Apprenticeship and Industry Training

Steamfitter/Pipefitter

Curriculum Guide

0075 (2022)

Alberta

Apprenticeship and Industry Training

ALBERTA ADVANCED EDUCATION

Steamfitter-pipefitter: apprenticeship education program curriculum guide

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Steamfitter/Pipefitter
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CURRICULUM GUIDE

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 journeyperson 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 post-secondary 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 Steamfitter/Pipefitter apprenticeship program is an individual who will be able to:

- install and maintain high pressure and low pressure steam and hot liquid systems, including various process and industrial systems
- fabricate, join and install any pipe system used for various purposes in buildings, using any type of pipe including steel, alloy, cast iron, copper or plastic, etc.
- provide safe and efficient systems which function in conjunction with other systems
- comply with rules and codes governing installations
- read and interpret plans, specifications and working drawings and prepare layouts
- be proficient with the safe use of hand and power tools and equipment
- calculate material quantities and compile materials lists
- install components according to specifications and assume responsibility for the end product
- relate to job situations and other trades that precede or follow
- understand the fundamentals of operating a small business.
- perform assigned tasks in accordance with quality and production standards required by 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. T. Hopman .....Airdrie
Mr. B. Thompson.....Edmonton
Mr. N. Wylie.....Edmonton
Mr. L. Yakemchuk .....Sherwood Park
Mr. D. Zenchuk.....Ardrossan
Ms. D. Francis .....Leduc
Ms. M. Pasula.....Beaumont
Mr. C. Ploof .....St. Albert
Mr. C. Van Petten.....Edmonton

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

Apprenticeship 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 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 Steamfitter/Pipefitter trade apprenticeship training:

Grande Prairie Regional College
Medicine Hat College
Northern Alberta Institute of Technology
Keyano College
Red Deer College
Southern Alberta Institute of Technology
Lakeland College
Portage College

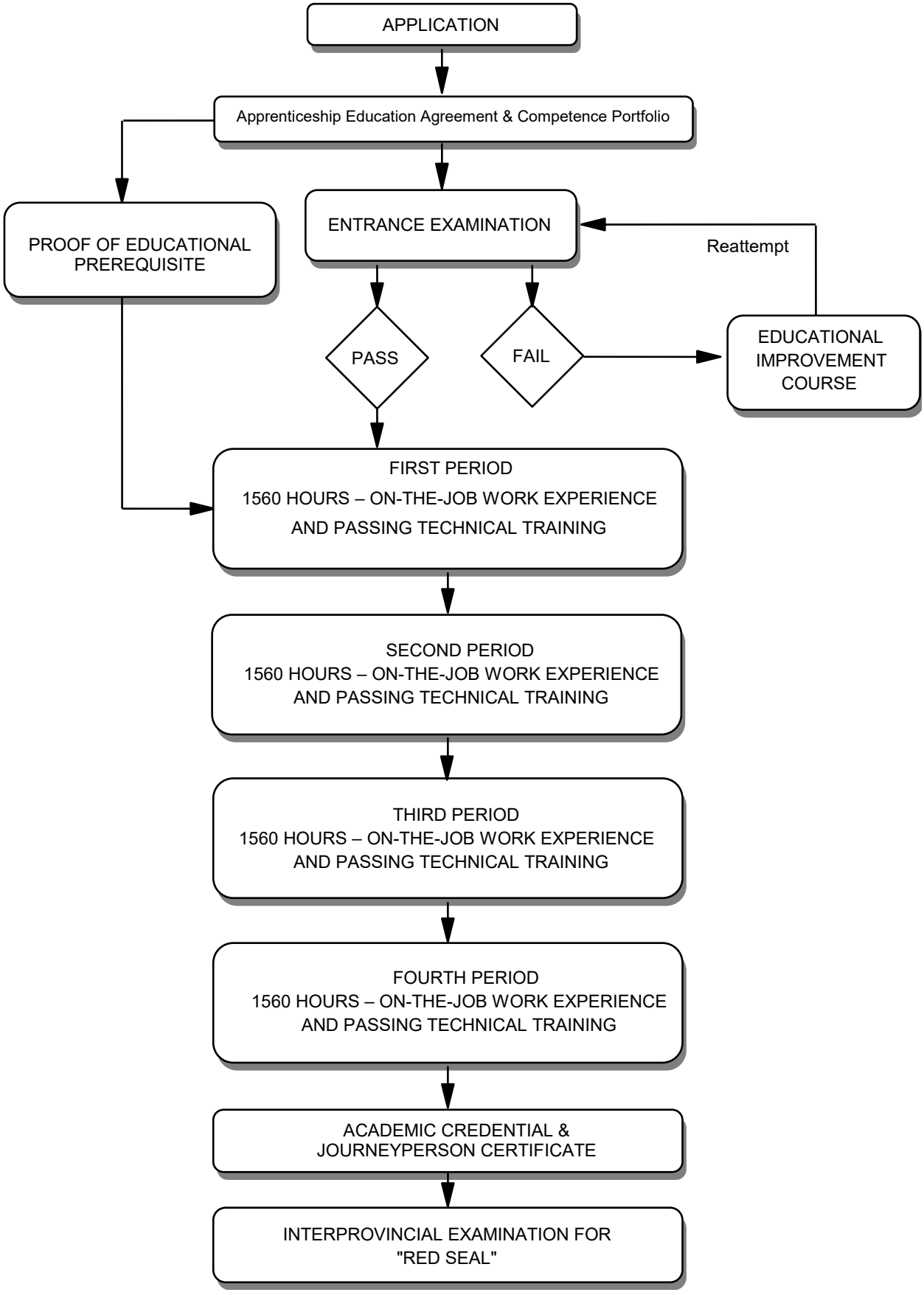
Procedures for Recommending Revisions to the Curriculum Guide

