

Apprenticeship and Industry Training

Plumber

Curriculum Guide

006 (2022)

Alberta 



Apprenticeship
and Industry
Training

ALBERTA ADVANCED EDUCATION

Plumber : apprenticeship education program curriculum guide

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**Plumber
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CURRICULUM GUIDE

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding a sponsor. Sponsors guide apprentices, and support on-the-job learning through provision of mentorship. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journey person or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution (PSI) – usually a college or technical institute.

To receive their postsecondary credential, apprentices must learn theory and skills, and they must pass examinations. Criteria for the program—including the content and delivery of technical training—are developed and updated by the Registrar.

The graduate of the plumber apprenticeship program is an individual who will be able to:

- install and service all plumbing systems, including hot water heating, water supply, water treatment, related hospital systems and compressed air and vacuum systems;
- fabricate and install any plumbing system of any material used in buildings;
- provide plumbing systems which function in conjunction with other systems;
- know and apply the manufacturers' specifications and codes governing installations;
- interpret plans and job specifications;
- prepare layouts and working drawings;
- use hand tools and power equipment;
- calculate material requirements and quantities;
- coordinate with other trades that relate to job situation; and
- perform assigned tasks in accordance with the required quality and production standards of industry.

Apprenticeship and Industry Training System

Alberta's apprenticeship programs are supported by industry stakeholders that ensures a highly skilled, internationally competitive workforce in the province. The Registrar establishes the educational standards and provides direction to the system supported by industry and the PSI's. The Ministry of Advanced Education provides the legislative framework and administrative support for the apprenticeship and industry training system.

Special thanks are offered to the following industry members who contributed to the development of the standard:

Mr. K Roskell Stony Plain
Mr. R. Dyck Lethbridge
Ms. J. Martin Spruce Grove
Mr. G. Prokopetz Calgary
Mr. E. Saunderson Ft. McMurray
Mr. J. Delorme Grande Prairie
Mr. J. Lucas Calgary
Mr. S. McCrimmon Calgary
Mrs. K. Marchand Sherwood Park

Alberta Government

Alberta Advanced Education works with industry, sponsor and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and sponsors
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Apprentice Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, sponsors, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Occupational Health and Safety

Persons engaged in, or supporting an individual in an experiential learning environment are often exposed to more worksite hazards than in other forms of traditional post-secondary education and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Occupational Health and Safety-OHS (a division of Alberta Labour and Immigration) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.alberta.ca/occupational-health-safety.aspx

Technical Training

Apprenticeship technical training is delivered by the PSI's throughout Alberta. The PSI's are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All PSI's place a strong emphasis on safety that complements safe workplace practices towards the development of a culture of safety for all professions.

The PSI's work with industry and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship education programs across the province. They develop curriculum from the curriculum guides established by the Registrar in consultation with the PSI's and industry and provide the technical training to apprentices.

The following PSI's deliver Plumber trade apprenticeship technical training:

Northern Alberta Institute of Technology
Red Deer College
Grande Prairie Regional College

Southern Alberta Institute of Technology
Medicine Hat College
Lethbridge College

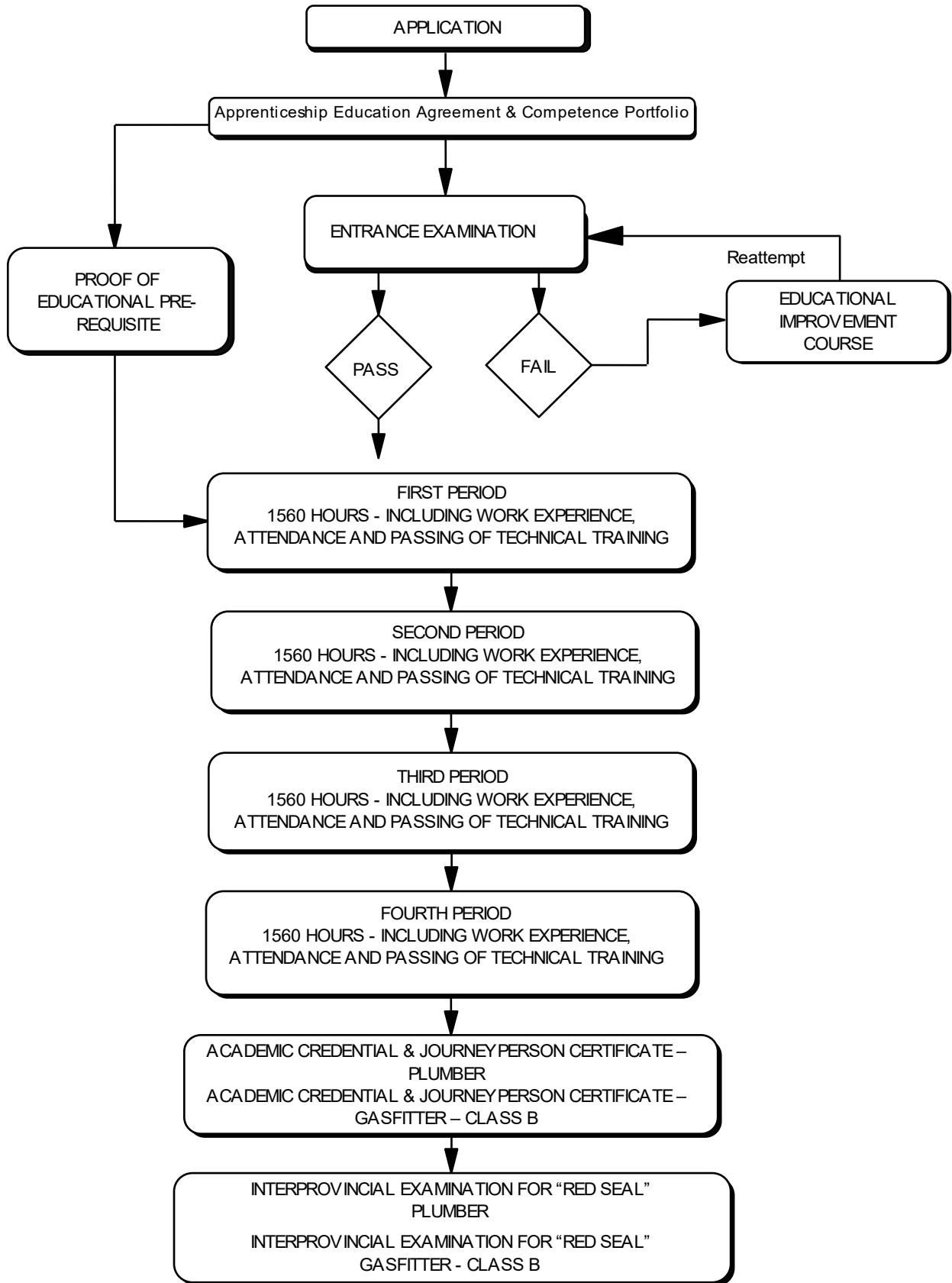
Procedures for Recommending Revisions to the Curriculum Guide

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Registrar of Apprenticeship Programs
c/o Apprenticeship Delivery and Industry Support Services
Apprenticeship Delivery and Industry Support
Advanced Education
19th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used.

Apprenticeship Route toward Academic Credential



**Plumber Training Profile
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)**

SECTION ONE

WORKPLACE SAFETY AND RIGGING
10%



A
Safety Legislation, Regulations & Industry Policy in the Trades
16%

B
Climbing, Lifting, Rigging and Hoisting
25%

C
Hazardous Material & Fire Protection
16%

D
Apprenticeship Training Program
13%

E
Pipe Trade Codes
13%

F
Electrical Safety
17%

SECTION TWO

TOOLS, EQUIPMENT AND MATERIALS
38%



A
Hand Tools
7%

B
Power Tools
7%

C
Welded Pipe and Fittings
13%

D
Plastic Pipe and Tube
13%

E
Threaded and Grooved Pipe
16%

F
Tube and Tubing
13%

G
Valves
13%

H
Hangers, Supports and Fasteners
11%

I
Pressure Testing
3%

J
Pumps
4%

SECTION THREE

METAL FABRICATION
19%



A
Welding Safety
9%

B
Welding
65%

C
Brazing and Soldering
26%

SECTION FOUR

DRAWINGS AND SPECIFICATIONS
13%



A
Sketching and Drawing
20%

B
Single Line Drawing
40%

C
Drawing Interpretation
40%

SECTION FIVE

CALCULATIONS AND SCIENCE
20%



A
Applied Calculations
17%

B
Perimeters, Areas, Percentage and Grade
23%

C
Volumes and Capacities
8%

D
Piping Offsets
13%

E
Matter, Density and Relative Density
12%

F
Pressure and Atmosphere
12%

G
Principles of Electricity
15%

SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

**SINGLE-FAMILY DWELLING
DRAIN-WASTE-VENT (DWV)**
33%

A
Drainage Systems
31%

B
Venting Systems
33%

C
Water Distribution
21%

D
Plumbing Fixtures
15%

SECTION TWO

HEATING SYSTEMS
13%



A
Temperature and Heat
Science
19%

B
Expansion/Contraction
Control
19%

C
Heat Transfer Equipment
9%

D
Temperature and Heat
Calculations
19%

E
Heat Loss Calculations
19%

F
Heat Emissions Units
9%

G
Buoyancy
6%

SECTION THREE

**SINGLE-FAMILY DWELLING
HYDRONIC SYSTEMS**
18%



A
Hydronic Heating Systems
24%

B
Hydronic Heating Boilers
19%

C
Boiler Trim
14%

D
Circulators
19%

E
Hydronic Heating/Cooling
Systems
14%

F
Mechanical Ventilation
10%

SECTION FOUR

SPECIALTY PIPING
10%



A
Plastic and Lined Piping
13%

B
Fiberglass Piping
8%

C
Iron and Glass Piping
8%

D
Alloy Piping
8%

E
Medical Gas Piping
17%

F
Specialty Pipe Joining
13%

G
Hot Tapping and Freeze
Isolation
17%

H
Compressed Air Systems
16%

SECTION FIVE

DRAWINGS, LAYOUT AND RIGGING

26%



A

Trigonometry

12%

B

Multiple Pipe Offsets

16%

C

Orthographic Projections

6%

D

Piping Isometrics

13%

E

Drawing Specifications

9%

F

Drawing Views

9%

G

Grades and Elevations

16%

H

Rigging

19%

THIRD PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

MULTI-FAMILY / COMMERCIAL DRAIN-WASTE-VENT (DWV) 25%	A	B	C
	Drainage Systems 33%	Venting Systems 20%	Water Distribution 30%
	D		
	Plumbing Fixtures 17%		

SECTION TWO

SINGLE-FAMILY DWELLING HYDRONIC DESIGN 24%	A	B	C
	System Design 17%	System Layout 21%	Heat Emitters 10%
	D	E	F
	Hydronic Controls 21%	Estimating and Documentation 10%	Commissioning and Maintenance 7%
	G	H	
	Alternative Heat Sources 4%	Low Pressure Steam Systems 10%	

SECTION THREE

TESTING EQUIPMENT AND ELECTRICAL COMPONENTS 13%	A	B	C
	Testing Equipment 19%	Pilot, Thermocouples and Thermopiles 25%	Electrical Components up to 400 MBH 56%

SECTION FOUR

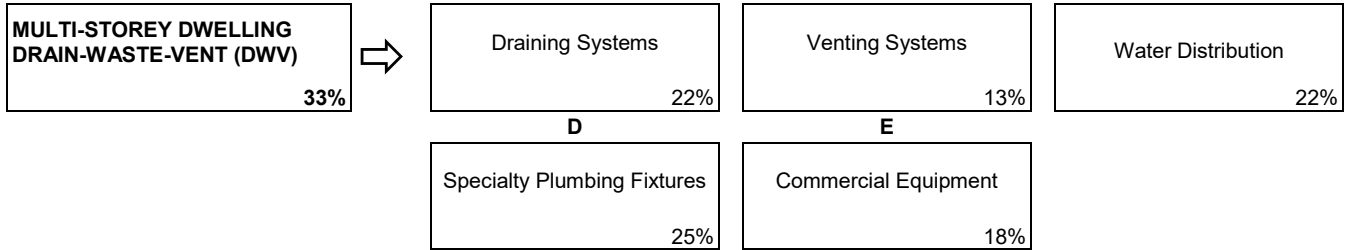
GAS SYSTEMS 24%	A	B	C
	Properties of Gas 21%	Temperature and Heat 4%	Gas System Components 20%
	D	E	F
	Pipe Sizing 14%	Pipe Installation 20%	Propane Storage and Handling Systems 21%

SECTION FIVE

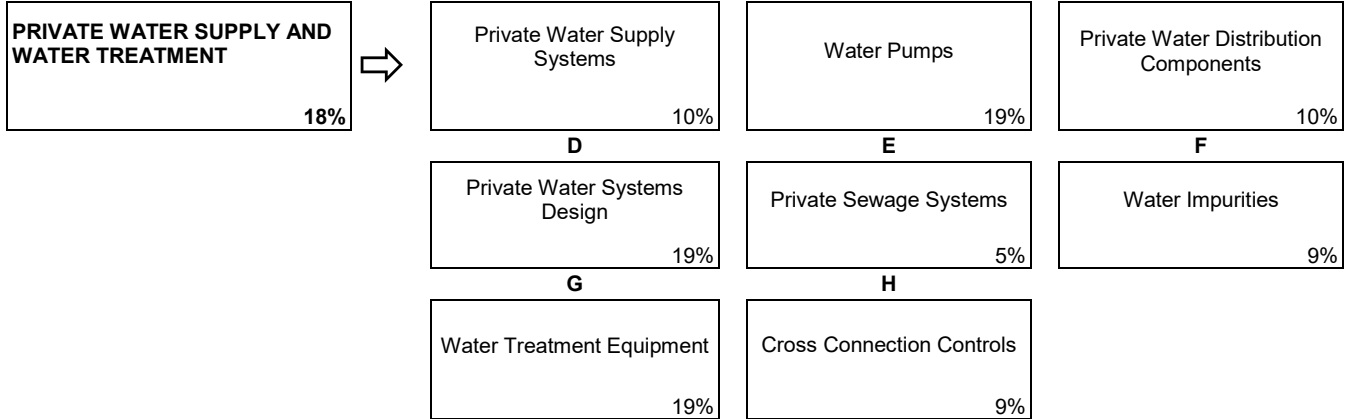
VENTING AND AIR SUPPLY 14%	A	B	C
	Appliance Installation 37%	Venting 44%	Air Supply 19%

FOURTH PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

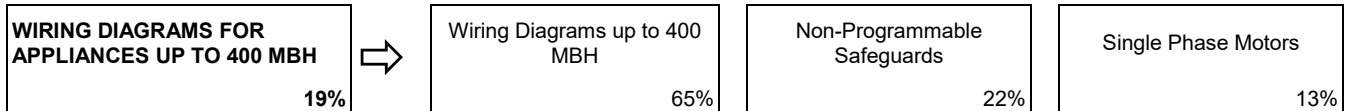
SECTION ONE



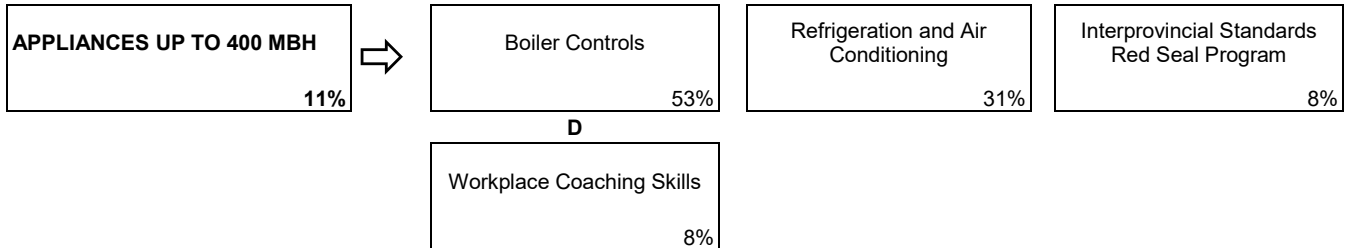
SECTION TWO



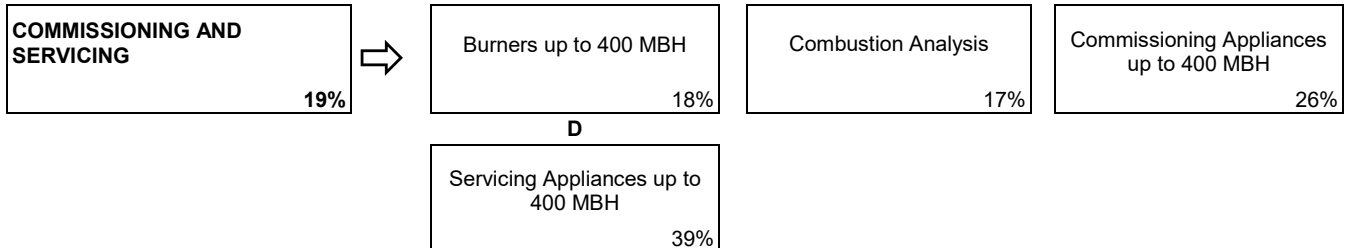
SECTION THREE



SECTION FOUR



SECTION FIVE



**FIRST PERIOD TECHNICAL TRAINING
PLUMBER TRADE
CURRICULUM GUIDE**

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:WORKPLACE SAFETY AND RIGGING..... 10%

A. Safety Legislation, Regulations & Industry Policy in the Trades..... 16%

Outcome: ***Apply legislation, regulations and practices ensuring safe work in this trade.***

1. Demonstrate the application of the Occupational Health and Safety Act, Regulation and Code.
2. Describe the sponsor's and employee's role with Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations and related advisory bodies and agencies.
3. Describe industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of worker and sponsors to apply emergency procedures.
5. Describe tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of sponsors and employees with the selection and use of personal protective equipment (PPE).
7. Maintain required PPE for tasks.
8. Use required PPE for tasks.

B. Climbing, Lifting, Rigging and Hoisting..... 25%

Outcome: ***Use industry standard practices for climbing, lifting, rigging and hoisting in this trade.***

1. Describe manual lifting procedures.
2. Describe rigging hardware and associated safety factors.
3. Select equipment for rigging loads.
4. Describe hoisting and load moving procedures.
5. Maintain personal protective equipment (PPE) for climbing, lifting and load moving equipment.
6. Use PPE for climbing, lifting and load moving equipment.

C. Hazardous Materials & Fire Protection 16%

Outcome: ***Apply industry standard practices for hazardous materials and fire protection in this trade.***

1. Describe roles, responsibilities, features and practices related to the Workplace Hazardous Materials Information System (WHMIS) program.
2. Describe three key elements of WHMIS.
3. Describe handling, storing and transporting procedures for hazardous material.
4. Describe venting procedures when working with hazardous materials.
5. Describe hazards, classes, procedures and equipment related to fire protection.

D. Apprenticeship Education Training Program 13%**Outcome: Manage an apprenticeship to earn journeyman certification.**

1. Describe the contractual responsibilities of the apprentice, sponsor and Alberta Apprenticeship and Industry Training.
2. Describe the purpose of the apprentice competency portfolio.
3. Describe the procedure for changing sponsors during an active apprenticeship.
4. Describe the purpose of the curriculum guide.
5. Describe the procedure for progressing through an apprenticeship.
6. Describe advancement opportunities in this trade.

E. Pipe Trades' Codes 13%**Outcome: Use codes and standards that are applied in the pipe trades.**

1. Identify code documents relating to pipe trades including ASME/ ABSA, CSA, NRC, NFPA, ASHRAE.
2. Explain the purpose of codes and standards.
3. Describe where codes and standards are applicable and by what authority.
4. Describe the procedures for the acceptance of the codes by the provinces and the local authorities.

F. Electrical Safety..... 17%**Outcome: Apply arc flash safety and lockout and tagout on a jobsite.**

1. Identify safe work practices to protect from arc flash hazards.
2. Describe lockout and tagout procedures.
3. Identify safe work practices to prevent electrical shock.

SECTION TWO:.....TOOLS, EQUIPMENT AND MATERIALS 38%**A. Hand Tools7%****Outcome: Use hand tools common to the pipe trades**

1. Identify the types of hand tools.
2. Describe use of hand tools.
3. Describe the maintenance of hand tools.

B. Power Tools7%**Outcome: Use power tools common to the pipe trades.**

1. Identify the types of hand tools.
2. Describe use of hand tools.
3. Describe the maintenance of hand tools.

C. Welded Pipe and Fittings 13%**Outcome: Construct welded and flanged piping system components.**

1. Identify types, markings, designations and pressure ratings for welded pipe fittings.

2. Identify stud tensioning systems.
3. State factors, methods and torque measurements for bolt ups.
4. Identify types, markings, designations, temperature and pressure ratings of flanged fittings and gaskets.
5. Describe the fabrication process for welded pipe and fittings to the tack-up stage.
6. Describe flange preparation and joining techniques for flanged joints.

D. Plastic Pipe and Tube 13%

Outcome: Construct plastic piping and tubing systems.

1. Identify types, applications and designations of plastic pipe, tubing and fittings.
2. Describe fabrication processes for solvent welding plastic pipe.
3. Describe fabrication processes for plastic pipe and tubing using alternative joining methods.
4. Describe fabrication processes for bell end joints.
5. Describe fabrication processes for plastic pipe using thermal fusion and electric resistance welding.
6. Fabricate and test a solvent weld spool to manufacturer's specifications.
7. Fabricate and test a fusion weld spool to manufacturer's specifications.

E. Threaded and Grooved Pipe 16%

Outcome: Construct threaded and grooved piping system components.

1. Identify types, markings, designations, temperature and pressure ratings of ferrous pipe and fittings.
2. Identify applications of codes, regulations and manufacturer's specifications.
3. Describe the composition of ferrous, alloyed and non-ferrous pipe.
4. Calculate cut length for threaded and grooved pipe.
5. Describe the fabrication steps for threading and grooving pipe.
6. Demonstrate use of hand tools to thread and groove pipe.
7. Demonstrate use of power tools to thread and groove pipe.
8. Assemble and pressure test an assigned project.

F. Tube and Tubing 13%

Outcome: Construct tube and tubing system components.

1. Identify types, designations and pressure ratings.
2. Identify fitting types, joining techniques.
3. Identify applications and manufacturer's specifications pertaining to joining methods.
4. Identify application to health and safety issues pertaining to joining methods.
5. Describe the process for bending tubing.
6. Describe the fabrication process to joining methods.
7. Assemble and pressure test an assigned project including flared, compression joints and bending components.

G. Valves 13%**Outcome: *Install valves in piping systems.***

1. Identify types of valves.
2. Describe major design variations and their applications.
3. Describe service and maintenance procedures.
4. Explain the purpose of manufacturer's instructions.

H. Hangers, Supports and Fasteners..... 11%**Outcome: *Install hangers, supports and fasteners for piping systems.***

1. Identify types of hangers, supports and fasteners.
2. Describe applications of hangers, supports and fasteners.
3. Describe installation techniques for hangers, supports and fasteners.
4. Explain specifications and manufacturer requirements for hangers, supports and fasteners.

I. Pressure Testing3%**Outcome: *Conduct a pressure test on a system.***

1. Identify equipment used for pressure testing piping installations.
2. Describe procedures and requirements for pneumatic and hydrostatic testing.
3. Describe hazards specific to pressure testing.

J. Pumps4%**Outcome: *Describe pumps for piping systems.***

1. Identify types of pumps.
2. Describe differences in pumps.
3. Describe factors affecting the operation of a pump.

SECTION THREE: METAL FABRICATION 19%**A. Welding Safety.....9%****Outcome: *Apply safe work practices according to Occupational Health and Safety Act (OHS) legislation.***

1. Identify hazards for welding and cutting operations.
2. Identify personal protective equipment for welding and cutting operations.
3. Explain hazards involved with welding fumes and gases.
4. Identify welding fume ventilation methods.
5. Explain effects of electricity and precautions used to prevent injury.
6. Describe procedures for welding or cutting in confined spaces.
7. Interpret sections of the *Occupational Health and Safety Act*, general safety regulations.

B. Welding 65%**Outcome: Use oxy-fuel and arc welding equipment.**

1. Identify five basic joint types.
2. Describe types of welds and their required dimensions.
3. Identify types of metals using practical tests.
4. Identify oxy-fuel cutting equipment.
5. Identify arc welding equipment.
6. Build a bracket project.
7. Build a spool project.

C. Brazing and Soldering 26%**Outcome: Braze and solder metal alloys.**

1. Identify applications of brazed and soldered joints.
2. Identify equipment and materials required to braze and solder.
3. Describe brazing and soldering procedures.
4. Assemble and test an assigned project.

SECTION FOUR:.....DRAWINGS AND SPECIFICATIONS..... 13%**A. Sketching and Drawing..... 20%****Outcome: Apply sketching and drawing concepts.**

1. Identify the types of drafting equipment.
2. Explain the use of drafting equipment.
3. Identify the types of drafting lines found on a drawing.
4. Identify the three views of an orthographic projection.
5. Draw and label the three views of an orthographic drawing.

B. Single Line Drawing40%**Outcome: Develop single line pipe drawings.**

1. Identify piping symbols.
2. Draw and label orthographic single-line drawings.
3. Draw and label isometric single-line piping drawings.

C. Drawing Interpretation 40%**Outcome: Interpret drawings.**

1. Identify the views of a drawing.
2. Explain usage of scales.
3. Calculate dimensions using imperial and metric scales.
4. Describe symbols found on a drawing.
5. Identify the five divisions of a drawing package.

6. Describe the purpose of drawing divisions.
7. Identify architectural and mechanical drawings.

SECTION FIVE: CALCULATIONS AND SCIENCE 20%

A. Applied Calculations 17%

Outcome: *Apply calculations using both metric and imperial measurements.*

1. Perform calculations using whole numbers, fractions and decimals.
2. Describe the metric and imperial measurement systems.
3. Describe the operation of the AIT calculator.
4. Perform number conversions using whole numbers, fractions and decimals.
5. Perform measurement conversions using whole numbers, fractions and decimals.

B. Perimeters, Areas, Percentage and Grade 23%

Outcome: *Perform calculations involving perimeter, areas, percentage and grade.*

1. Identify concepts when working with formulas.
2. Apply formulas for calculating perimeters of rectangles, triangles and circles.
3. Apply formulas for calculating the surface area of regular-shaped solids, tanks and cylinders.
4. Apply the formula for calculating percentages.
5. Calculate grades in percentage, fractions and ratio.

C. Volumes and Capacities8%

Outcome: *Calculate volumetric capacities for tanks and cylinders.*

1. Apply formulas for calculating volumes of regular shaped solids, tanks and cylinders.
2. Calculate capacity of regular shaped tanks and cylinders using both metric and imperial values.

D. Piping Offsets 13%

Outcome: *Calculate 45° and 90°offsets for piping systems.*

1. Calculate offsets for right angle triangles.
2. Apply formulas for 45° and 90° offsets.
3. Calculate offset dimensions around an object.

E. Matter, Density and Relative Density 12%

Outcome: *Calculate mass, volumes, densities and relative densities.*

1. Describe three common states of matter.
2. Define the terms matter, element, compound and mixture.
3. Define the terms adhesion, cohesion, surface tension and capillarity.
4. Calculate density, mass and volume of substances.
5. Calculate mass and density using relative densities.

F. Pressure and Atmosphere 12%

Outcome: **Calculate pressures in metric and imperial values.**

1. Define pressure and force.
2. State the six principles of hydrostatics.
3. Define pressure constants used for calculating pressures.
4. Describe atmospheric pressure and the effect of altitude.
5. Perform pressure and force calculations in both imperial and metric units.
6. Perform calculations to convert absolute, gauge and mercury pressures.

G. Principles of Electricity.....15%

Outcome: **Perform electrical calculations.**

1. Identify principles of electricity including direct and alternating current flow, electrolysis and electromagnetism.
2. Sketch series and parallel electrical circuits.
3. Apply Ohm's Law.

**SECOND PERIOD TECHNICAL TRAINING
PLUMBER TRADE
CURRICULUM GUIDE**

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:..... SINGLE-FAMILY DWELLING DRAIN-WASTE-VENT (DWV)..... 33%

A. Drainage Systems..... 31%

Outcome: *Install and service a single-family drainage system.*

1. Describe a drainage system.
2. Explain installation procedures of a drainage system.
3. Describe the installation of fittings and pipe above and below ground.
4. Apply standards from National Plumbing Code.
5. Sketch and size a drainage system.
6. Explain testing procedures for a drainage system.
7. Rough in a drainage system.
8. Test a drainage system.
9. Troubleshoot a drainage system.

B. Venting Systems.....33%

Outcome: *Install and service venting for a single- family drainage system.*

1. Describe a venting system.
2. Explain installation procedures of a venting system.
3. Describe the installation of fittings and pipe above and below ground.
4. Apply standards from National Plumbing Code.
5. Sketch and size a venting system.
6. Explain testing procedures for a venting system.
7. Rough in a venting system.
8. Test a venting system.
9. Troubleshoot a venting system.

C. Water Distribution.....21%

Outcome: *Install and service a single-family dwelling potable water distribution system.*

1. Describe the components in a municipal service.
2. Describe the components in a water distribution system.
3. Apply standards from National Plumbing Code.
4. Sketch and size the components of a water distribution system.
5. Explain installation procedures for a water distribution system.
6. Explain testing procedures for a water distribution system.

D. Plumbing Fixtures..... 15%

Outcome: Install and service plumbing fixtures in a single-family dwelling.

1. Describe types of plumbing fixtures.
2. Describe trim requirements for plumbing fixtures.
3. Explain installation procedures for plumbing fixtures.
4. Calculate plumbing fixture spacing.
5. Locate plumbing fixtures on a set of plans.
6. Apply standards from National Plumbing Code.
7. Install a plumbing fixture project.
8. Test a plumbing fixture project.
9. Troubleshoot a plumbing fixture project.

SECTION TWO: HEATING SYSTEMS 13%

A. Temperature and Heat Science 19%

Outcome: Apply scientific fundamentals relating to temperature and heat transfer processes.

1. Identify the three methods of heat transfer.
2. Explain the principles of expansion and contraction.
3. Calculate linear expansion using coefficients of expansion tables.

B. Expansion and Contraction Control 19%

Outcome: Apply expansion and contraction control measures on piping systems.

1. State the principles of expansion and contraction control.
2. Describe the methods to reduce friction between shoes and supports.
3. Describe the methods of anchoring and guiding pipe.
4. List the expansion and contraction equipment used for piping systems.
5. Describe installation procedures and commissioning of expansion/contraction equipment.

C. Heat Transfer Equipment 9%

Outcome: Install heat transfer equipment and piping.

1. Describe heat transfer equipment and piping.
2. Explain the operation of heat transfer equipment.

D. Temperature and Heat Calculations 19%

Outcome: Perform latent and sensible heat calculations.

1. Define latent and sensible heat.
2. State the heat values of different states of water.
3. Perform temperature conversion calculations.
4. Perform latent and sensible heat calculations.

E. Heat Loss Calculations 19%

Outcome: *Perform heat loss calculations to determine equipment selection.*

1. Define heat loss terminology.
2. Perform heat loss calculations.
3. Describe methods used to size equipment for heating systems.
4. Explain installation requirements of equipment and piping referencing codes.
5. Develop an isometric drawing with a complete material list.

F. Heat Emission Units 9%

Outcome: *Install heat emission units.*

1. Describe the types of heat emission units.
2. Describe trim used with heat emission units.
3. Explain installation procedures referencing codes and manufactures specifications.
4. Explain maintenance requirements for heat emission units.

G. Buoyancy 6%

Outcome: *Apply the principles of buoyancy to equipment submersed in fluids.*

1. State the three laws of buoyancy
2. Describe the effects of buoyancy on objects submersed in fluids.
3. Calculate buoyant force.

SECTION THREE: SINGLE FAMILY DWELLING HYDRONIC SYSTEM 18%

A. Hydronic Heating Systems 24%

Outcome: *Install and service hydronic heating systems.*

1. Describe the types of hydronic heating systems.
2. Describe equipment and materials used on hydronic heating systems.
3. Describe air elimination from hydronic heating systems.
4. Explain installation procedures for hydronic heating systems.
5. Apply standards from CSA B214.
6. Explain maintenance requirements for hydronic heating systems.

B. Hydronic Heating Boilers 19%

Outcome: *Install and service hydronic heating boilers.*

1. Describe the types of hydronic heating boilers.
2. Describe equipment and materials used on hydronic heating boilers.
3. Explain installation procedures for hydronic heating boilers.
4. Apply standards from CSA B214.
5. Describe maintenance requirements for hydronic heating boilers.

C. Boiler Trim 14%

Outcome: *Install and service boiler trim.*

1. Describe the components of boiler trim.
2. Identify component locations of boiler trim.
3. Describe maintenance requirements for boiler trim.
4. Test the components of boiler trim.
5. Troubleshoot the components of boiler trim.

D. Circulators 19%

Outcome: *Install and service circulators.*

1. Define the terminology pertaining to the flow of fluids in a piping system.
2. Describe the cause, effects and prevention of cavitation.
3. State determining factors for circulator selection.
4. Size a circulator according to head and flow rates.
5. Explain installation procedures for circulators.
6. Describe maintenance requirements for circulators.
7. Troubleshoot a circulator.

E. Hydronic Heating and Cooling Systems 14%

Outcome: *Install hydronic heating and cooling systems.*

1. Describe types of hydronic heating/cooling systems.
2. Describe the equipment and materials used in hydronic heating/cooling systems.
3. Explain installation procedures for hydronic heating/cooling systems.
4. Apply standards from CSA B214.
5. Describe maintenance requirements for hydronic heating/cooling systems.

F. Mechanical Ventilation.....10%

Outcome: *Recognize mechanical ventilation components with a hydronic system.*

1. Describe types of ventilation distribution systems.
2. Describe locations for intake and exhaust hoods.
3. Describe locations for indoor intakes and outlets.
4. Explain the start-up and balancing procedures for an HRV system.
5. Maintain a HRV system.

SECTION FOUR:SPECIALTY PIPING 10%

A. Plastic and Lined Piping 13%

Outcome: *Install and service plastic and lined piping.*

1. Describe types of plastic and lined piping.
2. Describe joining methods of plastic and lined piping.

3. Explain installation procedures for plastic and lined piping.

B. Fiberglass Piping 8%

Outcome: *Install and service Fiberglass Reinforced Plastic piping.*

1. Describe the materials and construction of fiberglass reinforced plastic piping.
2. Explain piping applications and the joining methods.
3. Explain the installation handling procedures of fiberglass reinforced plastic piping.

C. Iron and Glass Piping 8%

Outcome: *Install cast iron, ductile iron and glass piping.*

1. Describe the properties of cast iron, ductile iron and glass piping.
2. Explain applications of cast iron, ductile iron and glass piping.
3. Explain installation procedures of cast iron, ductile and glass piping.

D. Alloy Piping 8%

Outcome: *Install and service alloy piping.*

1. Describe types of alloy piping.
2. Explain applications of alloy piping.
3. Explain fabrication procedures of alloy piping.
4. Explain installation procedures of alloy piping.

E. Medical Gas Piping 17%

Outcome: *Recognize medical gas piping systems.*

1. Define the terminology pertaining to medical gas piping.
2. List the types of materials used to deliver medical gas.
3. Explain equipment installation procedures for medical gas piping systems.

F. Specialty Pipe Joining 13%

Outcome: *Install specialty pipe connectors.*

1. Describe types of pipe connectors.
2. Explain the principles of pipe connectors.
3. Fabricate a specialty pipe joining project.

G. Hot Tapping and Freeze Isolation 17%

Outcome: *Install a branch into an operational system.*

1. Explain the procedures for the use of a hot tap machine.
2. Outline the assembly of the hot tap machine.
3. Explain the procedures for the use of a freeze isolation.
4. Describe the applications of freeze isolation.
5. Observe a hot tap.
6. Observe a freeze isolation.

H. Compressed Air Systems 16%

Outcome: *Install and service for a compressed air system.*

1. Describe the operation of system components.
2. Describe applications for compressed air systems.
3. Explain installation procedures for compressed air systems.
4. Describe maintenance procedures for compressed air system.

SECTION FIVE: DRAWINGS, LAYOUT AND RIGGING 26%

A. Trigonometry 12%

Outcome: *Perform trigonometry calculations.*

1. Describe triangle terminology and trigonometry.
2. Perform Pythagorean Theorem.
3. Apply trigonometry formulas.

B. Multiple Pipe Offsets 16%

Outcome: *Calculate offsets for piping systems.*

1. State the formulas for 22.5°, 45° and rolling offsets.
2. Describe the application of equal and unequal spread offset around corners.
3. Calculate piping offsets and fitting allowances.
4. Assemble an assigned offset project.
5. Test an assigned offset project.

C. Orthographic Projections 6%

Outcome: *Draw orthographic projections of an object.*

1. Describe the principles of orthographic projection.
2. Draw orthographic projections of objects.

D. Piping Isometrics 13%

Outcome: *Sketch a piping system.*

1. Define terms used in isometric drawings.
2. Draw isometric piping with horizontal and vertical offsets.

E. Drawing Specifications 9%

Outcome: *Interpret drawing specifications.*

1. Explain the Construction Specification Institute format.
2. Interpret architectural and mechanical specifications.
3. Interpret drawing legends.

F. Drawing Views..... 9%

Outcome: *Locate piping and equipment from a set of drawings.*

1. Explain types of views from a set of drawings.
2. Explain types of elevations.
3. Define a grid line system.
4. Locate piping and equipment using grid lines from a set of drawings.

G. Grades and Elevations 16%

Outcome: *Locate elevations and calculate grades.*

1. Describe types of surveying equipment.
2. Define survey terminology.
3. Describe the use of surveying equipment.
4. Calculate grades using applicable formulas.
5. Calculate hanger spacing.
6. Calculate elevations.
7. Use survey equipment to locate elevations.
8. Complete a survey record sheet.

H. Rigging..... 19%

Outcome: *Perform rigging techniques.*

1. Describe types of rope used in rigging.
2. Describe types of slings used in rigging.
3. Perform tying procedures for knots and hitches.
4. Describe types of hoisting equipment.
5. Describe types of rigging equipment.
6. Describe the types of equipment related to mechanical advantage.
7. Calculate mechanical advantage.
8. Describe applications of lifting type equipment.
9. Perform hand signals to direct a crane.

**THIRD PERIOD TECHNICAL TRAINING
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UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:..... MULTI-FAMILY AND COMMERCIAL DRAIN-WASTE-VENT (DWV)..... 25%

A. Drainage Systems 33%

Outcome: *Install and service multi-family and commercial drainage system.*

1. Describe maintenance equipment for drainage systems.
2. Explain installation procedures for drainage systems.
3. Apply standards from National Plumbing Code.
4. Sketch and size a drainage system
5. Rough in a drainage system.
6. Maintain a drainage system.

B. Venting Systems..... 20%

Outcome: *Install and service a multi-family/commercial venting system.*

1. Explain installation procedures for a venting system.
2. Apply standards from National Plumbing Code.
3. Sketch and size a venting system
4. Rough in a venting system.
5. Maintain a venting system.

C. Water Distribution.....30%

Outcome: *Install and service a multi-family/commercial potable water distribution system.*

1. Describe the components in a water distribution system.
2. Apply standards from National Plumbing Code.
3. Sketch and size the components of a water distribution system.
4. Explain installation procedures for a water distribution system.

D. Plumbing Fixtures 17%

Outcome: *Install and service plumbing fixtures in a multi-family/commercial dwelling.*

1. Describe types of plumbing fixtures.
2. Describe trim requirements for plumbing fixtures.
3. Explain installation procedures for plumbing fixtures.
4. Calculate plumbing fixture spacing.
5. Locate plumbing fixtures on a set of plans.
6. Apply standards from National Plumbing Code.

7. Explain maintenance procedures for plumbing fixtures.
8. Troubleshoot a plumbing fixture project.

SECTION TWO:.....SINGLE-FAMILY DWELLING HYDRONIC DESIGN 24%

A. System Design 17%

Outcome: *Design a hydronic system.*

1. Define terminology pertaining to the calculation of heat loss values.
2. Calculate heat loss through a wall system.
3. Calculate the number of zones as it relates to size, spacing and length of piping.
4. Explain installation procedures of circuits and supplemental heat source.
5. Apply standards from CSA B214.

B. System Layout 21%

Outcome: *Layout a hydronic system.*

1. Identify materials installed in hydronic systems.
2. Describe methodology to size system components.
3. Apply standards for CSA B214.
4. Describe various piping layouts and their applications.
5. Explain methods of zoning and balancing hydronic systems.
6. Describe fluid requirements for a hydronic system.
7. Explain types of fluid dynamics in a hydronic system.

C. Heat Emitters 10%

Outcome: *Select a terminal unit for a hydronic system.*

1. Describe types of heat emitters.
2. Identify auxiliary components for heat emitters.
3. Describe installation procedures for heat emitters.
4. Sketch and size a room piping layout based on heat loss.
5. Describe troubleshooting procedures for heat emitters.

D. Hydronic Controls..... 21%

Outcome: *Select control configuration for a hydronic system.*

1. Describe various mixing valves, control valves and specialty equipment.
2. Describe applications for mixing valves, control valves and specialty equipment
3. Explain installation procedures for mixing valves, control valves and specialty equipment.
4. Explain troubleshooting techniques for various mixing valves, control valves and specialty equipment.
5. Apply standards from CSA B214.

E. Estimating and Documentation..... 10%

Outcome: Prepare documentation for a hydronic system.

1. Describe the process for preparing a hydronic heating estimate.
2. Complete a hydronic heating estimate for materials.
3. Explain how to maintain as-built records and documentation.
4. Apply standards form CSA B214.

F. Commissioning and Maintenance..... 7%

Outcome: Commission and service a hydronic system.

1. Identify manufacturer check lists.
2. Explain commissioning procedures of a hydronic system.
3. Perform commissioning on a hydronic system.
4. Explain maintenance procedures on a hydronic system.

G. Alternative Heat Source 4%

Outcome: Integrate alternative heat sources with hydronic systems.

1. Describe alternative heat sources.
2. Explain installation and design techniques.
3. Explain the efficiency of components.
4. Describe the technology integration relating to a hydronic system.

H. Low-Pressure Steam Systems 10%

Outcome: Install and service low-pressure steam systems.

1. Describe types of low-pressure steam systems.
2. Apply standards from CSA B214 and ASME.
3. Explain installation procedures for low pressure steam systems.
4. Explain maintenance requirements of low-pressure steam systems.
5. Explain troubleshooting a low-pressure steam system.

SECTION THREE: TESTING EQUIPMENT AND ELECTRICAL COMPONENTS..... 13%

A. Test Equipment..... 19%

Outcome: Use test equipment to service appliances.

1. Identify types of test equipment.
2. Describe functions of test equipment.
3. Describe settings for electrical testing equipment.
4. Use test equipment to service appliances.

B. Pilots, Thermocouples and Thermopiles 25%

Outcome: *Service pilots, thermocouples and thermopiles.*

1. Identify pilot burner types and terminology.
2. Describe characteristics of pilot burners.
3. Explain operating principles of thermocouples and thermopiles.
4. Describe operational tests performed on thermopiles and thermocouples.
5. Describe causes for thermocouple and thermopile failures.
6. Troubleshoot pilots, thermocouples, and thermopiles.

C. Electrical Components up to 400 MBH..... 56%

Outcome: *Service electrical components up to 400 MBH.*

1. Identify types of electrical and mechanical components.
2. Describe operating principles of controls.
3. Describe the function of a resistor in a circuit.
4. Apply standards from CSA B149.
5. Troubleshoot electrical and mechanical components.

SECTION FOUR: GAS SYSTEMS..... 24%

A. Properties of Gas 21%

Outcome: *Apply knowledge of the properties of gas.*

1. Describe the properties of fuel gas.
2. Identify chemical formulas.
3. Calculate problems using properties of gases.
4. Explain the principles of combustion.
5. Describe the products of complete and incomplete combustion.
6. Calculate air requirements for complete combustion.
7. Identify impurities found in fuel gas.

B. Temperature and Heat..... 4%

Outcome: *Apply knowledge of the heat transfer process relative to gasfitter trade.*

1. Explain the three methods of heat transfer.
2. Describe the principles of Charles and Boyles Law.
3. Define the terms latent and specific heat.

C. Gas System Components 20%

Outcome: *Install and service gas line components.*

1. Describe types of regulators.
2. Describe types of reliefs and vent piping.
3. Calculate vent sizing of reliefs.

4. Describe the types of meters.
5. Clock a meter at low pressure.
6. Clock a meter at high pressure.
7. Troubleshoot a regulator.
8. Apply standards for CSA B149.1.

D. Pipe Sizing 14%

Outcome: *Size a gas line system.*

1. Identify the types of gas and pressure.
2. Identify the types of gas line material.
3. Calculate the volume of gas consumed by appliance(s).
4. Sketch a gas line system.
5. Calculate the length of the gas piping systems.
6. Apply standards for CSA B149.

E. Pipe Installation 20%

Outcome: *Install a gas line system.*

1. Compile a materials list for a gas line.
2. Apply standards for CSA B149.
3. Install a gas line.
4. Test a gas line.

F. Propane Storage and Handling Systems 21%

Outcome: *Install and service propane storage and handling systems.*

1. Describe types of propane handling vessels.
2. Describe components used on propane systems.
3. Describe types of vapourizers.
4. Explain maintenance procedures for vessels and components.
5. Apply standards from CSA B149.
6. Calculate size and placement of components.

SECTION FIVE:.....VENTING AND AIR SUPPLY..... 14%

A. Appliance Installation 37%

Outcome: *Install a gas appliance.*

1. Describe the categories of appliances.
2. Identify rating plate requirements for specific appliances.
3. Identify gas appliance approval agencies.
4. Describe installation requirements for finish piping.
5. Explain the altitude rating requirements for appliances.
6. Calculate altitude ratings.

- 7. Apply standards from CSA B149.
- 8. Apply manufacturer specifications with appliance installation.

B. Venting 44%

Outcome: *Install and service venting systems.*

- 1. Describe venting principles.
- 2. Describe the types of flues and draft control devices.
- 3. List the installation procedures for types of venting materials.
- 4. Size vents according to appliance category.
- 5. Size chimneys and liners.
- 6. Describe installation procedures for single and double acting barometric dampers.
- 7. Apply standards from CSA B149.
- 8. Describe vent and chimney applications for gas and alternate fuel appliances.

C. Air Supply 19%

Outcome: *Install and service air supply systems.*

- 1. Describe air supply principles.
- 2. Apply standards from CSA B149.
- 3. Calculate the free area of grills and louvers.
- 4. Calculate the size of air supply ducts.
- 5. Calculate the air required for combustion, ventilation and flue gas dilution.

**FOURTH PERIOD TECHNICAL TRAINING
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UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:.....MULTI-STOREY DWELLING DRAIN-WASTE-VENT (DWV) 33%

A. Drainage Systems 22%

Outcome: *Install and service a multi-storey drainage system.*

1. Explain installation procedures for drainage systems.
2. Apply standards from National Plumbing Code.
3. Sketch and size a drainage system.
4. Rough in a carrier system.
5. Test a carrier system.

B. Venting Systems..... 13%

Outcome: *Install and service a multi-storey venting system.*

1. Explain installation procedures for a venting system.
2. Apply standards from National Plumbing Code.
3. Sketch and size a venting system.

C. Water Distribution 22%

Outcome: *Install and service a multi-storey water distribution system.*

1. Describe the components in a water distribution system.
2. Calculate distribution system using average pressure loss method.
3. Apply standards from National Plumbing Code.
4. Sketch and size a water service and distribution system.

D. Specialty Plumbing Fixtures 25%

Outcome: *Install and service specialty plumbing fixtures in a multi-storey dwelling.*

1. Describe types of plumbing fixtures.
2. Describe trim requirements for plumbing fixtures.
3. Locate plumbing fixtures on a set of plans.
4. Explain installation procedures for plumbing fixtures.
5. Apply standards from National Plumbing Code.
6. Test a specialty plumbing fixture project.
7. Install a specialty plumbing fixture project.

