	• Hazards
	• Purging/venting
	• Flushing
	• Chemical treatment
	  ○ Disinfecting and sampling
	• Commissioning equipment
	• Electrical supply and connections
	• Water supply
	• Load
	• Codes
	• Valves test
	• Leak test
	• Hydrostatic test

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	CONTENT

1. Identify electrical diagrams	• Types of diagrams
	  ○ Ladder
	  ○ Schematic
	  ○ Pictorial
	  ○ Wiring
	• Symbols used in schematic diagrams
	• Read schematics
	  ○ Identifying components
	  ○ Determining function of circuit
	  ○ Identifying control circuits
	  – Parallel circuits
	  – Series circuits
	• Apply circuit diagrams
	  ○ Troubleshooting techniques

2. Sketch a circuit	• Parallel circuit • Series circuit

3. Analyze simple circuits	• Safety
	  ○ Lock-out and fuse removal
	  ○ First aid for electrical shock
	• Test circuits
	  ○ Voltage test
	  ○ Amperage test
	  ○ Resistance test
	  ○ Continuity test
	• Analyze readings
	  ○ Compare to manufacturer's data
	  ○ Compare to previous readings
	  ○ Compare to expected data
	  ○ Reasons for unexpected readings

LEARNING TASKS	CONTENT
4. Describe appliance circuits	• Transformer • Limit/Safety • Pump/fan • Control

5. Sketch a ladder diagram	• 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 wiring components.
- Describe conductor installation.
- Describe wire termination.

LEARNING TASKS	CONTENT

1. Describe wiring components	• Wire types
	  ○ Solid
	  ○ Stranded
	• Connection types
	  ○ Wire nuts
	  ○ Crimp
	  ○ Solder
	  ○ Terminal strips/lug
	  ○ Heat shrink sleeve
	• Conduit types
	  ○ Metal conduit
	  – Rigid metal conduit
	  – Galvanized conduit
	  ○ Non-metallic conduit
	  ○ Flexible conduit
	• Fasteners
	• Junction box

2. Describe conductor installation	• Cutting of flexible conduit • Wire insulation removal • Wire nuts
3. Describe wire termination	• Wire nuts • Junction box • Terminal strips/lug • Mechanically secure • Heat shrink sleeve

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	CONTENT
1. Describe factors that affect fluid flow in a piping system	• Laminar flow • Turbulent flow • Specific gravity • Pressure drop • Velocity • Size • Piping material • Fittings

2. Describe natural gas fuel distribution systems	• 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

3. Describe piping, tubing and hoses	• Types
	  ○ Black iron pipe
	  ○ Copper tubing
	  ○ PE piping

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

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

Competency: 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	CONTENT

1. Describe flame detectors	• Thermocouple
	• Thermopile
	• Flame rectification (flame rod)
	• Pilot types
	  ○ Continuous
	  ○ Intermittent
	  ○ Interrupted

2. Describe ignition systems	• Pilot
3. Describe standing pilot/thermocouple systems	• 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	CONTENT

1. Describe burners	• Terminology
	  ○ Turndown
	  ○ High fire
	  ○ Low fire
	  ○ Modulation
	  ○ Port loading
	• Types
	  ○ Forced draft
	  ○ Fan assisted
	  ○ Atmospheric
	  ○ Insperating
	  ○ Asperating
	• Gas properties
	• Flame characteristics
	  ○ Aerated
	  – Oxidizing
	  – Carbonizing
	  – Neutral
	  ○ Non-aerated
	  ○ Bunsen
	  ○ Luminous
	  ○ Impingment
	  ○ Flame retention
	• High installations
	• Pilot
	  ○ Continuous
	  ○ Intermittent
	• Interrupted

2. Describe atmospheric burners	• Types
	  ○ Main burners
	  ○ Pilot burners
	• Parts
	  ○ Burner port
	  ○ Mixing tube

LEARNING TASKS	CONTENT
	○ Burner head • Operation ○ Venturi effect (Bernoulli's principle) ○ Primary air control ○ Fuel control • Application
3. Describe burner orifices	• Types ○ Plug ○ Cap ○ Adjustable • Sizing ○ Tables ○ Calculations – Orifice flow formula ○ 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
  - AHJ
- Manufacturers' specfications
- Types
- Methods
- Identification
- Procedures
- Fittings
- Valves
- Prohibited practice
- Location limitations
- Structural penetrations
  - Fire stopping
- Drip or dirt pockets
- Between buildings
- Concealment
  - Protection plates
  - In concrete
- Protective coatings
- Underground
- Support
- Tools
- Connectors

Level 4

Plumber

Line (GAC): C PERFORM ROUTINE TRADE ACTIVITIES

Competency: C2 Interpret Drawings and Specifications

Objectives

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

- Describe contractual documents and record management.

LEARNING TASKS	CONTENT

1. Describe contractual documents	• Purpose
	• Types
	  ○ Agreements
	  ○ General conditions
	  ○ Drawings
	  ○ Specifications
	  – Master format
	  – Divisions
	• General requirements
	• Responsibilities and obligations
	  ○ Permits and requirements
	  ○ Guarantees/warranties
	  ○ Liability
	  ○ Tests and inspections
	  ○ Workmanship
	• Change orders

2. Describe record management	• Paper based filing • Electronic filing • Service reports • Invoices • Time sheets • Purchase orders • Vehicle logs • Maintenance logs • Inventory • Permits • Statements of completion

Line (GAC): E INSTALL PLUMBING FIXTURES AND APPLIANCES

Competency: E3 Commission Fixtures and Appliances

Objectives

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

- Describe the commissioning of fixtures and appliances.

LEARNING TASKS	CONTENT
1. Describe the commissioning of fixtures and appliances	• Tools and equipment • System check/test • Manufacturers' specifications • Inspection • Adjustments • Documentation • Inform end-user of operation

Line (GAC): E INSTALL PLUMBING FIXTURES AND APPLIANCES

Competency: E4 Service Fixtures and Appliances

Objectives

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

- Describe the servicing of fixtures, trim and appliances.

LEARNING TASKS	CONTENT
1. Describe the servicing of fixtures, trim and appliances	• 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	CONTENT

1. Describe effective mentoring techniques	• Verbal
	• Non-verbal
	  ○ Body language
	  ○ Signals
	• Active listening
	  ○ Hearing
	  ○ Interpreting
	  ○ Reflecting
	  ○ Responding
	  ○ Paraphrasing
	• Personal responsibilities
	  ○ Attitude
	  ○ Harassment
	  ○ Descrimination

2. Describe learning strategies	• Coaching
	• Practice
	• Assessing
	  ○ Feedback
	  ○ Correcting
	• Reinforcement

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

Competency: G3 Test Manholes, Catch Basins and Piping for Sewers

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe the testing of manholes, catch basins and piping for sewers	• Types
	  ○ Sensory
	  ○ Hydrostatic
	  ○ Smoke and air
	  ○ Mandrel
	• Equipment
	  ○ Balloons
	  ○ Inflatable test balls
	  ○ Test plugs
	  ○ Mandrel
	• Faults
	  ○ Cracks
	  ○ Corrosion
	  ○ Inadequate flow
	  ○ Piping failure
	• Specifications, codes and regulations
	• Leak checks
	• Return to service
	• Documentation

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

Competency: G4 Service Manholes, Catch Basins and Piping for Sewers

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe maintenance procedures for manholes, catch basins and piping for sewers	• Inspection
	  ○ Schedules
	• Testing
	  ○ Smoke
	  ○ Cameras
	• Component verification
	• Specifications, codes and regulations
	• Tools and equipment
	  ○ Snakes
	  ○ Jetters
	  ○ Cameras
	  ○ Vacuum trucks
	• Isolation
	• Return to service
	• Documentation

2. Describe troubleshooting procedures for manholes, catch basins and piping for sewers	• Verify reported problem
	• Safe work practices
	  ○ Confined space
	  ○ Point of access
	  ○ Shoring
	• Inspection
	• Component verification

3. Describe repair procedures manholes, catch basins and piping for sewers	• Tools and equipment • Isolation • Repair or replace components • Testing • Return to service • Documentation

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

Competency: 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 component.