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



Steamfitter/Pipefitter Training Profile
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

WORKPLACE SAFETY AND RIGGING — **10%**

A	B	C
Safety Legislation, Regulations & Industry Policy in the Trades — 16%	Climbing, Lifting, Rigging and Hoisting — 25%	Hazardous Material & Fire Protection — 16%
D	**E**	**F**
Apprenticeship Training Program — 13%	Pipe Trade Codes — 13%	Electrical Safety — 17%

SECTION TWO

TOOLS, EQUIPMENT AND MATERIALS — **38%**

A	B	C
Hand Tools — 7%	Power Tools — 7%	Welded Pipe and Fittings — 13%
D	**E**	**F**
Plastic Pipe and Tube — 13%	Threaded and Grooved Pipe — 16%	Tube and Tubing — 13%
G	**H**	**I**
Valves — 13%	Hangers, Supports and Fasteners — 11%	Pressure Testing — 3%
J		
Pumps — 4%		

SECTION THREE

METAL FABRICATION — **19%**

A	B	C
Welding Safety — 9%	Welding — 65%	Brazing and Soldering — 26%

SECTION FOUR

DRAWINGS AND SPECIFICATIONS — **13%**

A	B	C
Sketching and Drawing — 20%	Single Line Drawing — 40%	Drawing Interpretation — 40%

SECTION FIVE

CALCULATIONS AND SCIENCE — **20%**

A	B	C
Applied Calculations — 17%	Perimeters, Areas, Percentage and Grade — 23%	Volumes and Capacities — 8%
D	**E**	**F**
Piping Offsets — 13%	Matter, Density and Relative Density — 12%	Pressure and Atmosphere — 12%
G		
Principles of Electricity — 15%		

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

SECTION ONE

HEATING SYSTEMS **13%**

A	B	C
Temperature and Heat Science 19%	Expansion/Contraction Control 19%	Heat Transfer Equipment 9%
D	**E**	**F**
Temperature and Heat Calculations 12%	Heat Loss Calculations 19%	Heat Emissions Units 9%
G		
Buoyancy 13%		

SECTION TWO

HYDRONIC HEATING **16%**

A	B	C
Hydronic Heating Systems 31%	Hydronic Heating Boilers 10%	Boiler Trim 15%
D	**E**	**F**
Circulators and Pumps 21%	Hydronic Heating/Cooling Systems 8%	Liquid Heat Tracing 15%

SECTION THREE

RIGGING EQUIPMENT AND HOISTING COMMUNICATION **23%**

A	B	C
Lift Planning 13%	Fibre and Wire Rope 33%	Pulleys and Levers 11%
D	**E**	**F**
Slings and Hoisting Equipment Hardware 26%	Hoisting Communication 11%	Scaffolds and Access Equipment 6%

SECTION FOUR

SPECIALTY PIPING **10%**

A	B	C
Plastic and Lined Piping 25%	Fiberglass Piping 17%	Iron and Glass Piping 8%
D	**E**	**F**
Alloy Piping 25%	Specialty Pipe Joining 12%	Pipe Bending 13%

SECTION FIVE

DRAWINGS, LAYOUT AND ELEVATIONS **22%**

A	B	C
Trigonometry 15%	Multiple Pipe Offsets 11%	Gasket Joint Layout 12%
D	**E**	**F**
Orthographic Projections 8%	Piping Isometrics 23%	Drawing Specifications 19%
G		
Drawing Views 12%		

SECTION SIX

GASFITTING FUNDAMENTALS **16%**

A	B	C
Properties of Gas 31%	Gas System Components 31%	Testing Equipment 15%

D
Pilot, Thermocouples and Thermopiles 23%

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

SECTION ONE

LOW PRESSURE STEAM AND CONDENSATE SYSTEMS **22%**

A	B	C
Low Pressure Steam Boilers 17%	Low Pressure Steam Systems 17%	Steam Properties and Gas Laws 11%

D	E	F
Boiler Piping and Trim 23%	Steam Traps 12%	Water Treatment 12%

G
Specialty Steam Equipment 8%

SECTION TWO

INSTRUMENTATION AND TRADE TECHNOLOGIES **15%**

A	B
Control Systems 67%	Trade Technologies 33%

SECTION THREE

WELDING PROCESSES **24%**

A	B	C
SMAW Equipment 31%	Weld Faults 5%	Mild Steel Electrodes 5%

D	E	F
Plasma Arc Cutting 8%	Filler Metals and Shielding Gases 5%	GMAW Equipment 36%

G
GTAW Equipment 10%

SECTION FOUR

HOIST PLANNING AND CRANES **12%**

A	B	C
Hoist Planning 21%	Lifting and Moving Equipment 38%	Cranes 41%

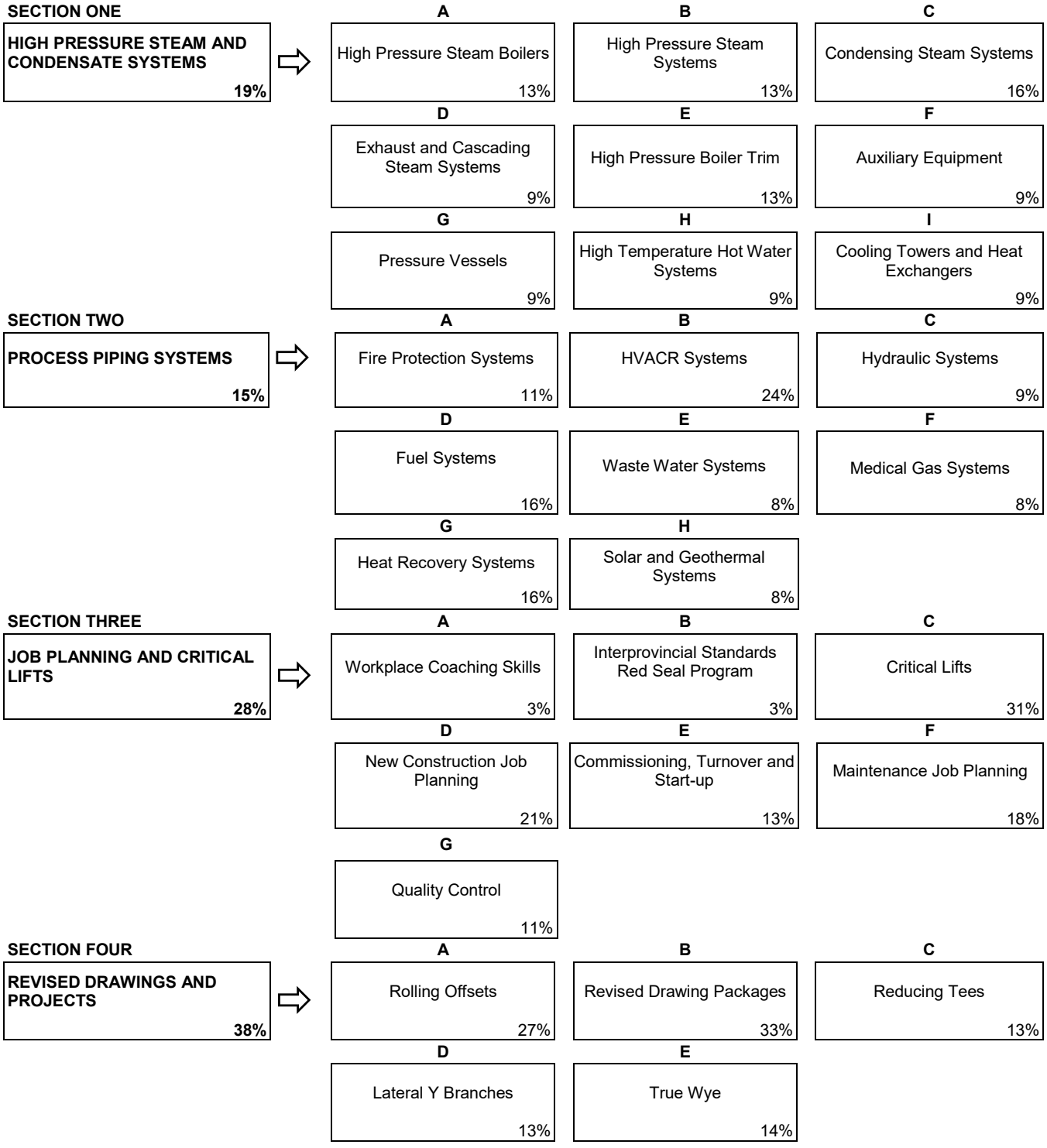
SECTION FIVE

PROCESS DIAGRAMS AND MITRE ELBOW **27%**

A	B	C
Process Diagrams 47%	Compound Mitre Elbow 14%	Applied Piping Isometrics 14%

D	E
Builders Level 6%	Dummy Leg 19%

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



FIRST PERIOD TECHNICAL TRAINING
STEAMFITTER/PIPEFITTER 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 and 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 Training Program 13%

Outcome: Manage an apprenticeship to earn journeyperson certification.

1. Describe the contractual responsibilities of the apprentice, sponsor and Alberta Apprenticeship and Industry Training.
2. Describe the purpose of the 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/ tagout procedures.
3. Identify safe work practices to prevent electrical shock.

SECTION TWO: ..... TOOLS, EQUIPMENT AND MATERIALS 38%

A. Hand Tools 7%

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 Tools 7%

Outcome: Use power tools common to the pipe trades.

1. Identify the types of power tools.
2. Describe use of power tools.
3. Describe the maintenance of power 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. Describe the fabrication steps for threading and grooving pipe.
5. Calculate cut length for threaded and grooved 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 and joining techniques.
3. Identify applications and manufacturer's specifications pertaining to joining methods.
4. Identify health and safety issues pertaining to joining methods.
5. Describe the process for bending tubing.
6. Describe the fabrication processes for joining tubing systems.
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 fundamental design variations and their applications.
3. Describe service and maintenance procedures.
4. Explain specifications and manufacturer's requirements for valves.

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 Testing 3%

Outcome: Conduct a pressure test 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. Pumps 4%

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 the 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 solder joints.
2. Identify equipment and materials required to braze and solder.
3. Describe brazing and soldering procedures.
4. Assemble and test assigned project.

SECTION FOUR : .....DRAWINGS AND SPECIFCATIONS 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 Drawing 40%

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. Use 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 a rectangle, triangle and a circle.
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 Capacities 8%

Outcome: Calculate volumetric capacities for tanks and cylinders.

1. Apply formulas for calculating volumes of regular shaped solids, tanks and cylinders.
2. Calculate capacities 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, 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
STEAMFITTER/PIPEFITTER TRADE
CURRICULUM GUIDE

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

SECTION ONE: 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/ 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/or guiding pipe.
4. List the expansion/ contraction equipment used for piping systems.
5. Describe installation and commissioning procedures of expansion/ contraction equipment.

C. Heat Transfer Equipment 9%

Outcome: Install heat transfer equipment and piping.

1. Describe heat transfer equipment.
2. Describe operation of heat transfer equipment.
3. Describe heat transfer piping systems.

D. Temperature and Heat Calculations 12%

Outcome: Perform latent and sensible heat calculations.

1. Define latent and sensible heat.
2. State the heat values of ice, water and steam.
3. Perform temperature conversion calculations.
4. Perform latent and sensible heat calculations.

E. Heat Loss Calculation 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 for heat emission units referencing codes.
4. Explain maintenance requirements for heat emission units.

G. Buoyancy 13%

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 TWO: ..... HYDRONIC HEATING 16%

A. Hydronic Heating Systems 31%

Outcome: Install and maintain 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. Describe installation procedures for hydronic heating systems referencing codes.
5. Explain maintenance requirements for hydronic heating systems.
6. Calculate the layout of a serpentine system.

B. Hydronic Heating Boilers 10%

Outcome: Install and maintain hydronic heating boilers.

1. Describe the types of hydronic heating boilers referencing codes.
2. Describe equipment and materials used on hydronic heating boilers.
3. Describe installation procedures for hydronic heating boilers.
4. Describe maintenance requirements for hydronic heating systems.

C. Boiler Trim 15%

Outcome: Install and maintain boiler trim.

1. Describe the components of boiler trim.
2. Identify components and boiler trim on a drawing.
3. Describe maintenance requirements for boiler trim.

D. Circulators and Pumps 21%

Outcome: Install and maintain circulators and pumps.

1. Describe the terminology pertaining to the flow of fluids in a piping system.
2. Describe the principle of a venturi.
3. Describe the cause, effects and prevention of cavitation.
4. State factors that determine pump selection.
5. Size pump according to head and flow rates.
6. Describe installation procedures for circulators and pumps.
7. Describe maintenance requirements for circulators and pumps.

E. Hydronic Heating/Cooling Systems..... 8%

Outcome: Install hydronic heating/cooling systems.

1. Describe types of hydronic heating/cooling systems.
2. Describe the equipment and materials used in hydronic heating/cooling systems.
3. Describe installation procedures for hydronic heating/cooling systems referencing codes.
4. Describe maintenance requirements for hydronic heating/cooling systems.

F. Liquid Heat Tracing 15%

Outcome: Install liquid heat tracing.

1. Describe types of heat tracing.
2. Describe equipment and materials used for liquid heat tracing.
3. Identify heat tracing symbols used on drawings.
4. Describe installation procedures for liquid heat tracing.
5. Fabricate a valve basket.

SECTION THREE: ..... RIGGING EQUIPMENT AND HOISTING COMMUNICATION..... 23%

A. Lift Planning 13%

Outcome: Develop a lift plan for hand rigging.

1. Describe a lift plan.
2. Calculate weights and center of gravity.

B. Fibre and Wire Rope..... 33%

Outcome: Use fibre and wire rope for rigging.

1. Describe fibre rope.
2. Calculate working load limits (WLL) for fibre rope.
3. Describe the purpose of knots, hitches and bends.
4. Tie knots, hitches and bends with fibre rope.
5. Describe wire rope.

6. Calculate working load limits (WLL) for wire rope.
7. Install wire rope hardware.

C. Pulleys and Levers 11%

Outcome: Use pulleys and levers for hoisting and lifting materials and equipment.

1. Describe types of pulleys and their applications.
2. Describe types of levers and their applications.
3. Calculate mechanical advantage.
4. Use pulleys and levers.

D. Slings and Hoisting Equipment Hardware 26%

Outcome: Use slings and hoisting equipment.

1. Describe the construction of chain and chain slings.
2. Describe the construction of steel and fibre slings.
3. Describe hoisting equipment hardware.
4. Use steel and fibre slings.

E. Hoisting Communication 11%

Outcome: Use forms of communication for hoisting operations.

1. Describe hand signals used for hoisting operations.
2. Describe voice communication protocols.
3. Perform hand signals.

F. Scaffolds and Access Equipment 6%

Outcome: Use scaffolds and aerial access equipment.

1. Describe types of scaffolds and access equipment.
2. Apply the Occupational Health and Safety Act, Regulation and Code when working from access equipment.

SECTION FOUR: .....SPECIALTY PIPING 10%

A. Plastic and Lined Piping 25%

Outcome: Install and maintain 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 17%

Outcome: Install and maintain fiberglass reinforced plastic (FRP) piping.

1. Describe the materials and construction of FRP.
2. Explain piping applications and the joining methods.

3. Explain the installation handling procedures of FRP piping.
4. Observe the joining methods of FRP 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.
4. Observe joining methods of cast iron, ductile and glass piping.

D. Alloy Piping 25%

Outcome: Install and maintain 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.
5. Observe joining methods of alloy piping.

E. Specialty Pipe Joining 12%

Outcome: Install specialty pipe connectors.

1. Describe types of pipe connectors.
2. Explain the principles of pipe connectors.
3. Observe installation procedures for pipe connectors.

F. Pipe Bending 13%

Outcome: Apply techniques for pipe bending.

1. Describe methods of pipe bending.
2. Explain pipe bending applications.
3. Calculate gain and fitting allowances on pipe bends.
4. Observe methods of pipe bending.

SECTION FIVE: ..... DRAWINGS, LAYOUT AND ELEVATIONS 22%

A. Trigonometry 15%

Outcome: Perform trigonometry calculations.

1. Describe triangle terminology and trigonometry.
2. Describe Pythagorean Theorem.
3. Use trigonometric formulas.

B. Multiple Pipe Offsets 11%

Outcome: Calculate offsets for piping systems.

1. State the formulas for 22.5° and 45° offsets.
2. Describe the application of equal and unequal spread offset around corners.
3. Calculate piping offsets and fitting allowances.

C. Gasket Joint Layouts 12%

Outcome: Construct flange and gasket templates.

1. Describe geometric terms of a gasket joint layout.
2. Layout a piping flange to scale.
3. Layout a gasket to scale.
4. Fabricate a gasket.

D. Orthographic Projections 8%

Outcome: Draw orthographic projections of an object.

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

E. Piping Isometrics 23%

Outcome: Fabricate a piping system.

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

F. Drawing Specifications 19%

Outcome: Interpret drawing specifications.

1. Explain the Construction Specification Institute (CSI) format.
2. Interpret architectural and mechanical specifications.
3. Interpret Line Designation Tables (LDT's).

G. Drawing Views 12%

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 coordinate systems.
4. Locate piping and equipment using coordinates.

SECTION SIX: GASFITTING FUNDAMENTALS 16%

A. Properties of Gas 31%

Outcome: Apply knowledge related to 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. Gas System Components 31%

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.

C. Test Equipment 15%

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.

D. Pilots, Thermocouples and Thermopiles 23%

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.

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:..... LOW PRESSURE STEAM AND CONDENSATE SYSTEMS 22%

A. Low Pressure Steam Boilers 17%

Outcome: Install and maintain low pressure steam boilers.

1. Describe types of low pressure steam boilers.
2. Describe equipment and materials used on low pressure steam boilers.
3. Explain installation procedures for low pressure steam boilers referencing codes.
4. Explain maintenance requirements on low pressure steam boilers.
5. Troubleshoot a low pressure steam boiler.

B. Low Pressure Steam Systems 17%

Outcome: Install and maintain low pressure steam systems.

1. Describe types of low pressure steam systems.
2. Describe materials and equipment used on low pressure steam systems referencing codes.
3. Explain installation procedures for low pressure steam systems referencing codes.
4. Explain maintenance requirements of low pressure steam systems.
5. Fabricate a low pressure steam system.
6. Troubleshoot a low pressure steam system.

C. Steam Properties and Gas Laws..... 11%

Outcome: Apply steam tables and gas laws.

1. Explain the applications of steam tables.
2. Define terms related with steam tables.
3. State the effects of pressure, vacuum and volume of steam.
4. Describe the principles of the gas laws.
5. Perform calculations using gas laws.

D. Boiler Piping and Trim 23%

Outcome: Install and maintain boiler piping and trim.

1. Describe piping components on a low pressure steam boiler.
2. Describe trim for a low pressure steam boiler.
3. Describe installation procedures for piping and trim referencing codes.
4. Describe cross-connection control.
5. Explain maintenance requirements for piping and trim.
6. Troubleshoot piping and trim on low pressure steam boilers.

E. Steam Traps 12%

Outcome: Install and maintain steam traps.

1. Explain the purpose of a steam trap.
2. Describe types of steam traps.
3. Explain steam trap selection.
4. Explain installation procedures of steam traps.
5. Troubleshoot steam traps.

F. Water Treatment 12%

Outcome: Install and maintain water treatment equipment.

1. Describe the principles of water treatment.
2. Identify types of water sources and their impurities.
3. Describe methods of testing water hardness.
4. Describe processes to neutralize or remove impurities.
5. Explain the effects of untreated water on piping and equipment.
6. Describe installation procedures for water treatment equipment.

G. Specialty Steam Equipment 8%

Outcome: Install and maintain specialty steam equipment.

1. Describe steam tracing methods.
2. Describe installation procedures for steam tracing systems.
3. Describe types of specialty steam equipment.
4. Describe installation procedures of utility steam piping systems.
5. Explain maintenance requirements for specialty steam equipment.

SECTION TWO: ..... INSTRUMENTATION AND TRADE TECHNOLOGIES 15%

A. Control Systems 67%

Outcome: Install and maintain control systems.

1. Describe the principles of control systems.
2. Identify the symbols and acronyms found on P&ID's.
3. Describe operators and final control elements.
4. Describe the primary elements of controls and instrumentation.
5. Describe auxiliary devices found on control systems.
6. Describe types of air supply.
7. Describe pneumatic controllers.
8. List the installation procedures for control systems.
9. Fabricate a closed loop instrumentation circuit.
10. Troubleshoot a control system.

B. Trade Related Technologies 33%

Outcome: Use emerging technologies on commercial and industrial sites.

1. Explain the purpose of a Radio Frequency Identification (RFID) Tag.
2. Explain 3-D modeling and imaging used in industry.
3. Explain CADD systems used in industry.
4. Explain the purpose of Maintenance Management Systems (MMS).
5. Identify the types of electronic pipeline inspection devices.
6. Create a CADD drawing.

SECTION THREE: ..... WELDING PROCESSES 24%

A. SMAW Equipment 31%

Outcome: Use SMAW equipment.

1. Describe the principles of SMAW.
2. Describe the components of a SMAW set-up.
3. Explain the effects of arc length on amperage and voltage.
4. Perform tacking and welding on plates.

B. Weld Faults 5%

Outcome: Recognize the cause and effect of weld faults.

1. Define the classifications of weld faults.
2. Define the notching effect.
3. Identify weld faults, their causes and methods of prevention.

C. Mild Steel Electrodes 5%

Outcome: Select mild steel electrodes for SMAW.

1. Define terms associated with SMAW electrodes.
2. Identify classifications and applications for SMAW electrodes.
3. Describe the types of SMAW electrode coatings.
4. Describe the function of slag.
5. Describe handling and storage procedures for electrodes.

D. Plasma Arc Cutting 8%

Outcome: Cut using the plasma arc.

1. Describe the plasma arc cutting process and equipment.
2. Describe hazards associated with plasma arc cutting.
3. Observe plasma arc cutting.

E. Filler Metals and Shielding Gases 5%

Outcome: Select filler metal, and shielding gases.

1. Describe types of filler metals.
2. Describe types of shielding gases.
3. Identify hazards associated with gas shielded welding processes.

F. GMAW Equipment 36%

Outcome: Use GMAW equipment.

1. Describe the principles of operation of GMAW.
2. Describe the components of a GMAW set-up.
3. Describe the modes of metal transfer.
4. Describe power sources and wire feeders.
5. Describe wire drive systems, gun and cable assemblies.
6. Troubleshoot GMAW equipment.
7. Perform fillet and groove welds.

G. GTAW Equipment 10%

Outcome: Set up GTAW equipment.

1. Describe the components of a GTAW set-up.
2. Describe the principles of operation of GTAW.
3. Prepare a pipe joint for GTAW.

SECTION FOUR: ..... HOIST PLANNING AND CRANES..... 12%

A. Hoist Planning..... 21%

Outcome: Use load charts to determine crane selection.

1. Describe factors that affect load chart conditions.
2. Use quadrant of operation to determine load capacity.
3. Calculate gross and net capacities.
4. Explain tipping axis and structural capacity.

B. Lifting and Moving Equipment 38%

Outcome: Use equipment for lifting and moving loads.

1. Describe a lift plan.
2. Calculate weights and center of gravity.
3. Describe equipment for lifting and moving loads.
4. Describe procedures for moving loads vertically.
5. Describe procedures for moving loads horizontally
6. Use equipment to lift and move loads.

C. Cranes 41%

Outcome: Hoist equipment and materials using cranes.

1. Describe types of mobile cranes.
2. List assembly, installation, removal and disassembly procedures for mobile cranes.
3. Describe types of Stationary cranes.
4. List operational procedures with stationary cranes.
5. Describe types of overhead travelling cranes.
6. Apply the Occupational Health and Safety Act, Regulation and Code pertaining to overhead travelling cranes.
7. List operational procedures with overhead travelling cranes.

SECTION FIVE: ..... PROCESS DIAGRAMS AND MITRE ELBOW 27%

A. Process Diagrams 47%

Outcome: Apply process diagrams from schematic to isometrics.

1. Describe the sequence of pipe drawings.
2. Describe piping and instrumentation diagrams (P&ID's) using International Society of Automation (ISA) standards.
3. Describe equipment related to P&ID's.
4. Describe the purpose of legends, notes and bill of materials (BOM).
5. Determine the relationship between drawings and P&ID's.
6. Identify piping and equipment using specifications and BOM.
7. Interpret P&ID's to verify isometric drawings.
8. Draw a P&ID.

B. Compound Mitre Elbow 14%

Outcome: Fabricate a compound mitre elbow.

1. