SKILLEDTRADES BC

PROGRAM OUTLINE

Plumber

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SKILLED TRADES BC

PLUMBER

PROGRAM OUTLINE

May 2009

Developed By
SkilledTradesBC
Province of British Columbia

SKILLED TRADES BC

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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 Occupational Analysis (2008) 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.

The Program Outline was prepared with the advice and assistance of the Plumber Review Committee and will form the basis for further updating of the British Columbia Plumber Program and learning resources by the Construction Industry Training Organization on behalf of SkilledTradesBC.

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

This Program Outline was prepared with the advice and direction from the Plumbing Review Committee with funding support from SkilledTradesBC.

SkilledTradesBC would like to acknowledge the dedication and hard work of the industry representatives appointed to identify the training requirements of the Plumbing trade:

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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 various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment	Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience	Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided	Understand the relative weightings of various areas 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 2

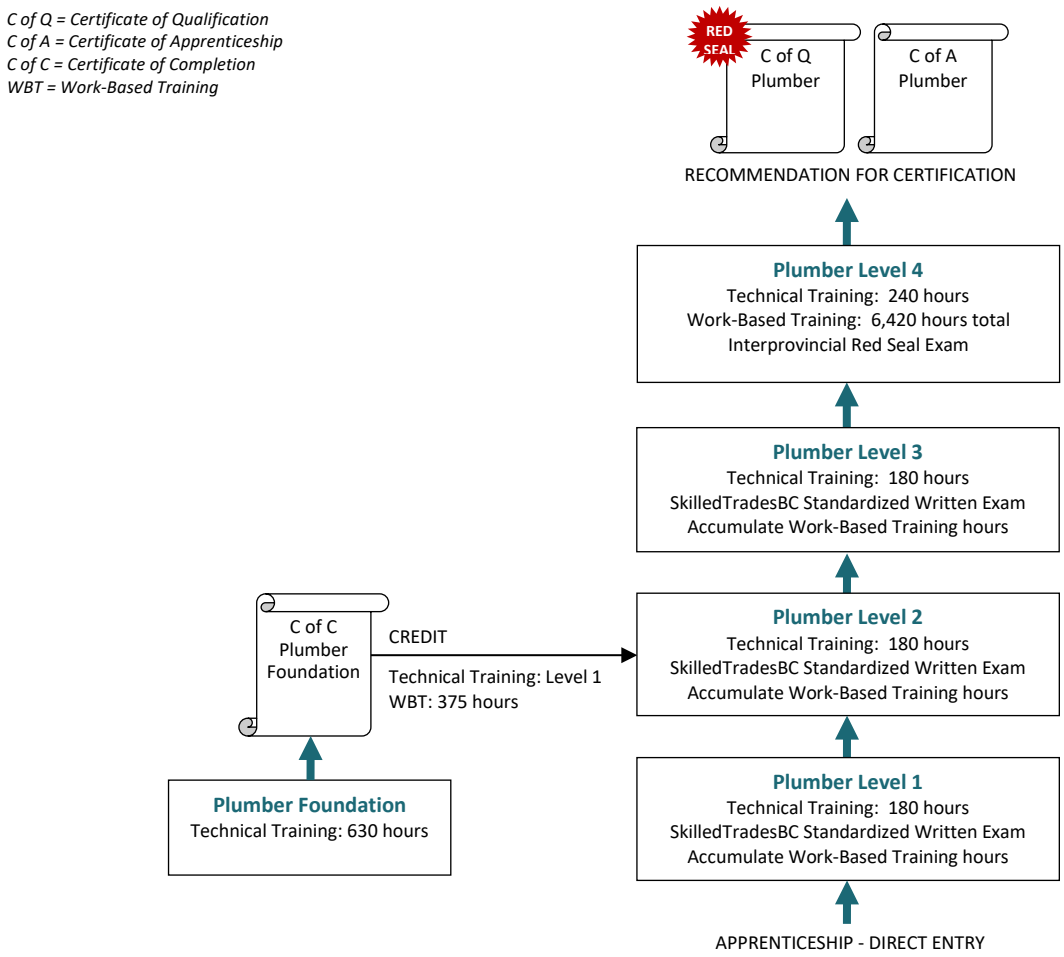
PROGRAM OVERVIEW

Plumber

PROGRAM CREDENTIALING MODEL

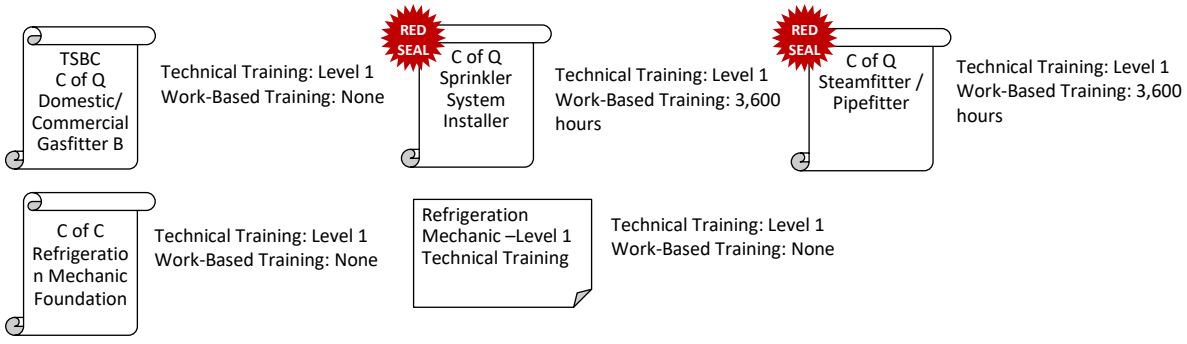
Apprenticeship Pathway

This graphic provides an overview of the Plumber apprenticeship pathway.



CROSS-PROGRAM CREDITS

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



Occupation Analysis Chart
PLUMBER

Competency	Task	Code	Levels
Use Safe Work Practices (A)	Control Workplace Hazards	A1	1
	Use information in the OHS Regulation and WCB Standards	A2	1
	Use WHMIS	A3	1
	Use personal protective equipment	A4	1
	Practice fire prevention	A5	1
Use Tools and Equipment (B)	Use hand tools	B1	1
	Use portable power tools	B2	1
	Use stationary power tools	B3	1
	Use measuring and levelling tools	B4	1, 2
	Use cutting, brazing and soldering equipment	B5	1
	Use ladders and platforms	B6	1
	Use rigging and hoisting equipment	B7	1
Organize Work (C)	Use mathematics and science	C1	1
	Read drawings and specifications	C2	1, 2, 3, 4
	Use codes, regulations and standards	C3	1
	Use manufacturer and supplier documentation	C4	1
	Plan a project	C5	2, 4
Prepare and Assemble Plumbing Components (D)	Install pipe	D1	1
	Install valves	D2	1
	Install fittings	D3	1
	Penetrate structures	D4	1
Install Sanitary and Storm Drainage Systems (E)	Install sanitary drain, waste and vent systems	E1	2, 4
	Install Storm Drainage Systems	E2	2, 4
	Install sanitary sewer systems	E3	4
	Test and commission sanitary and storm drainage systems	E4	2, 4
	Maintain and repair sanitary and storm drainage systems	E5	2, 4

Install Private Sewage Systems F	Install private sewage disposal systems	F1				4	
	Maintain and repair sewage disposal systems	F2				4	
Install Water Service and Distribution G	Install water services	G1			3		
	Install potable water distribution systems	G2			3	4	
	Install private potable water supply systems	G3			3		
	Install water treatment systems	G4			3		
	Test and commission potable water systems	G5			3		
	Maintain and repair potable water systems	G6			3		
Install Fixtures and Appliances H	Install fixtures and trim	H1		2			
	Install appliances	H2		2	3		
	Test and commission fixtures and appliances	H3		2	3		
	Maintain and repair fixtures and appliances	H4		2	3		
Install Hydronic Heating and Cooling I	Describe the operation of hydronic heating and cooling piping systems	I1		2			
	Install hydronic heating and cooling systems	I2		2		4	
	Test and commission hydronic systems	I3		2		4	
	Maintain and repair hydronic systems	I4		2		4	
Install Specialized Systems J	Install medical gas systems	J1		2			
	Install irrigation systems	J2				4	
	Install compressed air systems	J3		2			
	Install fire protection systems	J4			3		
	Test and commission specialized systems	J5		2	3	4	
	Maintain and repair specialized systems	J6		2	3	4	
Apply Plumbing Principles K	Apply Plumbing Principles	K1				4	
Install Natural Gas and Propane Systems L	Install and Service Fuel Systems	L1			3	4	
	Install and Service Gas Equipment	L2			3	4	
	Install Venting and Air Supply	L3				4	
	Install and Service Controls and Safeguards	L4				4	
	Use gas codes, regulations and standards	L5				4	

SUGGESTED SCHEDULE OF TIME ALLOTMENT FOR PLUMBER LEVEL ONE

		Theory %	Practical %
Line A	**Use Safe Work Practices**	**8**	**5**
A-1	Control Workplace Hazards	20	✓
A-2	Use information in the OHS Regulation and WCB Standards	20	
A-3	Use WHMIS	20	
A-4	Use Personal Protective Equipment	20	✓
A-5	Practice Fire Prevention	20	
Line B	**Use Tools and Equipment**	**11**	**53**
B-1	Use Hand Tools	16	
B-2	Use Portable Power Tools	16	
B-3	Use Stationary Power Tools	16	
B-4	Use Measuring and Levelling Tools	4	✓
B-5	Use Cutting, Brazing and Soldering Equipment	16	✓
B-6	Use Ladders and Platforms	16	
B-7	Use Rigging and Hoisting Equipment	16	✓
Line C	**Organize Work**	**70**	**8**
C-1	Use Mathematics and Science	60	
C-2	Read Drawings and Specifications	30	✓
C-3	Use Codes, Regulations and Standards	5	✓
C-4	Use Manufacturer and Supplier Documentation	5	
Line D	**Prepare and Assemble Plumbing Components**	**11**	**34**
D-1	Install Pipe	35	✓
D-2	Install Valves	25	
D-3	Install Fittings	25	
D-4	Penetrate Structures	15	
	Total Percentage for Level 1	**100%**	**100%**

The Composite level mark is to consist of 63% theory and 37% Practical.

SUGGESTED SCHEDULE OF TIME ALLOTMENT FOR PLUMBER LEVEL TWO

		Theory %	Practical %
Line B	**Use Tools and Equipment**	**3**	**6**
B-4	Use Measuring and Levelling Tools	100	✓
Line C	**Organize Work**	**3**	**15**
C-2	Read Drawings and Specifications	40	✓
C-5	Plan a Project	60	✓
Line E	**Install Sanitary and Storm Drainage Systems**	**50**	**50**
E-1	Install Sanitary Drain, Waste and Vent Systems	80	✓
E-2	Install Storm Drainage Systems	10	
E-4	Test and Commission Sanitary and Storm Drainage Systems	5	
E-5	Maintain and Repair Sanitary and Storm Drainage Systems	5	
Line H	**Install Fixtures and Appliances**	**10**	
H-1	Install Fixtures and Trim	30	
H-2	Install Appliances	30	
H-3	Test and Commission Fixtures and Appliances	10	
H-4	Maintain and Repair Fixtures and Appliances	30	
Line I	**Install Hydronic Heating and Cooling**	**30**	**29**
I-1	Describe the operation of Hydronic Heating and Cooling Piping Systems	40	
I-2	Install Hydronic Heating and Cooling Systems	40	✓
I-3	Test and Commission Hydronic Systems	10	
I-4	Maintain and Repair Hydronic Systems	10	
Line J	**Install Specialized Systems**	**4**	
J-1	Install Medical Gas Systems	40	
J-3	Install Compressed Air Systems	40	
J-5	Test and Commission Specialized Systems	10	
J-6	Maintain and Repair Specialized Systems	10	
	Total Percentage for Level 2	**100%**	**100%**

The composite level mark is to consist of 63% theory and 37% practical.

SUGGESTED SCHEDULE OF TIME ALLOTMENT FOR PLUMBER LEVEL THREE

		Theory %	Practical %
Line C	**Organize Work**	**9**	**12**
C-2	Read Drawings and Specifications	100	✓
Line G	**Install Water Service and Distribution**	**50**	**50**
G-1	Install Water Services	5	
G-2	Install Potable Water Distribution Systems	55	✓
G-3	Install Private Potable Water Supply Systems	15	✓
G-4	Install Water Treatment Systems	15	
G-5	Test and Commission Potable Water Systems	5	
G-6	Maintain and Repair Potable Water Systems	5	
Line H	**Install Fixtures and Appliances**	**9**	
H-2	Install Appliances	80	
H-3	Test and Commission Fixtures and Appliances	10	
H-4	Maintain and Repair Fixtures and Appliances	10	
Line J	**Install Specialized Systems**	**6**	
J-4	Install Fire Protection Systems	50	
J-5	Test and Commission Specialized Systems	25	
J-6	Maintain and Repair Specialized Systems	25	
Line L	**Install Natural Gas and Propane Systems**	**26**	**38**
L-1	Install and Service Fuel Systems	75	✓
L-2	Install and Service Gas Equipment	25	✓
	Total Percentage for Level 3	**100%**	**100%**

The composite level mark is to consist of 73% Theory and 27% Practical.

SUGGESTED SCHEDULE OF TIME ALLOTMENT For
Plumber **LEVEL FOUR**

		Theory %	Practical %
Line C	**Organize Work**	**3**	
C-2	Read Drawings and Specifications	50	✓
C-5	Plan a Project	50	✓
Line E	**Install Sanitary and Storm Drainage Systems**	**9**	**14**
E-1	Install Sanitary Drain, Waste and Vent Systems	30	✓
E-2	Install Storm Drainage Systems	30	
E-3	Install Sanitary Sewer Systems	30	
E-4	Test and Commission Sanitary and Storm Drainage Systems	5	
E-5	Maintain and Repair Sanitary and Storm Drainage Systems	5	
Line F	**Install Private Sewage Systems**	**6**	
F-1	Install Private Sewage Disposal Systems	80	
F-2	Maintain and Repair Sewage Disposal Systems	20	
Line G	**Install Water Service and Distribution**	**3**	
G-2	Install Potable Water Distribution Systems	100	✓
Line I	**Install Hydronic Heating and Cooling**	**9**	**14**
I-2	Install Hydronic Heating and Cooling Systems	80	✓
I-3	Test and Commission Hydronic Systems	10	
I-4	Maintain and Repair Hydronic Systems	10	
Line J	**Install Specialized Systems**	**3**	
J-2	Install Irrigation Systems	50	
J-5	Test and Commission Specialized Systems	25	
J-6	Maintain and Repair Specialized Systems	25	
Line K	**Apply Plumbing Principles**	**12**	
K-1	Apply Plumbing Principles	100	
Line L	**Install Natural Gas and Propane Systems**	**55**	**72**
L-1	Install and Service Fuel Systems	11	✓
L-2	Install and Service Gas Equipment	14	✓
L-3	Install Venting and Air Supply	18	✓
L-4	Install and Service Controls and Safeguards	28	✓
L-5	Use Gas Codes, Regulations, and Standards	29	
	Total Percentage for Level 4	**100%**	**100%**

The composite level mark is to consist of 82% Theory and 18% Practical.

Section 3

PROGRAM CONTENT

Plumber

LEVEL 1

Plumber

LINE A: USE SAFE WORK PRACTICES

Competency: A-1 Control Workplace Hazards

Learning Objectives:

1 The learner will be able to describe workplace hazards.
2 The learner will be able to manage workplace hazards.
3 The learner will be able to demonstrate emergency procedures.
4 The learner will be able to describe non-emergency injury reporting procedures.
5 The learner will be able to describe how worksite safety policies are established.

	LEARNING TASKS	CONTENT
1	Describe short term hazards in the plumbing industry	• Excavations • Working around heavy equipment • Sharp objects • Ladders • Work platforms • Confined space • Electrical • Lockout procedures • Compressed gas • Explosive material (dust) • Lifting – Procedures • Personal apparel – Clothing – Hair and beards – Jewellery • Housekeeping • Horseplay • Respect for others safety • Constant awareness of surroundings • Safe attitude • Management of hazards
2	Describe long term hazards in the plumbing industry	• Respiratory disease • Repetitive strain injuries • Management of hazards
3	Describe safety precautions when working at elevations	• Wind • Floor openings • Guard rails • Safety lines • Weather • Stressed Cables
4	Describe emergency procedures	• Emergency shutoffs • Fire control systems • Eye wash facilities • Emergency exits • Emergency contact/phone numbers • Outside meeting place • Disaster meeting place

5	Describe non-emergency injury reporting procedures	• First aid facilities • Reports
6	Describe how a workplace safety policy is established	• Process – Hazard assessment – Conditions – Meeting requirements ‣ Tool box – Reporting hazards and incidents – Reporting injuries – Investigations – Committees – Employee orientation – First-aid – Hearing – Records and statistics – Lock-out – Non-compliance procedures • Minimum standards – Acts and Regulations
7	Describe lock-out and tag-out procedures	• Understanding of system operation • Components requiring lock-out • Identification requirements • Situations where lock-out is required • Lock-out equipment – Chains – Tags – Locks • Fabrication of isolation devices – Blind flanges – Spades

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

1	Performance	The learner will lock-out mechanical and electrical equipment.
	Conditions	The learner will be given: Single and multiple lock-out equipment Motor control centre Disconnect Valve
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Proper procedure used Sequence Confirmation of lockout

LINE A: USE SAFE WORK PRACTICES

Competency: A-2 Use Information in the OHS Regulation and WCB Standards

Learning Objectives:

1 The learner will be able to locate the Parts of the Occupational Health and Safety Regulation as it applies to the Plumbing Worker's workplace.

LEARNING TASKS	CONTENT
1 Use terms used in the Workers' Compensation Act	• Definitions, Section 1 of the Act
2 Describe the conditions under which compensation will be paid	• Part 1, Division 2 of the Act
3 Describe the general duties of employers, employees and others	• Part 2, Division 3, Sections 115-124 of the Act
4 Describe the Workers' Compensation Act requirements for the reporting of accidents	• Part1, Division 5, Sections 53 and 54 of the Act
5 Describe the "Core Requirements" of the Occupational Health and Safety Regulation	• Definitions • Application • Rights and Responsibilities – Health and safety programs – Young worker orientation – Contractor's safety policy manuals – Investigations and reports – Workplace inspections – Right to refuse work • General Conditions – Building and equipment safety – Emergency preparedness – Preventing violence – Working alone – Ergonomics – Illumination – Indoor air quality – Smoking and lunchrooms

6	Apply the "General Hazard Requirements" of the Occupational Health and Safety Regulation (Book 2)	• Chemical and biological substances • Substance specific requirements • Noise, vibration, radiation and temperature • Personal protective clothing and equipment • Confined spaces • De-energization and lockout • Fall protection • Tools, machinery and equipment • Ladders, scaffolds and temporary work platforms • Cranes and hoists • Rigging • Mobile equipment • Transportation of workers • Traffic control • Electrical safety

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE A: USE SAFE WORK PRACTICES

Competency: **A-3** **Use WHMIS**

Learning Objectives:

1 The learner will be able to describe the purpose of the Workplace Hazardous Materials Information System (WHMIS) Regulations.
2 The learner will be able to explain the contents of material safety data sheets (MSDS).
3 The learner will be able to explain the contents of a WHMIS label.
4 The learner will be able to apply WHIMIS regulations

	LEARNING TASKS	CONTENT
1	State the legislation that requires suppliers of hazardous materials to provide MSDS's and label products as a condition of sale and importation	• Hazardous Product Act • Controlled Products Regulations • Ingredient Disclosure List • Hazardous Materials Information Review Act • Hazardous Materials Information Review Regulations
2	State the purpose of the Workplace Hazardous Materials Information System (WHMIS)	• Protection of Canadian workers from the adverse effects of hazardous materials through the provision of relevant information while minimizing the economic impact on industry and the disruption of trade • Recognition of rights – Workers – Employers – Suppliers – Regulators
3	Describe the key elements of WHMIS	• Material safety data sheets (MSDSs) • Labelling of containers of hazardous materials • Worker education programs
4	Describe the responsibilities of suppliers under WHMIS	• Provide – MSDSs – Labels
5	Describe the responsibilities of employers under WHMIS	• Provide – MSDSs – Labels – Work education programs in the workplace
6	Describe information to be disclosed on a MSDS	• Hazardous ingredients • Preparation information • Product information • Physical data • Fire or explosion • Reactivity data • Toxicological properties • Preventive measures • First-aid measures

7	Identify symbols found on WHMIS labels and their meaning	• Compressed gases • Flammable and combustible materials • Oxidizing materials • Poisonous and infectious materials – Materials Causing Immediate and Serious Toxic Effects – Materials Causing Other Toxic Effects – Biohazardous Infectious Materials • Corrosive Materials • Dangerously Reactive Materials
8	Apply WHMIS regulations as they apply to hazardous materials used in the shop	• Use, storage and disposal of shop materials

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE A: USE SAFE WORK PRACTICES

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

Learning Objectives:

1 The learner will be able to select and use personal protective equipment.

	LEARNING TASKS	CONTENT
1	Describe personal protective equipment requirements	• Safety footwear • Eye protection • Ear protection • Head protection • Respiratory protection • Clothing • Fall protection
2	Use personal protective equipment	• Selection • Purpose • Operating procedures • Training requirements • Inspection • Maintenance • Storage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will use personal protective equipment.
Conditions	The learner will be given: Personal protective equipment
Criteria	A suggested method of rating a student in this competency might be for the student to start with 100% and marks be deducted for each infraction that occurs while working in the shop. This would be reflected in the appropriate shop competencies

LINE A: USE SAFE WORK PRACTICES

Competency: **A-5 Practice Fire Prevention**

Learning Objectives:

1 The learner will be able to prevent and identify various classes of fires.

2 The learner will be able to select appropriate fire extinguishers for the class of fire and environmental 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 when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus	• Hot work permit (site specific) • Handling and storage of flammable materials • Symbols • Fuels – Diesel – Gasoline – Propane – Natural Gas • Ventilation – Purging • Lubricants • Oily rags • Combustible metals • Aerosols
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

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE B: USE TOOLS AND EQUIPMENT

Competency: **B-1 Use Hand Tools**

Learning Objectives:

1 The learner will be able to select hand tools appropriate to plumbing processes.
2 The learner will be able to use hand tools.
3 The learner will be able to inspect and maintain hand tools.

LEARNING TASKS	CONTENT
1 Describe hand tools used in the trade	• Cutting tools • Measuring and marking tools • Bracing and securing tools • Hammering tools • Leveling tools – Pitch levels • Wrenches and pliers • Screwdrivers • Chiseling tools • Squaring tools • Threading tools • Flaring and swaging tools • Tubing benders • Expanding and crimping tools
2 Use hand tools	• Types • Parts • Purpose/Uses • Procedures/Operations • Safety • Adjustment • Inspection • Maintenance • Storage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE B: USE TOOLS AND EQUIPMENT

Competency: **B-2 Use Portable Power Tools**

Learning Objectives:

1 The learner will be able to select portable power tools appropriate to plumbing processes.
2 The learner will be able to use portable power tools.
3 The learner will be able to inspect and maintain power tools.

LEARNING TASKS	CONTENT
1 Describe portable power tools	• Types – Electric – Pneumatic – Powder actuated • Certification requirements • Cutting tools • Grinding and abrasive tools • Threading tools • Drilling and boring tools • Specialty tools – Fusion tools – Power crimpers – Grooving tools – T-Drill • Accessories
2 Use portable power tools	• Types • Parts • Purpose/Uses • Procedures/Operations • Safety • Adjustment • Inspection • Maintenance • Storage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE B: USE TOOLS AND EQUIPMENT

Competency: **B-3 Use Stationary Power Tools**

Learning Objectives:

1 The learner will be able to select stationary power tools appropriate to plumbing processes.
2 The learner will be able to use shop equipment.
3 The learner will be able to inspect and maintain shop equipment.

	LEARNING TASKS	CONTENT
1	Describe stationary power tools	• Cutting tools • Grinding and abrasive tools • Threading tools • Drilling and boring tools • Specialty tools • Accessories • Grooving tools
2	Use stationary power tools	• Types • Parts • Purpose/Uses • Procedures/Operations • Capacities • Safety • Adjustment • Inspection • Minor maintenance • Storage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE B: USE TOOLS AND EQUIPMENT

Competency: B-4 Use Measuring and Levelling Tools

Learning Objectives:

1 The learner will be able to describe pressure measuring tools.
2 The learner will be able to use pressure measuring tools.

LEARNING TASKS	CONTENT
1 Describe pressure measuring tools	• Manometers – Types – Filling – Fluids • Mechanical gauges – Analog – Digital – Standard – Compound
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

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will use pressure gauges and manometers to measure standing and operating pressures.
Conditions	The learner will be given: A gas piping system Mechanical gauges Manometers
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Selection of test method Use of measurement devices Leak detection Correction Verification of correction

LINE B: USE TOOLS AND EQUIPMENT

Competency: **B-5 Use Cutting, Brazing and Soldering Equipment**

Learning Objectives:

1 The learner will be able to select cutting, brazing and soldering equipment appropriate to plumbing processes.
2 The learner will be able to use cutting brazing and soldering equipment.
3 The learner will be able to inspect and maintain cutting, brazing and soldering equipment.

LEARNING TASKS	CONTENT
1 Describe oxy-acetylene equipment	• Parts – Oxygen cylinders – Acetylene cylinders – Regulators – Gauges – Spark arrestors – Torches • Safety Devices
2 Describe cutting, brazing and soldering techniques	• Selection • Procedure • Limitations • Inspection
3 Use oxy-acetylene equipment	• Safety • Transportation of Dangerous Goods Legislation • Ventilation • Flammable material recognition • Types • Parts • Purpose/Uses • Procedures/Operations – Setup – Take down – Tip selection – Alloy selection – Flux selection • Adjustment • Inspection • Minor maintenance • Storage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

1	Performance	The learner will braze and solder
	Conditions	The learner will be given: Materials Specifications
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Penetration Accuracy Appearance Pressure test
2	Performance	The learner will cut carbon steel
	Conditions	The learner will be given: Materials Specifications
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Appearance Accuracy

LINE B: USE TOOLS AND EQUIPMENT

Competency: **B-6 Use Ladders and Platforms**

Learning Objectives:

1 The learner will be able to describe ladders and elevated platforms.
2 The learner will be able to select and use ladders and platforms.

LEARNING TASKS	CONTENT
1 Describe ladders and elevated platforms	• Types – Ladders – Platforms – Lifts • Uses • Safety • Fall arrest equipment • Hazard recognition • Government regulations
2 Use ladders and elevated platforms	• Selection • Operating procedures • Limitations • Securing • Inspection • Maintenance • Storage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE B: USE TOOLS AND EQUIPMENT

Competency: B-7 Use Rigging and Hoisting Equipment

Learning Objectives:

1 The learner will be able to describe hoisting, lifting and rigging equipment.
2 The learner will be able to tie knots, bends and hitches.
3 The learner will be able to select and use hoisting, lifting and rigging equipment.

	LEARNING TASKS	CONTENT
1	Describe the principles of lifting and hoisting	• Mechanical advantage • Balance points
2	Describe hoisting, lifting and rigging equipment	• Lifting and Hoisting – Cranes – Boom trucks – Loaders – Tirfors – Come-alongs – Tuggers – Chain falls • Accessories – Slings/chokes – Shackles – Chains – Tag lines – Spreader bars – Snatch blocks – Turnbuckles – Softeners
3	Describe lifting and hoisting communication	• Types – Hand signals – Communication with the operator – Communication with others • Purpose/meaning
4	Tie knots, bends and hitches	• Types – Half hitch – Timber hitch – Rolling hitch – Clove hitch – Figure of eight – Reef knot – Sheet bend – Bowline – Bowline on a bight – Trucker's hitch • Purposes • Limitations

5 Use hoisting, lifting and rigging equipment

- Safety
- Certification requirements
- Estimation of weights
- Equipment capacities
- Equipment selection
- Lifting location
- Operating procedures
- Communication/hand signals
- Securing of loads
- Equipment inspection
- Equipment maintenance
- Equipment storage
- Disposal procedures

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will set-up and lift loads
Conditions	The learner will be given: Two point lifts Three point lifts
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Proper equipment use

LINE C: ORGANIZE WORK

Competency: C-1 Use Mathematics and Science

Learning Objectives:

1 The learner will be able to use mathematics and science to solve problems in the plumbing trade.

	LEARNING TASKS	CONTENT
1	Add, subtract, multiply and divide whole numbers, fractions, decimals and percentages.	• Whole numbers, fractions, decimals, percentages
2	Transpose formulas	• Processes
3	Use formulas to calculate area.	• Circles, cylinders, squares, rectangles, triangles
4	Use formulas to calculate volumes.	• Cylinders, rectangular tanks, square tanks
5	Use formulas to calculate capacity.	• Imperial gallons, US gallons, Liters
6	Perform conversions	• Length • Volume • Capacity • Area • Mass • Weight • Heat energy • Temperature – Fahrenheit – Centigrade – Kelvin – Rankin • Pressure – Absolute – Gauge
7	Calculate piping measurements	• Terms – Thread allowance – Fitting allowance – End to end – End to centre – Centre to centre – Face to face – End to back – Back to back – Socket depth • Calculations • Grades • Elevations • Benchmarks

8	Use the Pythagorean theorem of right angles.	• Hypotenuse, side opposite, side adjacent
9	Calculate offsets using the applicable trigonometric function.	• Sine, cosine, tangent
10	Calculate the required measurements for a parallel piping offset.	• Equal spread • Rolling • Jumper
11	Define the properties of matter.	• Density • Cohesion • Adhesion • Tensile strength • Ductility • Malleability • Elasticity • Conductivity
12	Use Pascal's theory of pressure and force.	• Pounds • Newton's
13	Use Archimedes' principles of displacement and floatation.	• Specific weight • Specific gravity
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
17	Calculate the expansion and contraction of various piping materials due to heating and cooling.	• Ferrous • Non-ferrous • Thermoplastic
18	Define methods of heat transfer.	• Conduction • Convection • Radiation
19	Perform heat load calculations.	• Sensible, latent & specific heat

20	Describe characteristics of hydrocarbon gases	• Chemistry • Heat value • Specific gravity • Flow characteristics • Ignition temperature

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE C: ORGANIZE WORK

Competency: C-2 Read Drawings and Specifications

Learning Objectives:

1 The learner will be able to use drafting tools.
2 The learner will be able to use drafting symbols, lettering and line conventions.
3 The learner will be able to convert between isometric and orthographic projections.
4 The learner will be able to interpret information found on a set of drawings.

	LEARNING TASKS	CONTENT
1	Describe drafting tools and materials.	• Drawing boards • T-squares • Triangles • Protractors • French curves • Pencils • Erasers and shields • Scale rulers • Compasses • Dividers • Templates
2	Use scale rulers to determine actual dimensions from a piping diagram.	• Scale rulers
3	Describe piping and fixture symbols currently used in the plumbing trade.	• Tees • Wyes • Flanges • Elbows • Valves • Water closets • Urinals • Sinks • Tubs and showers
4	Describe lettering and dimensioning of piping diagrams.	• Hidden lines • Object lines • Border lines • Center lines • Dimension lines • Extension lines • Phantom lines
5	Describe drawing projections	• Isometric • Orthographic • Oblique • Views
6	Use drawing projections.	• Isometric • Orthographic • Conversion from one to the other

7	Use tools to sketch irregular shapes	• French curves • Templates • Compasses • Splines

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will create an isometric drawing from a set of orthographic drawings.
Conditions	The learner will be given: A set of orthographic drawings Sketching tools Paper
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Correct use of symbols, lines and lettering

LINE C: ORGANIZE WORK

Competency: **C-3 Use Codes, Regulations and Standards**

Learning Objectives:

1 The learner will be able to identify codes and standards encountered in the plumbing trade.
2 The learner will be able to identify various environmental agencies that affect the plumbing trade.

	LEARNING TASKS	CONTENT
1	Identify code, standards and organizations affecting the plumbing trade	• American National Standards Institute (ANSI) • American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) • American Society of Plumbing Engineers (ASPE) • American Society of Testing and Materials (ASTM) • American Water Works Association (AWWA) • National Standard of Canada (CAN) • Canadian Commission on Building and Fire Codes (CCBFC) • Canadian Gas Association (CGA) • Canadian General Standards Board (CGSB) • Canadian Standards Association (CSA) • National Building Code of Canada (NBC) • National Fire Protection Association (NFPA) • Underwriters' Laboratories of Canada (ULC) • Municipal bylaws – Permits • Health Act • Safety Standards Act • Leadership in Energy and Environmental Design (LEED)
2	Describe where the various codes and standards are encountered within the plumbing trade.	• Planning • Installation • Maintenance
3	Identify various environmental agencies with concerns to sewage disposal.	• BC Health Department • Workers' Compensation Board (WCB) Regulations (Worksafe BC) • BC Water and Waste Association (BCWWA)

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will use codes and standards in the application of shop projects
Conditions	The learner will be given: Projects Codes and standards
Criteria	This would be reflected in the appropriate shop competencies.

LINE C: ORGANIZE WORK

Competency: C-4 Use Manufacturer and Supplier Documentation

Learning Objectives:

1 The learner will be able to describe documentation encountered in the plumbing trade.
2 The learner will be able to describe information contained in manufacturer and supplier documentation.
3 The learner will be able to describe how to use the internet to source manufacturer's documentation.

	LEARNING TASKS	CONTENT
1	Describe documentation encountered in the plumbing trade	• Tool and equipment documentation • Material Safety and Data Sheets • System component documentation • Proprietary product documentation • Certification agencies
2	Describe information contained in manufacturer and supplier documentation	• Installation instructions and requirements • Operation and maintenance manuals • Product specifications • Warranty information
3	Describe how to use the internet to source manufacturer's documentation	• Manufacturer's web-sites • Search engines

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE D: PREPARE AND ASSEMBLE PLUMBING COMPONENTS

Competency: **D-1 Install Pipe**

Learning Objectives:

1 The learner will be able to describe piping and tubing materials used in the plumbing trade.
2 The learner will be able to join piping.

LEARNING TASKS	CONTENT
1 Describe piping and tubing materials.	• Copper pipe and tubing • Cast iron soil and pressure • Carbon and stainless steel pipe and tubing • Brass pipe and tubing • Thermoplastic pipe and tubing • Thermoset plastic pipe • Pyrex pipe • Specialty piping and tubing
2 Describe the method of manufacture.	• Carbon and stainless steel • Copper pipe and tubing • Thermoplastic pipe and tubing • Cast iron pipe • Schedules
3 Describe methods of pipe support	• Types – Hangers – Supports – Seismic – Anchors – Guides – Slide plates • Compatibility with piping • Size • Spacing • Fasteners – Beam clamps – Drop-in anchors – Draw bolts – Toggle bolts • Interferences • Insulation thickness • Elevation of hangers • Attachment methods • Tools and equipment
4 Describe methods of protecting piping	• Frost protection – Heat tape – Frost boxes – Circulating pumps • Ultraviolet protection • Corrosion protection

- Coatings
- Tape
- Physical damage
- Protective plates
- Sleeving
- Metal stud grommets
- Protective measures
- Insulating
- Water treatment
- Dielectric protection

5 Describe the inspection of pipe before installation

- Potential defects
- Pin holes
- Cracked fittings
- Bent ends
- Uneven casting
- Damaged pipe and coatings
- Environmental effects
- Inspection techniques
- Visual
- Sounding of cast iron pipe and fittings
- Interpretation of markings
- Checking against specifications

6 Install tubing and pipe

- Types
- Sizes
- Uses
- Hazards
- Safety
- Measuring procedures
- Selection for application
- Calculations
- Length
- Fitting allowances
- Offsets
- Gain or loss
- Cutting
- Bending
- Jointing Methods
- Common fitting angles
- Tools and equipment

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will install piping projects that include the following types of pipes: Plastic Copper Carbon steel
Conditions	The learner will be given: Project specifications Tools and materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Threading Soldering Brazing Solvent welding Crimping/Expanding Flaring Roll grooving Fusion Power crimping Compression fittings Pressure testing Mechanical joints

LINE D: PREPARE AND ASSEMBLE PLUMBING COMPONENTS

Competency: **D-2 Install Valves**

Learning Objectives:

1 The learner will be able to describe valves used in the plumbing trade.
2 The learner will be able to select and install valves.

LEARNING TASKS	CONTENT
1 Describe basic valve types.	• Types • Purpose • Materials • Seating design • Orientation • Temperature limitations • Pressure limitations • Applications • Specifications • Special purpose – Pressure relief – Temperature relief – Pressure reducing/Regulator
2 Install valves	• Selection – Applications – Specifications – Pressure limitations • Orientation • Installation requirements

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE D: PREPARE AND ASSEMBLE PLUMBING COMPONENTS

Competency: **D-3 Install Fittings**

Learning Objectives:

1 The learner will be able to describe fittings and connection methods used in the plumbing trade.
2 The learner will be able to select and install fittings.

	LEARNING TASKS	CONTENT
1	Describe fittings used in the plumbing trade.	• Purpose • Types • Applications • Limitations
2	Describe connection methods of fittings.	• Welded • Threaded • Compression • Flared • Soldered/brazed • Mechanical • Solvent welded
3	Select fittings	• Applications • Specifications

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE D: PREPARE AND ASSEMBLE PLUMBING COMPONENTS

Competency: **D-4 Penetrate Structures**

Learning Objectives:

1 The learner will be able to use acceptable methods of structure penetration.
2

LEARNING TASKS	CONTENT
1 Describe considerations when making penetrations in structures	• Structural integrity • Fire separation • Interference with other building components and systems • Hidden components behind the surface • Sleeve installation – Fabrication – Timing – Sealing around ‣ Fire stopping ‣ Water-proofing ‣ Isolating groundwater ‣ Protecting pipe ‣ Preventing oxidation – Sizing – Positioning – Fastening – Protection during concrete pour
2 Describe acceptable methods of structure penetration.	• B.C. Building Code • Manufacturer's literature • Fire stopping – Doughnut type – Gasket type – Caulking – Mineral wool • Fire rating requirements • Required gaps • Codes, specifications and requirements • Fastening or wrapping fire stopping to pipes • Sealing of vertical and horizontal penetrations • Selection of sealants according to specifications

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LEVEL 2

Plumber

LINE B: USE TOOLS AND EQUIPMENT

Competency: **B-4 Use Measuring and Levelling Tools**

Learning Objectives:

1 The learner will be able to describe the use of levelling equipment.

	LEARNING TASKS	CONTENT
1	Describe levelling equipment used in the plumbing trade to establish elevations	• Builder's level • Laser levels • Level rods and scales
2	Use levelling equipment to establish elevations	• Grade and pitch calculations • Procedures • Manufacturers' documentation • Inspection • Adjustment • Maintenance • Storage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will establish 10 sights
Conditions	The learner will be given: Sights Specifications Levelling equipment
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Accurate to within specifications

LINE C: ORGANIZE WORK

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

Learning Objectives:

1 The learner will be able to create plan and isometric drawings of residential piping systems.

	LEARNING TASKS	CONTENT
1	Create isometric drawings of piping systems	• Lettering • Line type • Information to be contained • Detail required • Dimensioning • Pipe sizing

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

1	Performance	The learner will create a plan view of a residential piping system from an architectural drawing.
	Conditions	The learner will be given: Architectural drawing Drawing instruments
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Done to code Efficient routing of piping
2	Performance	The learner will create an isometric projection from a plan view of a residential piping system.
	Conditions	The learner will be given: Orthographic projections
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Utilization of an isometric axis Proportional Correct symbols

LINE C: ORGANIZE WORK

Competency: **C-5 Plan a Project**

Learning Objectives:

1 The learner will be able to plan a residential plumbing project.
2 The learner will be able to select the proper procedure for handling plumbing materials.

	LEARNING TASKS	CONTENT
1	Describe organization of a residential project	• Project specifications • Safety • Sequence of operation • Prioritization • Coordination with other trades • Estimate material • Tools and equipment • Inventory requirements – Secure storage – Time delivery – Labelling materials – Stock maintenance – Consumables • Checklist utilization • Cost efficiency • Post job efficiency analysis
2	Describe considerations when handling plumbing materials	• Safety • Availability • Storage • Timing/sequencing • Transportation • Hoisting and rigging • Work platforms • Labelling • Moving • Product protection • Disposal • Recycling
3	Select procedures for handling plumbing materials	• Safety • Procedures • Securing • Packaging/Shipping

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will create a materials take-off list.
Conditions	The learner will be given: Drawings
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Accurate Complete Efficiency

LINE E: INSTALL SANITARY AND STORM DRAINAGE SYSTEMS

Competency: **E-1 Install Sanitary Drain, Waste and Vent Systems**

Learning Objectives:

1 The learner will be able to install sanitary drain, waste and vent systems as per code requirements.

	LEARNING TASKS	CONTENT
1	Describe terminology used in interior drain-waste-vent systems	• Definitions in the BC Plumbing Code
2	Describe the functions of pipes in an interior drain-waste-vent system	• Parts of a drain-waste-vent system • Function
3	Interpret Code requirements for parts of an interior drain-waste-vent system	• Types of piping • Size • Slopes • Fittings – Orientation – Prohibitions • Traps • Cleanouts • Venting • Hangers and supports – Spacing – Seismic • Jointing practices
4	Plan the layout of an interior drain-waste-vent system	• Location of structure penetrations • Routing • Pipe supports
5	Install drain-waste-vent systems	• Safety • Tools and equipment • Determination of slopes • Installation of components • Location of cleanouts • Testing • Inspection • Sealing of penetrations

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will install the drain, waste and vent for a bathroom group.
Conditions	The learner will be given: Specifications Tools and materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Accuracy Grade Piping support Code requirements Testing requirements

LINE E: INSTALL SANITARY AND STORM DRAINAGE SYSTEMS

Competency: **E-2 Install Storm Drainage Systems**

Learning Objectives:

1 The learner will be able to install storm drainage systems as per code requirements.

	LEARNING TASKS	CONTENT
1	Describe terminology used in storm drainage systems	• Definitions in the BC Plumbing Code
2	Describe the functions of pipes in storm drainage systems	• Parts • Function
3	Interpret Code requirements for parts of storm drainage systems	• Types of piping • Size • Slopes • Fittings – Orientation – Prohibitions • Traps • Cleanouts • Venting • Hangers and supports – Spacing – Seismic • Jointing practices • Insulation
4	Plan the layout of a storm drainage system	• Location of structure penetrations • Routing • Pipe supports
5	Install storm drainage systems	• Safety • Tools and equipment • Determination of slopes • Installation of components • Location of cleanouts • Testing • Inspection • Sealing of penetrations

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE E: INSTALL SANITARY AND STORM DRAINAGE SYSTEMS

Competency: **E-4 Test and Commission Sanitary and Storm Drainage Systems**

Learning Objectives:

1 The learner will be able to test and commission sanitary and storm drainage systems as per the BC Building Code.

	LEARNING TASKS	CONTENT
1	Identify code and requirements affecting testing of DWV systems.	• B.C. Plumbing Code • Authority having jurisdiction
2	Explain testing methods.	• Safety • Equipment • Procedure • Duration • Inspection • Documentation

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE E: INSTALL SANITARY AND STORM SYSTEMS

Competency: **E-5 Maintain and Repair Sanitary and Storm Drainage Systems**

Learning Objectives:

1 The learner will be able to maintain and repair sanitary and storm drainage systems.

LEARNING TASKS	CONTENT
1 Describe the use of drain cleaning equipment	• Video inspection – Pipe locators • Drain augers • Water blasters • Steam cleaning • Shop vacuum

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE H: INSTALL FIXTURES AND APPLIANCES

Competency: **H-1 Install Fixtures and Trim**

Learning Objectives:

1 The learner will be able to install fixtures and trim.

	LEARNING TASKS	CONTENT
1	Describe the installation of fixtures and trim	• Types • Fixtures and trim – Residential – Commercial – Institutional – Materials and finishes • Purpose • Supports – Carriers – Blocking – Wall hangers • Fasteners • Chaulking • Barrier-free requirements and regulations
2	Install fixtures and trim	• Manufacturers documentation • Protection during installation • Mounting heights • Levelling • Layout • Tools and equipment • Assembly • Mounting • Connection to water distribution systems and drainage • Application of sealants • Adjustment of settings • Coordination of connection of power

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE H: INSTALL FIXTURES AND TRIM

Competency: **H-2 Install Appliances**

Learning Objectives:

1 The learner will be able to install appliances.

LEARNING TASKS	CONTENT
1 Describe the installation of appliances	• Types • Appliances – Residential – Commercial – Institutional – Materials and finishes • Purpose • Supports
2 Install appliances	• Manufacturers documentation • Protection during installation • Mounting heights • Layout • Tools and equipment • Assembly • Mounting • Connection to water distribution systems and drainage • Application of sealants • Adjustment of settings • Coordination of connection of power

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE H: INSTALL FIXTURES AND APPLIANCES

Competency: **H-3 Test and Commission Fixtures and Appliances**

Learning Objectives:

1 The learner will be able to test and commission fixtures and appliances.

LEARNING TASKS	CONTENT
1 Describe the process of testing the correct operation of fixtures and appliances.	• Manufacturer's literature
2 Test and commission fixtures and appliances	• Flushing • Temperature checks • Set pressure • Set sensor ranges • Set levels

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE H: INSTALL FIXTURES AND APPLIANCES

Competency: **H-4 Maintain and Repair Fixtures and Appliances**

Learning Objectives:

1 The learner will be able to explain the procedures to maintain and repair fixtures and appliances.

	LEARNING TASKS	CONTENT
1	Describe the operation of fixtures and appliances	• Parts – Mechanical – Electrical • Purpose • Operation
2	Perform the maintenance procedures for fixtures and appliances	• Appurtenances • Faucet repair • Mixing and tempering valves • Water closet repair • Flush valve repair
3	Perform the repair procedures for fixtures and appliances	• Troubleshooting • Isolation • Replacement • Tools • Warranty

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE I: INSTALL HYDRONIC HEATING AND COOLING

Competency: I-1 Describe the Operation of Hydronic Heating and Cooling Systems

Learning Objectives:

1 The learner will be able to describe the operation of hydronic heating and cooling piping.

LEARNING TASKS	CONTENT
1 Describe the principles of electrical controls	• Circuit concepts – Source – Load – Switches – Conductors • Circuit types • Test equipment • Circuit diagrams • Symbols
2 Describe hydronic heating and cooling systems	• Purpose • Operation • Piping components – Circulating pumps – Flanges – Unions – Y-strainer and side stream filters – Check valves – Isolation valves – Pressure and temperature relief valves – Pressure reducing valves – Air scoops – Automatic air vents – Flow switches – Gauges – Pot feeders – Chemical treatment and backflow prevention – Expansion tanks – Low-water cutoffs – Expansion joints • Piping system configurations • Heating and cooling generating equipment – Boilers – Heat pumps – Heat exchangers – Solar panels • Controls – Valves – Thermometers – Thermostats – Sensors • Transfer units – In-floor heating

- Radiant panels
- Heat exchangers
- Force flow units
- Unit heaters
- Perimeter radiation

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE I: INSTALL HYDRONIC HEATING AND COOLING

Competency: I-2 Install Hydronic Heating and Cooling Systems

Learning Objectives:

1 The learner will be able to plan and install hydronic heating and cooling systems.
2

LEARNING TASKS	CONTENT
1 Plan and install hydronic heating and cooling piping systems	• Piping – Engineering specifications – High and low pressure – Routing and elevations – Drains and vents – Support and fastening – Jointing – Insulation • Circulating pumps – Types – Flanges and unions – Size and position – Engineering specifications – Supports – Y-strainer and sidestream filters – Check valves – Isolation valves – Loops to prevent thermal shock and deadhead – Coordination of power connections • System components – Types – Location for proper operation – Expansion joints
2 Plan and install hydronic heating and cooling generating equipment	• Purpose • Operation • Types • Codes and regulations • Clearances for venting and access • Fuel sources • Layout • Mounting and support – Seismic – Housekeeping pads • Connection of piping and flue • Coordination of power connections
3 Plan and install hydronic system transfer units	• Purpose • Operation • Types • Location of transfer units • Operating temperatures

- Heat loss calculations
- Mounting and support of transfer units
- Piping connections
- Coordination of power connections

4 Plan and install hydronic system controls

- Purpose
- Operation
- Types
- Temperature settings
- Connections
- Heating curves
- Location of controls
- Location of sensors
- Coordination of power connections
- Setting system priorities
- Setting pump speeds

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will install a hydronic system.
Conditions	The learner will be given: Specifications Tools and materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Accuracy Safety Function Start and commission

LINE I: INSTALL HYDRONIC HEATING AND COOLING

Competency: I-3 Test and Commission Hydronic Systems

Learning Objectives:

1 The learner will be able to test and commission hydronic systems.

	LEARNING TASKS	CONTENT
1	Perform testing procedures	• Types
2	Perform start-up procedures	• Visual inspection • Filling – Metering • Flushing and cleaning • Air removal • Motor rotation • Pressure settings • Start hydronic generating equipment • Verification of flow and temperatures
3	Describe water treatment	• Inhibitors • Freeze protection

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE I: INSTALL HYDRONIC HEATING AND COOLING

Competency: **I-4** **Maintain and Repair Hydronic Systems**

Learning Objectives:

1 The learner will be able to maintain and repair hydronic systems.

	LEARNING TASKS	CONTENT
1	Maintain hydronic systems	• Scheduling • Filters • Lubrication • Chemical treatment • Temperature checks • Expansion tanks • Leak inspection • Backflow testing
2	Repair hydronic systems	• Pump seals • Couplers • Leaks • Automatic air vents • Feeders • Valves • Relief valves

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: J-1 Install Medical Gas Systems

Learning Objectives:

1 The learner will be able to describe medical gas systems.
2 The learner will be able to install medical gas systems.

LEARNING TASKS	CONTENT
1 Describe medical gas systems	• Gas types • Uses/purpose • Sources of medical gas – Bulk – Cylinders – Compressors • Valve and accessory placement • Safety features • Advantages of pipe systems versus individual cylinders • Relationships – Owner – Installer – Third party inspectors
2 Layout a medical gas piping system	• Areas not permitted • Service requirements for different areas • Cross-connection – Hazards – Areas most commonly occurs at • Location and limitations of cylinders and bulk supplies
3 Install piping for medical gas systems	• Where located • Codes and regulations • Pipe types • Hangers and supports • Jointing methods • Cleaning and storing methods • Cutting, fitting and brazing methods • Degreasing • Capping • Certification requirements • Purging requirements and procedures • Brazing material requirements and characteristics • Dangers associated with cross-connection • Tools and equipment • Coordination with other trades • Pipe and component labelling • Purging braze piping • Pressure testing – Gauge requirements

- Testing for cross-connection

4 Install equipment for medical gas systems

- Codes and regulations
- Jurisdictional requirements
- Equipment
  - Vacuum pumps
  - Air compressors
  - Bulk systems
  - Reserve systems
- Characteristics and requirements of equipment
  - Zone valves
  - Alarms
  - Manifolds
- Accessories
  - Pressure reducing valves
  - Pressure relief valves
  - Dew-point sensors
- Diameter Index Safety System (DISS)
- Tools and equipment
- Pipe connection to equipment
- Pressure testing equipment
- Location of alarm points

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: J-3 Install Compressed Air Systems

Learning Objectives:

1 The learner will be able to plan and install compressed air systems.

LEARNING TASKS	CONTENT
1 Describe compressed air systems	• Hazards • Pipe types • Codes and regulations regarding vessels • Piping arrangements – Straight line – Loop • Tools and equipment • Jointing methods • Draining of moisture • Compressors – Types – Operation • Safety devices
2 Install compressed air systems	• Codes and regulations • Components – Air driers – Flex-connectors – Auto drains – Pressure regulators – Filters • Compressors • Tools and equipment • Vibration isolation • Connection of equipment to piping

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: **J-5** **Test and Commission Specialized Systems**

Learning Objectives:

1 The learner will be able to describe the testing and commissioning of medical gas systems.
2 The learner will be able to test and commission compressed air systems

	LEARNING TASKS	CONTENT
1	Describe the testing and commissioning of medical gas systems	• Approved testing agencies • Cross-connection testing • Pressure testing • Purity and flow testing • Alarm testing • Quality control testing
2	Test and commission compressed air systems	• Manufacturers' documentation • Air quality tests • Leak test • Pressure settings

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: **J-6** **Maintain and Repair Specialized Systems**

Learning Objectives:

1 The learner will be able to maintain and repair compressed air systems.

	LEARNING TASKS	CONTENT
1	Maintain and repair compressed air systems	• Compressor maintenance – Manufacturers' instructions • Receiver draining • Filters • Desiccants • Quick connects

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LEVEL 3

Plumber

LINE C: ORGANIZE WORK

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

Learning Objectives:

1 The learner will be able to read contract documents and specifications.
2 The learner will be able to plan take-offs to establish material and labour components.

	LEARNING TASKS	CONTENT
1	Describe contract documents used in the construction industry	• Types – Agreements – General conditions – Drawings – Specifications ‣ Divisions • Purpose • Master format • Change orders
2	Describe information contained in contract documents	• General requirements • Site work • Concrete • Masonry • Metals • Carpentry • Moisture protection • Doors, windows • Finishes • Responsibilities and obligations • Permits • Guarantees • Materials • Workmanship • Tests and inspections
3	Describe drawings	• Types – Architectural – Structural – Mechanical ‣ Plumbing ‣ Heating ‣ Sprinkler – Electrical • Parts – Plot plan – Foundation plan – Floor plan – Elevation – Sections – Details – Title block

  - Revisions
  - Schedules
  - Legends
- Information contained
  - Building dimensions
  - Construction type
  - Room layout
  - Fixture locations
  - Finish details
- Symbols
- Conventions

4 Plan take-offs to establish material and labour components

- Take-off terminology
- Take-off calculations
- Take-off lists and formulas
- Utilize various construction documents to perform calculations for piping and associated product take-offs
- Factors to consider

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

1	Performance	The learner will establish materials and labour from a given set of plans.
	Conditions	The learner will be given: Plans and specifications
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Completeness Accuracy

LINE G: INSTALL WATER SERVICE AND DISTRIBUTION

Competency: **G-1 Install Water Services**

Learning Objectives:

1 The learner will be able to use proper plumbing terminology to describe the function of the parts of a water service.
2 The learner will be able to plan and install a water service.

	LEARNING TASKS	CONTENT
1	Describe terminology used in water services	• Parts • Purpose
2	Describe the components of water services	• Municipal systems – Water main layouts • Codes and jurisdictional requirements • Health services act requirements • Equipment – Water meters – Flow restrictors – Pressure reducing valves – Isolation valves – Bypasses • Burial depth • Frost protection methods – Recirculation – Frost boxes – Heat tracing • Restraining systems – Thrust blocks – Anchors – Guides • Coordination of wiring connections • Irrigation connections
3	Plan and install water services	• Tools and Equipment • Pipe type and size • Jointing methods • Testing • Inspection

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE G: INSTALL WATER SERVICE AND DISTRIBUTION

Competency: G-2 Install Potable Water Distribution Systems

Learning Objectives:

1 The learner will be able to plan and install potable water distribution systems.

LEARNING TASKS	CONTENT
1 Describe terminology used in potable water distribution systems	• Parts • Purpose
2 Describe the components of a potable water distribution system	• Code requirements • Piping materials • Shut-off valves • Check valves • Pressure relief valves • Isolation valves • Water hammer arrestors • Frost proof hydrants • Stop-and-waste cocks • Types of fixtures • Expansion joints • Hot water storage tanks • Hot water recirculation equipment • Boilers and heat exchangers • Temper water valves and equipment • Booster pump assemblies
3 Describe and test cross-connection control assemblies and devices	• Types • Code and jurisdictional requirements • Installation requirements – Height – Location – Accessibility • Certification requirements for testing and certifying assemblies • Hazard assessment – Minor, moderate, severe • Assembly and device selection according to hazards and application • Testing procedures • Device inspection • Annual verification and calibration
4 Plan and layout a potable water distribution system	• Code requirements • Supply water pressure at the main • Maximum and minimum pressures • Arrangement of piping – Branch – Home run – Manifold

  - Hot and cold
- Appropriate piping materials
- Size and capacity of pipes
  - Height of highest fixture
  - Developed length of water line
  - Fixture units
  - Hydraulic load
  - Static pressure
- Drainage
- Support
- Shut-off valve requirements
- Frost protection for pipes passing through exterior walls
- Placement of check valves
- Capacity for flushing devices
- Relief valve requirements
- Water hammer
- Thermal expansion
- Protection from contamination
- Jointing methods

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will practically test the assemblies required for certification
Conditions	The learner will be given: Assemblies Test equipment
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Current accepted certification test procedures and equipment

LINE G: INSTALL WATER SERVICE AND DISTRIBUTION

Competency: G-3 Install Private Potable Water Supply Systems

Learning Objectives:

1 The learner will be able to describe private potable water supply systems.
2 The learner will be able to plan and layout private potable water systems.

LEARNING TASKS	CONTENT
1 Describe pressure systems	• Terminology • Purpose • Requirements – Pressure – Demand • Head pressure • Friction loss • Pumps – Location – Voltage and horsepower requirements – Submersible – Jet ‣ Shallow well ‣ Deep well – Installation procedures • Torque arrestors • Vibration isolation • Well types and locations • Well connections – Pitless adapter – Drive point (screened) – Well seals – Check valves – Strainers – Pump support ‣ Safety cable • Heat tracing • Pressure tanks • Electrical – Pumps – Wiring – Pressure switches – Control panels
2 Plan pressure systems	• Health Act requirements • Requirements – Pressure – Demand • Pump selection – Location – Type – Voltage and horsepower requirements

- Calculations
  - Pressure tank draw-downs
  - Pressure differences from tanks to highest fixtures
- Selection
  - Pump
    - Wire sizing and selection
    - Well head terminations and connections
  - Tank
- Pump curves and charts
- Grades of polyethylene pipe
- System accessories
- Heat tracing systems
- Insulation requirements
- Installation procedures

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will troubleshoot a private potable water system.
Conditions	The learner will be given: Water supply system Faults Test equipment
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Method Safety

LINE G: INSTALL WATER SERVICE AND DISTRIBUTION

Competency: **G-4 Install Water Treatment Systems**

Learning Objectives:

1 The learner will be able to size and install water treatment systems.
2

LEARNING TASKS	CONTENT
1 Size water treatment equipment	• Types – Softeners – Filters – UV sterilizers – Reverse Osmosis – De-ionizers • Water Composition – Hardness – pH level – Turbidity • Contaminants • Function of treatment equipment • Service/regeneration interval (time and volume) • Calculations – Amount of water required between regeneration cycles • Incoming water testing – Sampling procedures – Canadian Drinking Water Guidelines – BC Safe Water Drinking Act • Equipment selection criteria
2 Install water treatment equipment	• Types • Manufacturers' documentation • Cycle knowledge • Assembly • Positioning • Mounting • Securing • Coordination with electrical connection • Programming • Drain termination • Treated water testing – Canadian Drinking Water Guidelines – BC Safe Water Drinking Act

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE G: INSTALL WATER SERVICES AND DISTRIBUTION

Competency: **G-5 Test and Commission Potable Water Systems**

Learning Objectives:

1 The learner will be able to describe potable water test procedures.

LEARNING TASKS	CONTENT
1 Describe potable water test procedures	• Code requirements – Test certificates – NFPA 13 • Specifications • Equipment • Flushing • Disinfecting and sampling

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE G: INSTALL WATER SERVICE AND DISTRIBUTION

Competency: **G-6 Maintain and Repair Potable Water Systems**

Learning Objectives:

1 The learner will be able to maintain and repair potable water systems

	LEARNING TASKS	CONTENT
1	Describe maintenance and repair of potable water systems	• Pumps • Treatment equipment • Specialty equipment • Controls • Backflow assemblies

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE H: INSTALL FIXTURES AND APPLIANCES

Competency: **H-2 Install Appliances**
Learning Objectives:
1 The learner will be able to install appliances with electrical connections.

LEARNING TASKS	CONTENT
1 Describe appliances	• Types • Parts • Functions/Operation • Installation procedures • Code requirements • Seismic requirements
2 Install water heaters	• Types – Direct/Indirect – Tankless/instantaneous • Sizing – ASPE – Manufacturers' literature • Location • Parts • Function/Operation • Controls • Safety valves • Storage tanks – Manifolding – Equal length manifold – Reverse return • Expansion control • Heat exchangers • Recirculation lines – Pump types • Installation procedures • Code requirements • Seismic requirements

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE H: INSTALL FIXTURES AND APPLIANCES

Competency: **H-3 Test and Commission Fixtures and Appliances**

Learning Objectives:

1 The learner will be able to test and commission appliances.

LEARNING TASKS	CONTENT
1 Commission appliances	• Test water temperature • Checking relief valves • Manufacturers' checklist • Expansion tank pre-charge

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE H: INSTALL FIXTURES AND APPLIANCES

Competency: **H-4 Maintain and Repair Fixtures and Appliances**

Learning Objectives:

1 The learner will be able to maintain and repair appliances

LEARNING TASKS	CONTENT
1 Maintain and repair appliances	• Element checks • Sacrificial anodes • Flushing • Relief valves • Warranty • Re-inspection/certification of large storage tanks – Pressure Vessels Act

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: **J-4** **Install Fire Protection Systems**

Learning Objectives:

1 The learner will be able to describe the installation of fire protection systems.

	LEARNING TASKS	CONTENT
1	Describe fire protection systems	• Purpose • Codes and regulations • Piping materials • Limitations of materials • System types • Tools and equipment • Pressures and heads • Pipe sizing
2	Describe the installation of fire protection systems	• Pump requirements • Cross-connection prevention • Components – Gauges – Pressure switches – Supervisory valves – Flow alarm switches – Sprinkler heads – Sway bracing • Tools and equipment • Fire extinguishers • Hose cabinets • Trim • Pipe connection to equipment • Coordination of power to equipment
3	Install fire protection systems in single-family dwellings	• Codes and regulations • Piping materials • Flow-through systems • Components • Sprinkler types – Concealed – Sidewall – Pendant – Upright • Location of sprinklers • Fitting to and existing plumbing system • Pipe modification to accommodate water requirements • Tools and equipment

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: J-5 Test and Commission Specialized Systems

Learning Objectives:

1 The learner will be able to test and commission fire protection systems.

	LEARNING TASKS	CONTENT
1	Test and commission fire protection systems	• Alarm verification • Testing – Pressure – Flow • Flushing as per NFPA requirements

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: **J-6** **Maintain and Repair Specialized Systems**

Learning Objectives:

1 The learner will be able to describe the maintenance and repair of fire protection systems.

LEARNING TASKS	CONTENT
1 Describe the maintenance and repair of fire protection systems	• Dry system air compressor maintenance • Air system pressures • Reset dry system • Enunciator notification procedures • Sprinkler head damage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE L: INSTALL NATURAL GAS AND PROPANE SYSTEMS

Competency: **L-1 Install and Service Fuel Systems**

Learning Objectives:

1 The learner will be able to describe types of fuel gases and their characteristics
2 The learner will be able to describe the parts of a natural gas delivery and distribution system
3 The learner will be able to describe the parts of a propane delivery and storage system.
4 The learner will be able to install gas piping and tubing
5 The learner will be able to read gas meters and calculate heat flow rates.

LEARNING TASKS	CONTENT
1 Describe gas	• Types • Specific gravity • Calorific value • Parameters of combustibility • Air/gas ratio for combustion • Ignition and flame temperatures • Flame speeds • Odorant
2 Describe the parts of a natural gas fuel delivery system	• Utility provider • Consumer • Gas pressures – High – Low
3 Describe the parts of a propane gas system	• Vapour distribution • Liquid distribution • Storage
4 Describe residential and commercial gas pipe installation	• Code requirements • Pressures – Low Pressure – 2 psig (14 kPa) – High Pressure • Pipe/tube sizing – Appliance rating – Distance – Allowable pressure drop – Piping or tubing type – Type of gas – Fittings • Hanger spacing • Leak testing – Rough in – After appliance connection • Leak repair • Valve tightness of closure testing and repair • Purging – Air with gas – Gas with inert gases

- Pressure measurement
  - Standing
  - Operating
  - Manifold
  - Differential
  - Drop
- Pressure adjustment
  - Gas line
  - Manifold
- Appliance connection
  - Approved hose
  - Flexible metallic hose
  - Connectors

5 Install piping, tubing and hoses

- Methods
- Size
- Pressures
- Identification
- Procedures
- Fittings
- Valves
- Prohibited practice
- Location limitations
- Outlets
- Drip or dirt pockets
- Between buildings
- Concealment
- In concrete
- Underground
- Support
- Protection
- Tools
- Testing
  - Prior to appliance connection
  - After appliance connection
- Purging
  - Under 4 inch
  - 4 inch and larger

6 Describe gas meters

- Types
  - Low pressure propane
  - Low pressure natural gas
  - Pressure factor metering
  - Positive displacement
  - Non-positive displacement
- Principles of operation
  - Positive displacement
- Capacity
- Pressure compensation
- Reading
  - Test dials

- Clocking

7 Use calorific values of fuel and meter readings to determine input

- Calorific values
- Clocked flow rates
- Calculated inputs
- High altitude installations

8 Install propane cylinder systems

- Code requirements
- Sizing
  - Load factors
- Temperature effects on pressure
- Filled capacity effect on vaporization rate
- Cylinder sizing
  - Determine vaporization capacity of cylinders at various temperatures, colours, humidity and filled capacities
- Describe cylinder clearances
- Installation procedures
- Safety relief valves
  - Pressures
  - Location of discharge outlets
  - Calculations of rate of discharge
- Maintenance
- Valves and accessories for vapour withdrawal applications
- Valves and accessories for liquid withdrawal applications
- Valves and accessories for filling applications
- Filling density at standard temperature
- Filling capacity by mass
- Vehicle access for filling storage tanks
- Filling safety
- Emergency procedures

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

1	Performance	The learner will clock a gas appliance.
	Conditions	The learner will be given: Appliance connected to meter Manufacturer's specifications for the appliance Tools and equipment
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Correct meter reading Consumptions rates in imperial and metric units Interpretation of the manufacturer's nameplate data Conversion of volume consumption to heat flow consumption Corrective

LINE L: INSTALL NATURAL GAS AND PROPANE SYSTEMS

Competency: **L-2 Install and Service Gas Equipment**

Learning Objectives:

1 The learner will be able to install and adjust burners for gas fired appliances rated at less than or equal to 400 MBH.

2 The learner will be able to perform combustion analysis and adjust equipment for maximum efficiency.

LEARNING TASKS	CONTENT
1 Describe combustion requirements	• Terminology • Flammability – Range of flammability – Upper limit of flammability – Lower limit of flammability – Ignition temperature • Gas properties – Rate of flame propagation – Flashback – Turndown ratio • Combustion air – Primary – Secondary – Excess • Flame characteristics – Aerated ‣ Oxidizing ‣ Carbonizing ‣ Neutral – Non-aerated
2 Describe atmospheric burners	• Terminology • Characteristics • Types – Main burners – Pilot burners • Parts • Operation • Application
3 Describe mechanical burners	• Terminology • Characteristics • Types • Parts • Air adjustment • Operation • Applications • Start-up procedures

4	Describe burner orifices	• Types – Plug – Cap – Adjustable • Sizing – Tables – Calculations – Drilling
5	Install and adjust burners	• Codes • Approval agencies • Rating plates • Manufacturers' documentation • Start up procedures • Use test equipment • Manifold pressure – Measurement – Adjustment • Burner input calculations – Port loading – Clocking • Altitude compensation – High altitude de-rating • Flame characteristics • Perform flue gas analysis • Troubleshooting procedures • Fault correction
6	Install pilots	• Purposes of a pilot • Position relative to main burner • Position relative to thermocouples
7	Describe the chemical process of combustion	• Methane • Propane • Chemical equations – Theoretical – Complete – Incomplete
8	Describe combustion analysis in appliances up to and including 400 MBH	• Related factors • Efficiency • Adjustments – Primary air – Secondary air – Excess air – Dilution air • Methods for testing and adjusting – Manifold pressure – Gas consumption – Primary air – Secondary air

- Excess air
- Types of analyzers
- Calibration
- Readings
- Liabilities
- Calculating volume of excess air
- Flue gas temperature measurement
- Efficiency determination
- Optimizing efficiency

9 Perform combustion analysis

- Percentage of oxygen in the flue gas
- Carbon dioxide relationship
- Carbon monoxide measurements
- Flue gas temperature
- Determine excess air flowing through the combustion chamber
- Appliance efficiency
- Plotting of combustion efficiency
- Troubleshoot
- Corrective measures to achieve maximum efficiency
- Check and/or adjust draft

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will convert an appliance between propane and natural gas.
Conditions	The learner will be given: Appliance Orifices Tools and equipment Sizing tables
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Input verification Correct flame Set up

LEVEL 4

Plumber

LINE C: ORGANIZE WORK

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

Learning Objectives:

1 The learner will be able to describe electrical drawings.
2 The learner will be able to interpret electrical drawings.

LEARNING TASKS	CONTENT
1 Describe electrical drawings	• Types – Pictorial – Ladder – Schematic • Symbols – Manual switches – Pressure switches – Temperature switches – Relays – Transformers – Aquastats – Overcurrent protection – Power and lighting panels – Receptacles

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will create a schematic or ladder diagram of a heating system.
Conditions	The learner will be given: Project specifications Tools and materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Symbols Accuracy Functionality

LINE C: ORGANIZE WORK

Competency: **C-5 Plan a Project**

Learning Objectives:

1 The learner will be able to plan a project.

	LEARNING TASKS	CONTENT
1	Describe considerations when planning a project	• Communication with – Other trades – Engineers – Owners – Crew • Tools • Coordination with other trades • Housekeeping • Scheduling – Materials ‣ Quantity ‣ Timing ‣ Storage ‣ Security – Job tasks – Major equipment ‣ Excavation ‣ Lifting
2	Perform plan take-offs to establish material and labour components for a building.	• Take-off terminology • Take-off calculations • Take-off lists and formulas • Utilize various construction documents to perform calculations for piping and associated product take-offs • Factors to consider • Methods – Manual systems – Computer systems

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will plan a project.
Conditions	The learner will be given: Drawings and specifications
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Accuracy Completeness

LINE E: INSTALL SANITARY AND STORM DRAINAGE SYSTEMS

Competency: **E-1 Install Sanitary Drain, Waste and Vent Systems**

Learning Objectives:

1 The learner will be able to install sanitary drain, waste and vent systems as per code requirements.

	LEARNING TASKS	CONTENT
1	Review terminology used in interior drain-waste-vent systems	• Definitions in the National Plumbing Code
2	Describe island venting	• Methods • Code regulations
3	Interpret National Plumbing Code Regulations related to indirectly connected systems.	• Commercial kitchens
4	Describe requirements of a trade-waste system.	• Application
5	Describe the placement and operation of sumps and catch basins.	• National Plumbing Code • Pumps – Types – Sizing • Confined space requirements
6	Describe interceptors	• Types • Applications • Regulations – Venting
7	Plan the layout of an interior drain-waste-vent system	• Location of structure penetrations • Routing • Pipe supports • Sizing

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will plan the layout of a commercial or institutional DWV system.
Conditions	The learner will be given: Specifications Schedule Drawings
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Code compliant Efficient Accuracy

LINE E: INSTALL SANITARY AND STORM DRAINAGE SYSTEMS

Competency: **E-2 Install Storm Drainage Systems**

Learning Objectives:

1 The learner will be able to install storm drainage systems as per code requirements.

	LEARNING TASKS	CONTENT
1	Review terminology used in storm drainage systems	• Definitions in the National Plumbing Code
2	Describe the placement and operation of sumps and catch basins.	• National Plumbing Code • Pumps – Types ‣ Ejector pumps (power failure) – Sizing • Confined space requirements
3	Describe sub-soil drainage systems	• Purpose • Material • Perforation orientation • Backwater valve – Surcharge requirements • Curtain drain • Backfilling • Location •
4	Describe site retention systems	• Overflow to municipal • Green technology

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE E: INSTALL SEWAGE SYSTEMS

Competency: **E-3** **Install Sanitary Sewer Systems**

Learning Objectives:

1 The learner will be able to install sanitary sewers.

LEARNING TASKS	CONTENT
1 Plan the installation of underground site services for drainage	• Code requirements • Types of pipe • Sizing • Slope • Routes • Cleanouts, manholes, catch basins • Backflow prevention – Sewer surcharge • Jointing methods • Support/bedding • Testing • Connection to public system – Storm and sanitary connection identification • Protection of piping
2 Describe the installation of underground site drainage systems	• Trenching – Safety – WorkSafeBC – Location of other services prior to digging – Methods – Depth – Slope – Shoring • Installation – Pipe – Cleanouts – Manholes – Catch basins • Testing • Backfilling • Determination of finish grade • Protection of piping

3	Plan the installation of manholes and catch basins	• Manhole applications – Cleanout – Change of direction – Change of elevation • Catch basins • Levelling beds – Tool selection and use • Use of lifting equipment • Positioning of components • Application of gaskets and sealants • Setting of elevations • Locating of entrance and exit points • Creating penetrations • Sealing of penetrations • Channelling bottom to direct waste

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE E: INSTALL SANITARY AND STORM DRAINAGE SYSTEMS

Competency: **E-4 Test and Commission Sanitary and Storm Drainage Systems**

Learning Objectives:

1 The learner will be able to test and commission sanitary and storm drainage systems as per the National Building Code.

	LEARNING TASKS	CONTENT
1	Identify code and requirements affecting testing of DWV and storm systems.	• National Plumbing Code • Authority having jurisdiction
2	Explain testing methods.	• Safety • Equipment • Procedure • Duration • Inspection • Documentation

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE E: INSTALL SANITARY AND STORM SYSTEMS

Competency: E-5 Maintain and Repair Sanitary and Storm Drainage Systems

Learning Objectives:

1 The learner will be able to maintain and repair sanitary and storm drainage systems

LEARNING TASKS	CONTENT
1 Describe routine maintenance of sumps, catch basins and interceptors.	• Manufacturer's literature • Pumps • Controls • Backwater valves • Baffles • Filters • Flow control devices • Strainer baskets

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE F: INSTALL PRIVATE SEWAGE SYSTEMS

Competency: F-1 Install Private Sewage Disposal Systems

Learning Objectives:

1 The learner will be able describe a private sewage disposal system.

LEARNING TASKS	CONTENT
1 Describe private sewage disposal systems	• Purpose • Operation • Process that occurs in a septic tank • Process that occurs in a disposal field • Conditions detrimental to the processes • Holding tank • Septic tank • Pump chambers • Siphon chambers • Codes and regulations – BC Health Act – Health Act Sewage Disposal Regulation • Absorption field • Limiting factors – Soil conditions ‣ Type ‣ Structure ‣ Percolation rates – Property boundaries – Water table elevation – Proximity to potable water sources and courses • Alternatives • Packaged sewage treatment plants • Calculating expected daily sewage volume • Pump sizing • Plan preparation and submittal
2 Describe the rationale for municipal sewage disposal systems and sewage treatment plants	• B.C. Plumbing Code • B.C. Health Act
3 Plan a private sewage disposal systems	• 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

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE F: INSTALL PRIVATE SEWAGE SYSTEMS

Competency: **F-2** **Maintain and Repair Sewage Disposal Systems**

Learning Objectives:

1 The learner will be able to maintain and repair sewage disposal systems.

	LEARNING TASKS	CONTENT
1	Maintain and repair sewage disposal systems	• Filters • Interceptors • Tank pumping • Effluent sampling • Flow balancing – Distribution box – Balancing valves • Field inspections • Pumps • Controls

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE G: INSTALL WATER SERVICE AND DISTRIBUTION

Competency: **G-2 Install Potable Water Distribution Systems**

Learning Objectives:

1 The learner will be able to size and install potable water distribution systems.

	LEARNING TASKS	CONTENT
1	Size pipes for potable water distribution	• National Plumbing Code

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will use the National Plumbing Code to size piping.
Conditions	The learner will be given: National Plumbing Code Diagram of a potable water distribution system
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Sized correctly

LINE I: INSTALL HYDRONIC HEATING AND COOLING

Competency: I-2 Install Hydronic Heating and Cooling Systems

Learning Objectives:

1 The learner will be able to describe hydronic system controls and sensors.

	LEARNING TASKS	CONTENT
1	Describe hydronic heating and cooling system design	• Radiant – Zones • Control strategies – PID – Analog – Proportional
2	Describe hydronic system controls and sensors	• Types • Control valves – Mixing – Diverting – Injection – Autoflow • Purpose/Operation • Temperature settings • Heating curves • Location – Controls – Sensors • Priorities • Pump speed controls

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

1	Performance	The learner will create an instruction manual which will layout the sequence of operation for a hydronic heating system.
	Conditions	The learner will be given: An existing heating system
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Zones Design temperatures Control sequencing

LINE I: INSTALL HYDRONIC HEATING AND COOLING

Competency: I-3 Test and Commission Hydronic Systems

Learning Objectives:

1 The learner will be able to test and commission hydronic systems.

LEARNING TASKS	CONTENT
1 Test and commission controls systems	• Inspection – Return – Supply • Piping configuration • Air removal • Limits • System balancing • Control sequencing • Temperature checks • Sensor checks

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE I: INSTALL HYDRONIC HEATING AND COOLING

Competency: I-4 Maintain and Repair Hydronic Systems

Learning Objectives:

1 The learner will be able to maintain and repair hydronic system controls.

LEARNING TASKS	CONTENT
1 Maintain and repair controls	• Testing • Replacement • Adjustment

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: **J-2 Install Irrigation Systems**

Learning Objectives:

1 The learner will be able to describe irrigation systems.
2 The learner will be able to install irrigation systems.

	LEARNING TASKS	CONTENT
1	Describe irrigation systems	• Types of systems – Residential – Commercial – Agricultural • Design criteria • Pipe types • Cross-connection hazards • Trenching • Coordination with underground utilities • Tools and equipment • Service testing
2	Install irrigation systems	• Equipment types – Sprinkler heads – Valve boxes – Timers – Pumps – Solenoid valves • Winterization consideration – Slope – Drainage points – Purge points • Tools and equipment • Sprinkler head selection • Equipment adjustment – Patterns – Timers

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: **J-5** **Test and Commission Specialized Systems**

Learning Objectives:

1 The learner will be able to test and commission irrigation systems.

	LEARNING TASKS	CONTENT
1	Test and commission irrigation systems	• Zone sequencing • Coverage

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE J: INSTALL SPECIALIZED SYSTEMS

Competency: **J-6** **Maintain and Repair Specialized Systems**

Learning Objectives:

1 The learner will be able to maintain and repair irrigation systems.

	LEARNING TASKS	CONTENT
1	Maintain and repair irrigation systems	• Replace heads • Annual winterization • Diaphragm valves • Controls

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE K: APPLY PLUMBING PRINCIPLES

Competency: **K-1 Apply Plumbing Principles**

Learning Objectives:

1 The learner will be able to recall the application of plumbing principles to practical problems.

	LEARNING TASKS	CONTENT
1	Use safe work practices	• Workplace hazards • OHS Regulation and WCB standards • WHMIS • Personal protective equipment • Fire prevention
2	Use tools and equipment	• Hand tools • Portable power tools • Stationary power tools • Measuring and levelling tools • Cutting, brazing and soldering equipment • Ladders and platforms • Rigging and hoisting equipment
3	Organize work	• Mathematics • Science • Drawings and specifications
4	Prepare and assemble plumbing components	• Pipe • Valves • Fittings • Structural penetration
5	Install sanitary and storm drainage	• Sanitary DWV systems • Storm drainage systems • Sanitary sewer systems • Testing and commissioning • Maintaining and repairing
6	Install water service and distribution	• Water services • Potable water distribution systems • Private potable water supply systems • Testing and commissioning • Maintaining and repairing
7	Install fixtures and appliances	• Fixtures and trim • Appliances • Testing and commissioning • Maintaining and repairing
8	Install specialized systems	• Medical gas • Compressed air • Fire protection • Testing and commissioning • Maintaining and repairing

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE L: INSTALL NATURAL GAS AND PROPANE SYSTEMS

Competency: **L-1 Install and Service Fuel Systems**

Learning Objectives:

1 The learner will be able to describe the purpose and operation of gas pressure regulators.
2 The learner will be able to select, install and adjust gas pressure regulators.
3 The learner will be able to service gas pressure regulators.

LEARNING TASKS	CONTENT
1 Describe pressure regulators	• Types – Appliance – Line pressure – Service – Direct operated – Lever operated – Propane ‣ First stage ‣ Second stage • Operating elements – Loading – Measuring – Restricting • Parts – Pressure relief • Operating principles – Droop – Lock-up – Set point – Critical flow • Applications • Sizing tables – Flow rate – Pressure drop • Maintenance • Troubleshoot • Freeze ups
2 Describe regulator venting	• Vent attachments – Lines – Limiting orifices – Surge arrestors • Sizing • Orientation • Termination
3 Install pressure regulators	• Code requirements • Procedures • Gas pressure readings upstream and downstream of each regulator

4 Service pressure regulators

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

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will troubleshoot a regulator
Conditions	The learner will be given: Gas pressure regulator connected to an appliance Tools and equipment
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Verification of factory settings • Droop • Lock-up • Inlet pressure • Manifold pressure

LINE L: INSTALL NATURAL GAS AND PROPANE SYSTEMS

Competency: **L-2 Install and Service Gas Equipment**

Learning Objectives:

1 The learner will be able to describe installation requirements for gas fired appliances rated at less than or equal to 400 MBH.

2 The learner will be able to install and adjust gas fired appliances rated at less than or equal to 400 MBH.

LEARNING TASKS	CONTENT
1 Describe gas fired appliances	• Types – Boilers – Instantaneous water heaters – Direct fired make-up air heaters – Direct vent appliances – Fireplaces – Furnaces – Infrared heaters – Radiant tube heaters – Ranges – Rooftop units – Unit heaters – Water heaters – Gas fired refrigerators • Characteristics • Applications • Approval agencies
2 Describe installation requirements	• Impact of type of building construction on installation requirements • Altitude rating requirement • Code and Regulation requirements • Manufacturers' requirements – Rating plate requirements • Appliance sizing • Site preparation • Clearances • Installer's responsibilities
3 Install and commission appliances	• Setup • Code requirements • Testing – Air flow – Temperature rise – Circulation – Safety and limits • Purging and flushing • Check electrical and air supply • Clocking for gas consumption rate • Orifice sizing • Gas pressure measurement • Instructions to the consumer

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will commission a gas appliance to manufacturer and code requirements.
Conditions	The learner will be given: Appliance connected to a meter Tools and equipment
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Manufacturers specifications Code requirements Commissioning sequence

LINE L: INSTALL NATURAL GAS AND PROPANE SYSTEMS

Competency: L-3 Install Venting and Air Supply

Learning Objectives:

1 The learner will be able to size and install venting systems for gas appliances rated for up to and including 400 MBH.
2 The learner will be able to describe and install air supply systems.

LEARNING TASKS	CONTENT
1 Describe gas appliance venting	• Purpose • Venting action – Natural draft – Mechanical draft • Direct venting • Types – A – B – Single wall – L – BW – BH • Appliance categories • Materials • Application • Temperature rating • Parts of a venting system • Problems – Spillage – Condensation – Causes – Solutions • Draft control devices – Applications – Installation procedures – Draft hoods – Barometric dampers • Thermally operated flue dampers • Electrically operated flue dampers
2 Describe mechanical draft appliances	• Types • Parts • Operation • Applications • Fan sizing limitations • Fan location – Natural draft – Induced draft – Forced draft • Code requirements

3	Install venting systems for gas appliances up to and including 400 MBH	• Code and manufacturer requirements • Installation procedures – Terminations – Support – Fire stopping – Location • Building construction – Tightness and ventilation • Sizing – Vent connectors – Vents – Chimney • Clearances – Clearance reductions • Height • Length • Appliance gas input rating • More than one appliance • Chimney area conversions – Round to square – Square to round
4	Install direct vented flues	• Description • Operation • Code and manufacturer requirements • Termination clearances – Building construction – Fresh air intakes – Regulator and meter sets
5	Describe gas appliance air supply requirements	• Purpose – Combustion air ‣ Primary air ‣ Secondary air ‣ Excess air – Dilution air – Ventilation air • Building as a system – Negative air pressure • Openings and ducts – Terminations
6	Determine combustion air requirements for gas appliances installations with a combined input of up to and including 400 MBH	• Code requirements • Building envelope and construction • Category of the appliance • Draft control • Air requirement calculations – Combustion – Ventilation – Flue gas dilution • Table selection

		• Grills and louvers – Types – Sizing – Free area calculations • Air ducts – Length – Size
7	Determine combustion air requirements for gas appliance installations with a combined input exceeding 400 MBH	• Code requirements • Dilution air requirements • Air requirement calculations – Combustion – Ventilation – Flue gas dilution • Calculations • Grills and louvers – Types – Sizing – Free area calculations • Air ducts – Length – Size
8	Install air supply	• Code requirements • Structural penetrations • Sealing • Openings and ducts – Terminations • Wind conditions • Length • Supply by mechanical means

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

LINE L: INSTALL NATURAL GAS AND PROPANE SYSTEMS

Competency: **L-4 Install and Service Controls and Safeguards**

Learning Objectives:

1 The learner will be able to describe the principles of direct and alternating current circuits.
2 The learner will be able to describe the principles of magnetism and magnetic induction.
3 The learner will be able to connect and test electric circuits.
4 The learner will be able to describe the principles of operation for gas controls on appliances rated less than or equal to 400 MBH.
5 The learner will be able describe the installation requirements for gas controls used on appliances rated up to and including 400 MBH.
6 The learner will be able to install and adjust gas controls on appliances rated up to and including 400 MBH.

LEARNING TASKS	CONTENT
1 Describe principles of electricity	• Safety • Electron theory • Circuit components – Sources of electricity – Loads – Controls • Terminology – Electromotive force – Current – Resistance – Power – Conduction • Units – Volt – Ampere – Ohm – Watt – Volt-ampere • Ohm's Law • Watt's Law – Effects of changing voltage, current or resistance on power. • Series, parallel, series/parallel • Polarity • Direct current principles • Schematic symbols • Diagrams – Wiring – Schematic – Ladder – Block (one-line) • Use of measuring instruments – Connections – Range selection – Voltage

- Current
- Resistance
- Alternating current principles
- Rectification
- Wire types and sizing
- Overcurrent protection
- Overload protection
- Fan motor drives
- Function
- Testing

2 Describe principles of magnetism and magnetic induction

- Characteristics of magnetic lines of force
- Factors affecting the strength of a magnetic field
- Electromagnetism
- Electromagnetic induction
- Coils and solenoids
- Relays
- Types
  - Time delay
  - Single contact
  - Multiple contact
- Troubleshooting
- Transformers
- Operating principles
- Ratings
- Uses
  - Control
  - Ignition
- Symbols
- Installation
- Phasing
- Troubleshooting

3 Describe nonelectric controls

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

4	Describe electric control circuits	• Transformer circuits • Fan circuits • Control circuits • Safety circuits • Pump circuits • Heating/cooling units • Ignition circuits • Vent damper circuits • Air supply circuits • Forced vent draft fans
5	Describe electric control components	• Operating Controls • Limit and safety controllers • Combustion safety controllers • Ignition systems • Gas valves
6	Describe control modules	• Ignition control modules – Intermittent pilot – Direct spark ignition – Hot surface ignition • Fan timers • Integrated appliance controls
7	Wire controls for appliances up to and including 400 MBH	• Installation • Limits and safety controllers • Gas valves • Ignition systems • Transformers • Matching controls to the appliance • Wiring to manufacturer's specifications • Flame rods • Thermostats – Wiring
8	Test and service controls for appliances up to and including 400 MBH	• Operational checks • Set point adjustments • Set and adjust calibration • Lockout • Troubleshooting – Electrical controls – Mechanical controls • Repair and/or replacement

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

1	Performance	The learner will select, test and troubleshoot transformers.
	Conditions	The learner will be given: Application Selection of transformers Tools and equipment
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Transformer with the correct ratings selected Wired correctly Correct test procedures Check voltage and phasing Use of test equipment
2	Performance	The learner will install, test and troubleshoot relays.
	Conditions	The learner will be given: Application Relay Tools and equipment
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Wired correctly Correct test procedures Use of test equipment
3	Performance	The learner will wire and test control circuits for mid and high efficiency appliances up to and including 400 MBH
	Conditions	The learner will be given: Appliances Components and wiring materials Test equipment Wiring/schematic diagrams
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Wiring Description of sequence of operation Sequence of operation correct Component testing Testing Interpretation of test data
4	Performance	The learner will test and troubleshoot fireplace millivolt circuits
	Conditions	The learner will be given: Gas fireplace with millivolt system Test equipment
	Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Test procedures Results interpretation Corrections made Final system operation

LINE L: INSTALL NATURAL GAS AND PROPANE SYSTEMS

Competency: L-5 Use Gas Codes, Regulations and Standards

Learning Objectives:

1 The learner will be able to identify code rules and regulations applicable to the level B Gasfitter certification.

2 The learner will be able to interpret code rules and regulations applicable to the level B Gasfitter certification.

LEARNING TASKS	CONTENT
1 Describe the B149.1 Gas Code	• Layout • Sections • Contents • Index • Annexes • Tables • Definitions • Scope • Revisions
2 Interpret Sections of the B149.1 Gas Code	• Scope • Reference Publications • Definitions • General • Pressure Controls • Piping and Tubing Systems, Hose, and Fittings • Installation of Specific Types of Appliances • Venting Systems and Air Supply for Appliances • Natural Gas Compressors and Cylinders
3 Use the Gas Regulations	• Gas Safety Act • Gas Safety Regulations • Permits • Notification of completion • Approvals • Variations to the National Gas Code • Bulletins and Directives
4 Use the Canadian Electrical Code Part 1	• Sections required for Gasfitters – 0, 2, 4, 8, 10, 12, 14, 16, 26, 28

Theory Assessment: The learner must score a minimum of 70 percent on a written examination.

Achievement Criteria:

Performance	The learner will use codes and standards in the application of shop projects
Conditions	The learner will be given: Projects Codes and standards
Criteria	This would be reflected in the appropriate shop competencies.

Section 4

FACILITY REQUIREMENTS

FACILITY REQUIREMENTS

Classroom Areas

- Minimum 22 square feet per student.
- Comfortable seating and tables suitable for learning.
- Compliance with the local and national fire code and occupational safety requirements.
- Meets applicable municipal zoning bylaws for technical instruction and education facilities.
- Overhead and multimedia projectors with a projection screen.
- Whiteboard with marking pens and erasers.
- Lighting controls to allow easy visibility of the projection screen while allowing students to take notes.
- Windows must have shades or blinds to adjust sunlight.
- Heating/Air conditioning for comfort all year round.
- Acoustics in the room must allow audibility of the instructor.

Shop Areas

- Minimum 3000 square feet of shop area including a tool crib and work stations.
- Minimum 10 foot ceiling height in shop areas
- Minimum 8 foot ceiling in lab areas
- Adequate heating, lighting and ventilation.
- Refuse and recycling bins for used shop materials.
- First-aid equipment.
- Shops will support practical requirements as outlined in the program outline.
- Shop facilities will support:
  - Cross-connection practical training
  - Gasfitting practical training
  - Hydronic practical training

Student Facilities

- Adequate eating area as per WorkSafeBC requirements (4.84 OHS Regulation and Guidelines)
- Adequate washroom facilities as per WorkSafeBC requirements (4.85 OHS Regulation and Guidelines)
- Personal Storage lockers

Instructor's Office Space

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

TOOLS AND EQUIPMENT

Hand Tools

Adjustable wrench
Ball-peen hammer
Basin wrench
Broom
Caulking gun
Chalk line
Chisels
Claw hammer
Combination wrench
Drywall saw
Faucet seat wrench
Files
Flashlight
Hacksaw
Hand saw
Hex Keys (set)
Hole saw
Knife
Levels
Pick
Pipe wrench
Pliers (lineman, needle nose, water pump, channel lock)
Plumb bob
Pry bars
Punch
Ratchet
Rubber mallet
Scratch awl
Screwdrivers (complete set)
Shovel
Sledgehammer
Socket set (imperial and metric)
Spud wrench
Square
Striker
Swedge (hand flaring tool)
T square
Tap and die sets
Tin snips (set)
Torque wrench
Transfer pump (hand-operated)
Tri-square
Utility brushes
Wire brushes

Power Tools

Air compressor and accessories
Band saw
Bench grinder
Booster pump
Chop saw
Circular saw
Cordless drills
Drain cleaning equipment
Drill press
Heat lamp
Heat pump
Impact wrench
Mini grinder
Portable band saw (hack saw)
Powder-actuated tools
Power drills
Power hole saw
Reciprocating saw
Rotary hammer
Task lighting equipment

Hoisting, Rigging and Access Tools and Equipment

Block and tackles
Come-a-longs and Tirfors
Ladders
Lifting eyes
Rope/cable
Scaffolding
Shackles (varying sizes)
Slings and chokers
Snatch blocks
Wire rope or nylon (synthetic

Personal Protective and Safety Equipment

Eye wash kit
Face shield
Fire blanket
Fire extinguisher
First aid kit
Gloves (industrial rubber)
Hard hat
Hearing protection
Lock-out devices
Overalls
Rubber boots
Respiratory mask
Safety boots
Safety glasses/goggles
Safety harness, lanyard and life line

Cutting and Joining Equipment

Copper tube cutter
Crimpers
PEX pipe expander (manual and power)
Half round file
Flaring tools
Gas cylinders, and soldering and brazing equipment
Hand operated oiler
Mechanical crimper
Oxy-acetylene welding equipment
Pipe cutter
Pipe groover
Pipe reamer
Pipe roller
Pipe stand
Pipe threader
Pipe vise
Plastic tube cutters (set)
Power vise
Ratchet cutter
Snap cutter
Specialized assembly tools and equipment
Tube bender
Tube cutter

Testing and Measuring equipment

Builder's level
Differential pressure gauge and sight tube
Calculator
Computer
Drafting equipment
Electronic leak detector
Hand pump and accessories
Hydrostatic pump and gauge (manual and power)
Laser level
Measuring tape and markers
Multimeter
Scale ruler

FACULTY CREDENTIAL AND EXPERIENCE REQUIREMENTS

FACULTY CREDENTIAL AND EXPERIENCE REQUIREMENTS

The instructor shall possess:

- A BC Certificate of Qualification preferably with a Red Seal Endorsement.
- Certificate of Qualification from another Canadian jurisdiction complete with Red Seal Endorsement.
- A minimum of 5 years experience working in the industry as a journeyperson.
- This experience requirement may be varied based on:
    - Type of experience and scope of exposure to the industry
    - Other related credentials
    - Specialized experience

The instructor shall possess or be working towards:

- An Instructors Diploma or equivalent
- A Bachelor's Degree in Education
- A Master's Degree in Education