LEARNING TASKS	CONTENT

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

LEARNING TASKS	CONTENT

2. Describe municipal sewage disposal systems and sewage treatment plants
 	
3. Describe a private sewage treatment system installation
	• Purpose
	• B.C. Health Act
	• Codes and regulations
	  ○ AHJ
	• Site plan
	• Permits
	• Percolation tests
	  ○ Procedure
	  ○ Mandatory inspection of test
	  ○ Maximum rate
	• Components
	  ○ Pumps
	  ○ Controls
	  ○ Distribution piping
	  ○ Septic tanks
	  – Location
	  – Sizing
	  – Elevation
	  ○ Fields
	  – Location
	  – Sizing
	  – Elevation
	  ○ Distribution boxes
	  ○ Bell-and-siphons
	  ○ 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 System 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	CONTENT

1. Describe the testing of sewage treatment systems and components	• Testing equipment
	  ○ Inflatable test balls
	  ○ Test plugs
	  ○ Compressed air
	• System check
	  ○ Leaks
	  ○ Inadequate grade
	• Specifications
	• Pressure test
	• Codes and regulations
	• Sensory inspection
	• Safe work practices

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

Competency: G7 Service Sewage Treatment System 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	CONTENT
1. Describe the maintenance of sewage treatment systems and components	• Schedules • Pumping • Inspection • Component verification • Specifications • Tools and equipment • Documentation

2. Describe troubleshooting procedures for sewage treatment systems and components	• Inspection
	• Safe work practices
	  ○ Confined space
	  ○ Point of access
	• Verify reported problem
	  ○ Cause
	  ○ Result
	• Faults
	• Component verification
	• Tools and equipment
	• Isolation
	• Return to service
	• Documentation

3. Describe the repair of sewage treatment systems and components	• Safe work practices
	  ○ Confined space
	  ○ Point of access
	• Tools and equipment
	• Isolation
	• Repair or replace components
	• Testing
	• Return to service
	• Documentation

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

Competency: 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	CONTENT

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
	• Verify reported problem
	  ○ Cause
	  ○ Result
	• Faults
	  ○ Tree roots
	  ○ Settling
	  ○ Physical damage
	  ○ Fatbergs
	  ○ 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 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.

LEARNING TASKS	CONTENT

1. Describe the testing of water service and distribution systems	• Safe work practices
	• Types
	  ○ Hydrostatic
	  ○ Compressed gas
	• Tools and equipment
	  ○ Gauges
	  ○ Pumps
	  ○ Compressor
	• Code and regulations
	  ○ AHJ
	• Components
	  ○ Water meters
	  ○ Isolation valves
	  ○ Cross connection control devices
	  ○ Check valves
	  ○ Expansion devices
	  ○ Pumps
	  ○ Post indicator valves
	  ○ Fire hydrants
	• Inspection
	• Documentation

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

Competency: I4 Service Water Service and Distribution Systems

Objectives

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

- Describe the servicing of water service and distribution systems.

LEARNING TASKS	CONTENT
1. Describe the maintenance of water service and distribution systems	• Maintenance schedules • Inspection • Component verification • Specifications, codes, regulations ○ AHJ • Tools and equipment • Isolation • Testing • Return to service • Documentation

2. Describe the troubleshooting and repair of water service and distribution systems	• Troubleshoot
	  ○ Verify reported problem
	  ○ Inspection
	  ○ Component verification
	  ○ Isolation
	• Repair
	  ○ Safe work practices
	  – Confined space
	  – Point of access
	  – Shoring
	  ○ Tools and equipment
	  ○ Isolation
	  ○ Repair or replace components
	  ○ Testing
	  ○ Return to service
	  ○ Documentation

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

Competency: I5 Commission Water Service and Distribution Systems

Objectives

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

- Describe the commissioning of water service and distribution systems.

LEARNING TASKS	CONTENT

1. Describe the commissioning of water service and distribution systems	• Pre-check
	• Hazards
	• Safe work practices
	• Chemical treatment
	• Purging
	  ○ Air
	  ○ Chemical
	  ○ Test water
	• Flushing
	• Commissioning equipment
	• Start-up
	  ○ Permits
	  – AHJ
	  ○ Electrical supply and connections
	  – Hot water tanks
	  – Water treatment equipment
	  – Pumps
	  – Heat tracing
	  – Water meters
	  ○ Codes and regulations
	  – AHJ
	  ○ Manufacturer's documentation
	  ○ Valves test
	  – Cross connection control assemblies
	  – Pressure reducing valve (PRV) set points

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

LEARNING TASKS	CONTENT
	○ Flow control valve ○ Pump support – Safety cable • Heat tracing • Pressure tanks • Electrical ○ Pumps ○ Wiring ○ Pressure switches ○ Control panels ○ Variable frequency drives (VFD)
2. Size pressure systems	• Calculations ○ Peak flow demand ○ Elevations and distances ○ Total dynamic head • Codes and regulations ○ AHJ • Drawings and specifications ○ Manufacturers documentation • Components • Equipment • Water source factors ○ Drawdown ○ Yield ○ Depth • Pump selection
3. Describe the installation of piping for pressure systems	• Layout/routing ○ Environmental ○ Site conditions • Safe work practices • Materials • Components • Tools and equpiment • Codes and regulations ○ AHJ • Drawings and specifications • Connections • Protection

Achievement Criteria

Performance	The learner will be able to size a pressure system and select a pump.
Conditions	To be assessed during technical training. The learner will be given: • Drawing and specifications • Pump performance curve
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
  - AHJ
  - Manufacturers specifications
- Drawings and specifications
- Components
  - Hydropneumatic tank
  - Pressure relief valve
  - Pitless adapters
  - Cables for removal
  - Well seals
  - Torque arrestor
  - Electrical
    - Pressure switch
    - Load sensor
    - Pump control
    - Variable frequency drives (VFD)
- Tools and equipment
- Assembly
- Connection
  - Power
  - Controls
  - Water
- Protection methods
  - Pitless adapters
  - Pump house
  - Heat tracing

Line (GAC): K INSTALL PRESSURE SYSTEMS

Competency: K3 Test Pressure Systems

Objectives

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

- Describe the testing of pressure systems.

LEARNING TASKS	CONTENT

1. Describe the testing of pressure systems	• Safe work practices
	• Tools and equipment
	• Types
	  ○ Fluid
	  ○ Test air
	• Purging
	• Apply test
	• Procedures
	  ○ Filling
	  ○ Draining
	• Faults
	  ○ Electrical
	  ○ Leaks
	• Lock-out/tag-out
	• Return to service
	• Sensory inspection
	• Documentation

Line (GAC): K INSTALL PRESSURE SYSTEMS

Competency: K4 Service Pressure Systems

Objectives

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

- Describe the servicing of pressure systems.

LEARNING TASKS	CONTENT

1. Describe maintenance procedures for pressure systems	• Schedules
	• Sensory inspection
	• Lubrication
	• Chemicals
	• Fluids
	• Components
	  ○ Pressure tanks
	  ○ Pressure switch
	  ○ Check valve
	  ○ Pressure relief valve
	  ○ Sensor lines
	• Faults
	  ○ Wear
	  ○ Leaks
	  ○ Noise
	  ○ Corrosion
	  ○ Electrical

2. Describe troubleshooting and repair procedures for pressure systems	• 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

Line (GAC): K INSTALL PRESSURE SYSTEMS

Competency: K5 Commission Pressure Systems

Objectives

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

- Describe the commissioning of pressure systems.

LEARNING TASKS	CONTENT

1. Describe the commissioning of pressure systems	• 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
	• Documentation
	• Instruct client in equipment operation

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L6 Test 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.

LEARNING TASKS

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

CONTENT

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

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L7 Service Hydronic Systems, Components and Controls

Objectives

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

- Describe the servicing of hydronic systems, components and controls.

LEARNING TASKS	CONTENT

1. Describe the maintenance of hydronic systems, components and controls	• Manufacturers' specfications
	• Schedules
	• Sensory inspection
	• Lubrication
	• Fluids
	• Components
	  ○ Wear
	  ○ Noise
	  ○ Leaks

2. Describe troubleshooting and repair procedures hydronic systems, components and controls	• Client consultation
	• Inspection/testing
	  ○ Sensory
	  ○ Diagnostic
	  ○ Monitoring
	• Lock-out/tag-out
	• Isolate components
	• Conditions for repair/replacement
	  ○ Thermal anomolies
	  ○ Leaks
	  ○ Corrosion
	  ○ Control malfunction
	  ○ Vibration
	  ○ Irregular flow
	  ○ Air lock
	• Tools and equipment
	• Repair/replace components
	• Return to service
	• Documentation

Line (GAC): L INSTALL HYDRONIC SYSTEMS

Competency: L8 Commission Hydronic Systems, Components and Controls

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe commissioning procedures for hydronic systems, components and controls	• Design requirements
	  ○ Safety features
	  – Limits
	  ○ Temperature drop
	  ○ System balancing
	  – Flow rates (zones)
	  ○ Air flow (forced convector)
	  ○ Flow directions
	  ○ Control sequence
	  – Sensor checks
	  ○ Piping configuration
	  ○ Air removal
	  ○ Cross connection controls
	  ○ Make-up water line

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

- Types
  - De-ionizers
  - Filters
    - Mechanical removal (screen)
    - Adsorption
- Ionic exchange
  - Water softeners
  - Iron
  - Tannin
- Neutralizing
- Reverse osmosis systems
- Ultra-violet (UV) disenfection
- Chemical feed
  - Chlorination
  - pH adjustment
- Distillation
- Characteristics
  - Heat
  - Pressure
- Water quality
  - Hardness
  - Minerals
    - Iron
    - Calcium
    - Magnesium
    - Arsenic
  - Hydrogen Sulfide (H_2S)
  - Methane
  - Trihalomethane (THM)
  - Contamination/pollution
  - pH
  - Taste/odour
  - Turbidity
- Operation

LEARNING TASKS	CONTENT

2. Describe the sizing of water treatment equipment	• Water samples
	  ○ Collection
	  ○ Testing
	  ○ Analysis
	• Water demand
	• Selection
	  ○ Test results
	  ○ Specifications
	  ○ Space contraints

3. Describe the installation of water treatment equipment	• 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
	• Leveling
	• Restraints
	• Connections
	• Protection
	  ○ Mechanical damage
	  ○ Seismic activity
	  ○ Environmental conditions

Line (GAC): M INSTALL WATER TREATMENT SYSTEMS

Competency: M2 Test and Commission Water Treatment Equipment

Objectives

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

- Test and commission water treatment equipment.

LEARNING TASKS

1. Describe testing and commissioning for water treatment equipment

CONTENT

- Safe work practices
- Testing equipment
  - pH kits
  - mineral kits
- Drawings and specifications
- Codes and regulations
  - AHJ
  - Manufacturers requirements
- Faults
  - Leaks
  - Inadequate operation
  - Cracks
  - Improper selection/sequence
- Inspection
- System verification
- Post-test
- Water samples
  - Collection
  - Testing
  - Analysis
- Adjustments
- Commissioning equipment
- Service/regeneration intervals
- Instruct client in equipment operation

Achievement Criteria

Performance	The learner will be able to test a water sample.
Conditions	To be assessed during technical training. The learner will be given: • Water sample test kit • Water samples
Criteria	The learner will be evaluated on: • Accuracy

Line (GAC): M INSTALL WATER TREATMENT SYSTEMS

Competency: M3 Service Water Treatment Equipment

Objectives

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

- Describe the servicing of water treatment equipment.

LEARNING TASKS	CONTENT

1. Describe maintenance procedures for water treatment equipment	• Sensory inspection
	• Replace Consumables
	  ○ Filters
	  ○ Regeneration materials
	  ○ Ultra-violet (UV) lamps
	  ○ Limestone chips
	  ○ Reverse-osmosis (RO) membrane
	• Components
	  ○ Scale removal (distillers)
	  ○ Cleaning

2. Describe troubleshooting and repair procedures for water treatment equipment	• Safe work practices
	• Verify reported problem
	• Tools and equipment
	• Inspection/testing
	  ○ Sensory
	  ○ Diagnostic
	  ○ Monitoring
	• Lock-out/tag-out
	• Isolate components
	• Conditions for repair/replacement
	  ○ Temperature
	  ○ Leaks
	  ○ Corrosion
	  ○ Control malfunction
	  ○ Vibration
	  ○ Irregular movement
	• Repair/replace components
	• Return to service
	• Documentation

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	CONTENT

1. Describe medical gas systems	• Gas types
	• Uses/purpose
	• Sources of medical gas
	  ○ Storage
	  – Bulk tanks
	  – Cylinders
	  ○ Compressors
	• Accessory placement
	• Equipment
	  ○ Vacuum pumps
	  ○ Air compressors
	  ○ Reserve systems
	  ○ Valves
	  ○ Alarms
	• Safety features
	• Relationships
	  ○ Owner
	  ○ Installer
	  ○ Third party inspectors

2. Describe process piping systems	• Safe work practices
	• System types and application
	• Design criteria
	  ○ Engineered drawings
	  – Code and regulations
	  – AHJ
	• Piping materials
	  ○ Application specific
	• Damage protection
	  ○ Mechanical
	  ○ Chemical
	  ○ Temperature

3. Describe the installation of medical gas piping system	• Layout ○ Areas not permitted

LEARNING TASKS	CONTENT
	○ Service requirements for different areas ○ Cross connection ○ Location ○ Limitations • Safe work practices • Codes and regulations ○ AHJ • Tools and equipment • Pipe types • Hangers and supports • Jointing • Cleaning and storing • Cutting, fitting, brazing • Degreasing • Capping • Certification requirements ○ CSA • Purging • Pressure testing

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N2 Install Equipment 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	CONTENT

1. Describe the installation of medical gas equipment	• Codes and regulations
	  ○ AHJ
	• Equipment
	  ○ Vacuum pumps
	  ○ Air compressors
	  ○ Bulk systems
	  ○ Reserve systems
	• Characteristics and requirements of equipment
	  ○ Zone valves
	  ○ Alarms
	  ○ Manifolds
	• Accessories
	  ○ Pressure reducing valves
	  ○ Pressure relief valves
	  ○ Dew-point sensors
	• Diameter Index Safety System (DISS)
	• Tools and equipment
	• Pipe connection to equipment
	• Pressure testing equipment
	• Alarm points

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N3 Test Specialized Systems

Objectives

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

- Describe testing for medical gas systems.

LEARNING TASKS	CONTENT

1. Describe testing for medical gas systems	• Types
	  ○ Cross connection
	  ○ Pressure
	  ○ Destructive
	  ○ Purity and flow
	  ○ Alarm
	• Applications
	• Equipment
	• Test medium
	• Components
	• Procedures
	• Testing agencies
	  ○ Third Party
	• Lock-out/tag-out
	• Return to service
	• Documentation

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N4 Service Specialized Systems

Objectives

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

- Describe the servicing of medical gas systems.

LEARNING TASKS	CONTENT

1. Describe maintenance procedures for medical gas systems	• Codes and regulations
	  ○ AHJ
	• Schedules
	• Sensory inspection
	• Components
	  ○ Lubrication

2. Describe troubleshooting and repair procedures for medical gas systems	• Codes and regulations
	  ○ AHJ
	• Interpret operator's information
	• Inspection/testing
	  ○ Sensory
	  ○ Diagnostic
	  ○ Monitoring
	• Safe work practices
	  ○ Lock-out/tag-out
	• Tools and equipment
	• Isolate components
	• Conditions for repair/replacement
	  ○ Temperature
	  ○ Leaks
	  ○ Corrosion
	  ○ Control malfunction
	  ○ Vibration
	• Procedures
	  ○ Cleaning
	  – Before
	  – During
	  – After
	  ○ Open system protection and identification
	• Repair/replace components
	• Return to service
	• Documentation

Line (GAC): N INSTALL SPECIALIZED SYSTEMS

Competency: N5 Commission Specialized Systems

Objectives

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

- Describe the commissioning of medical gas systems.

LEARNING TASKS	CONTENT

1. Describe the commissioning of medical gas systems	• Codes and regulations
	  ○ AHJ
	• Manufacturer's documentation
	• Permits
	• Visual pre-check
	• Safe work practices
	• Purging
	• Equipment
	• Electrical supply and connections
	• Test
	  ○ Valves
	  ○ Leak
	  ○ Alarms
	• 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	CONTENT
1. Identify motor components	• Types of components

2. Describe characteristics and operation of single phase motors	• AC theory
	  ○ Electromagnetic theory
	  ○ 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	CONTENT

1. Describe three phase motors	• Three phase supplies
	  ○ Delta supply
	  ○ 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	CONTENT

1. Describe the Canadian Electrical Code Part 1	• Section
	  ○ 0,2,4,8,10,12
	  ○ Appendix B
	  ○ Appendix D

2. Interpret the Electrical Safety Regulations	• Technical Safety BC (formerly BC Safety Authority [BCSA])
3. Size conductors	• Section 4 CEC
4. Describe wiring installation	• Section 12 CEC
5. Describe grounding and bonding techniques	• 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:

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

LEARNING TASKS	CONTENT

1. Describe manual valves	• Types
	  ○ Plug valves
	  ○ Butterfly
	  ○ Ball valves
	  ○ Needle valves
	• Construction
	• Operation
	• Pressure markings and ratings
	• Maintenance

2. Describe automatic gas valves	• Electric
	  ○ Solenoid
	  ○ Diaphragm
	  ○ Combination
	  ○ Single stage
	  ○ Two stage
	  ○ Modulating
	  ○ Pilot safety
	  – Safety shut off
	• Non-electric
	  ○ Rod and tube
	  ○ Hydraulic

3. Describe pressure regulators	• Types
	  ○ Appliances
	  ○ Line pressure
	  ○ Service
	  ○ Direct operated
	• Operating elements
	  ○ Loading
	  ○ Measuring
	  ○ Restricting
	• Pressure adjustment
	  ○ Gas line
	  ○ Manifold

LEARNING TASKS	CONTENT

4. Describe gas valve train for appliances 400 MBH or less	• Parts
	• Operating principles
	• Applications
	• Regulators
	• Gas valves
	• Manual valves
	  ○ A-cock
	  ○ B-cock
	  ○ Test firing
	• Flow control

5. Describe the operation of a gas valve train	• 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	CONTENT
1. Determine load	• Appliance rating plates • Manufacturer's documentation
2. Layout the system	• Pressure • System Regulators • Regulator locations • Hangers and supports • Valve placement • Drip legs • Routing

3. Size the system	• Piping material
	• Pressure
	  ○ 7-14 in WC
	  ○ 2 psig
	• Lengths
	• Type of gas
	• Pressure drop

4. Determine material take-off	• 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 — To be assessed during technical training.
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 Train Components

Objectives

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

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

LEARNING TASKS	CONTENT
1. Describe the installation of manual shut-off valves	• Code requirements • Manufacturer's specifications • Procedures ○ 2 piece ball valves
2. Describe the installation of pressure regulators	• Code requirements • Manufacturer's 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	CONTENT

1. Describe installation of passive air supply	• 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 COMMISSION GAS-FIRED APPLIANCES AND EQUIPMENT

Competency: 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	CONTENT
1. Describe piping and tubing testing requirements	• B149.1 • Pressure • Duration • Equipment

2. Describe piping and tubing pressure testing procedures	• Air
	  ○ Tools
	  ○ Equipment
	  ○ Spools
	  ○ System isolation
	  – Lock-out
	• Inert gases
	  ○ Tools
	  ○ Equipment
	  ○ Spools
	  ○ System isolation
	  – Lock-out
	  ○ Calculations
	• Leak (integrity) testing
	  ○ Soap test
	  ○ After appliance connection
	• Valve tightness of closure testing

3. Describe purging procedures for piping and tubing under 4 inch diameter	• Code requirements
	  ○ Locations
	  ○ Equipment
	  ○ Duration

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 mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Plumber Standardized Level exam.		IN-SCHOOL %	

In-school mark Combined theory and practical subject competency multiplied by	80%
Standard Level Exam mark The exam score is multiplied by	20%
Final Level mark	100%

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 mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Plumber Standardized Level exam.		IN-SCHOOL %	

In-school mark Combined theory and practical subject competency multiplied by	80%
Standard Level Exam mark The exam score is multiplied by	20%
Final Level mark	100%

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 mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Plumber Standardized Level exam.		IN-SCHOOL %	

In-school mark	80%
Standard Level Exam mark The exam score is multiplied by	20%
Final Level mark	100%

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%	40%
L	Install Hydronic Systems	5%	0%
M	Install Water Treatment Systems	12%	10%
N	Install Specialized Systems	8%	0%
O	Apply Electrical Concepts	11%	0%
P	Plan Gas-Fired Appliance System Installations	11%	50%
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 percentage score of 70% or greater will write the Interprovincial Red Seal examination as their final assessment.

SkilledTradesBC will enter the apprentices' Plumber Interprovincial Red Seal examination percentage score into SkilledTradesBC Portal.

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

Section 5

TRAINING PROVIDER STANDARDS

Facility Requirements

Classroom Area

- 350 square feet of floor space (22 square feet per learner)
- Compliance with the local and national fire code and occupational safety requirements
- Meets applicable municipal zoning bylaws for technical instruction and education facilities
- Comfortable seating and tables suitable for learning
- Overhead and multimedia projectors and screen
- Whiteboard with marking pens and erasers
- 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

Other

- N/A

Tools and Equipment

Shop (Facility) Tools and Equipment

Hand Tools

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

Power Tools

Air compressor (and accessories)
Beveling tools (hand and electric drive)
Compaction equipment
Concrete cutter
Coring machines
Cryogenic equipment
Die grinder
Drain cleaning equipment
Drills (electric, pneumatic, hammer, bench or stand press, mag)
Hydraulic jacks
Hydraulic torque wrench
Impact driver
Inspection cameras
Mini-grinder
Portable end-prep milling (pneumatic, electric)
Powder-actuated tools
Pumps (booster, hydrostatic)
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))
Magnahelic 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
Grip hoist (Tirfor®)
Hooks
Jacks (hydraulic, ram and piston)
Plate clamp
Rope (nylon, synthetic)
Rugger
Shackles
Skid steer loader

Chain block hoist (endless chain)
Chain puller
Come-along
D-ring
Dolly
Equalizer beam
Eye bolts
Forklift , telescopic forklift
Slings (nylon, wire rope, wire mesh) and chokers
Snatch block
Softeners
Spreader bar
Tag line
Tuggers (power)
Winches

Ladders and Platforms (Access Equipment)

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

Personal Protective and Safety Equipment

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

Testing, Measuring and Communication Equipment

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

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
- Student Materials Package 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.technicalsafetybc.ca
- Candian Electrical Code (current version)
- Safety Standards Act

Recommended Resources

- CSA Gas Trade Training Modules, ISBN 978-1-4883-0127-8
- Low Pressure Boilers, Frederick M. Steingrass, Daryl R. Walker, American Technical Publishers, ISBN 978-0-8269-4365-1
- High Pressure Boilers, Frederick M. Steingrass,Harold J. Frost, Daryl R. Walker, American Technical Publishers, ISBN 978-0-8269-4315-6
- IPT's Guide to Blueprint Interpretation, ISBN: 978-0-920855-42-3
- CAN/ CSA B.214 Installation of Hydronic Heating Systems
- Modern Hydronic Heating – John Seigenthaler, ISBN
- Fundamentals of Gas Utilization – John Dutton, ISBN 978-0-9198-5235-8
- Design of Fluid Systems – Spirax Sarco, ISBN
- Electricity & Controls for HVAC/R – Herman/Sparkman, ISBN 978-1133-2782-07

Suggested Texts/Websites

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

NOTE:

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

Instructor Requirements

Occupation Qualification

The instructor must possess:

- 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
  - Word processing
  - Spreadsheets
  - Presentations
- CAD

Appendices

Appendix A
Acronyms

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

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

Appendix B
Previous Contributors

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

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

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

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

Appendix C
Technical Safety BC Requirements

(in support of Gasfitter – Class B training)

Gasfitter – Class B Exam administered by Technical Safety BC:

- Successful completion of 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 beginning on page 183)

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