E. Commercial Equipment.....18%

Outcome: *Install and service commercial equipment.*

1. Describe types of commercial equipment.
2. Describe trim requirements for commercial equipment.
3. Locate commercial equipment on a mechanical drawing.
4. Explain installation procedures for commercial equipment.
5. Apply standards from National Plumbing Code.
6. Test a commercial equipment project.
7. Install a commercial equipment project.

SECTION TWO: PRIVATE WATER SUPPLY AND WATER TREATMENT..... 18%

A. Private Water Supply Systems 10%

Outcome: *Install and service a private water supply system.*

1. Define the terminology used for private water supply systems.
2. Explain different applications for private water sources.
3. Describe the types of wells used for private water supplies.

B. Water Pumps 19%

Outcome: *Install and service a water pump.*

1. Describe types of water pumps.
2. Outline the operation of a water supply pump.
3. Describe the relationship between head, pressure, friction loss and flow rates.
4. Size a water pump.
5. Describe installation procedures for various water pumps.
6. Install a water pump.
7. Test a water pump.
8. Describe maintenance procedures for water pumps.

C. Private Water Distribution Components..... 10%

Outcome: *Install and service components for a private water distribution system.*

1. Describe components of a private water distribution system.
2. Describe installation procedures for private water distribution components.
3. Install components of a private water distribution system.
4. Test components of a private water distribution system.
5. Describe maintenance procedures with private water distribution components.

D. Private Water System Design 19%

Outcome: *Size a private water system.*

1. Describe design requirements for a private water system.
2. Describe the sizing procedure for a private water system.
3. Sketch and size a private water system.
4. Apply standards from National Plumbing Code.
5. Troubleshoot a private water system.

E. Private Sewage Systems 5%

Outcome: *Recognize the components of a private sewage system.*

1. Describe types of private sewage systems.
2. Identify the components of a private sewage system.
3. List hazards relating to the components on a private sewage system.
4. Explain troubleshooting a private sewage system.

F. Water Impurities 9%

Outcome: *Perform water impurity tests.*

1. List impurities found in water.
2. Describe the types of tests to measure contaminants.
3. Describe water-associated problems.
4. Perform water impurity tests.

G. Water Treatment Equipment 19%

Outcome: *Install and service water treatment equipment.*

1. Describe methods of treating contaminants in the water supply.
2. Identify the components of water treatment equipment.
3. Describe the operation of water treatment equipment.
4. Calculate the capacity of types of water treatment equipment.
5. Perform installation procedures for types of water treatment.
6. Troubleshoot a water treatment equipment.

H. Cross Connection Control Awareness 9%

Outcome: *Install cross connection assemblies.*

1. Define the requirements for tester certification.
2. Describe definitions pertaining to cross connection control.
3. Apply standards from CSA B64 and National Plumbing Code.
4. Identify the categories of cross connection control assemblies.
5. Explain installation procedures of cross-connection assemblies.

SECTION THREE:WIRING DIAGRAMS FOR APPLIANCES UP TO 400 MBH..... 19%

A. Wiring Diagrams up to 400 MBH..... 65%

Outcome: *Apply wiring diagrams for appliances up to 400 MBH.*

1. Identify types of transformers.
2. Describe the operating principles of transformers.
3. Calculate transformer load capacity.
4. Describe types of wiring diagrams.
5. Identify symbols found on wiring diagrams.
6. Describe the sequence of operation.
7. Sketch a sequence of operations flow chart.
8. Sketch wiring diagrams.
9. Wire circuits from wiring diagrams.
10. Troubleshoot circuits from a wiring diagram.

B. Non-Programmable Safeguards..... 22%

Outcome: *Service non-programmable safeguards.*

1. Identify ignition systems.
2. Describe flame rectification.
3. Describe the operating principles.
4. Describe the sequence of operations
5. Sketch the sequence of operations.
6. Sketch wiring diagrams.
7. Wire circuits from wiring diagrams.
8. Troubleshoot circuits from wiring diagrams.

C. Single Phase Motors..... 13%

Outcome: *Service single phase motors.*

1. Describe types of single phase motors.
2. Describe applications for single phase motors.
3. Describe the maintenance on a single phase motor.
4. Interpret the data on a motor nameplate.
5. Calculate the current draw on single phase motors.
6. Troubleshoot single phase motors.

SECTION FOUR:APPLIANCES UP TO 400 MBH..... 11%

A. Boiler Controls 53%

Outcome: *Install and service gas fired boilers.*

1. Describe the operation of boilers.
2. Apply standards from CSA B149, ASME and CSA B214.

3. Describe the operation of boiler controls.
4. List the sequencing process of the boiler controls.
5. Sketch wiring diagrams for a gas fired boiler.
6. Troubleshoot a gas fired boiler.

B. Refrigeration and Air Conditioning 31%

Outcome: Service heat/cool units.

1. Identify the hazards with combined heating/cooling gas fired appliances.
2. Describe the components and symbols of a combined heating/cooling gas fired unit...
3. Describe the operation of a combined heating/cooling gas fired unit.
4. Explain handling requirements for refrigerants in heat/cool units.
5. Describe a compression refrigeration cycle.
6. Interpret wiring diagrams to troubleshoot heating/cooling gas fired units.

C. Interprovincial Standards Red Seal Program..... 8%

Outcome: Use Red Seal products to challenge an Interprovincial examination.

1. Identify Red Seal products used to develop interprovincial examinations.
2. Use Red Seal products to prepare for an interprovincial examination.

D. Workplace Coaching Skills 8%

Outcome: Use coaching skills when training an apprentice.

1. Describe the process for coaching an apprentice.

SECTION FIVE:..... COMMISSIONING AND SERVICING 19%

A. Burners up to 400 MBH 18%

Outcome: Install and service burners up to 400 MBH.

1. Describe types of burners.
2. Describe components of burners.
3. Explain the ignition process for burners.
4. Adjust burners as per manufacturer's specifications.

B. Combustion Analysis 17%**Outcome: Perform a combustion analysis.**

1. Explain combustion analysis principles.
2. Describe factors relating to combustion analysis.
3. Describe methods for testing and adjusting combustion.
4. Calculate excess air volumes.
5. Calculate CO₂, O₂ and excess air.
6. Describe the effects of flame temperature on nitrogen oxide.
7. Perform a combustion analysis.

C. Commissioning Appliances up to 400 MBH..... 26%**Outcome: Commission appliances up to 400 MBH.**

1. Describe appliance testing, start-up and setup procedures as per manufacture specifications.
2. Explain the requirements when conducting a pre-heat chimney procedure.
3. Apply standards from CSA B149.
4. Verify gas pressures for the installation.
5. Verify electrical requirements.
6. Commission an appliance.

D. Servicing Appliances up to 400 MBH 39%**Outcome: Service appliances up to 400 MBH.**

1. Use orifice sizing charts to determine orifice sizes.
2. Calculate orifice sizing using interpolation of the sizing charts.
3. Convert orifice sizes to drill sizes for hand drilling.
4. Explain methods used to check the condition of heat exchangers.
5. Perform a fuel gas conversion.
6. Apply standards from CSA B149.



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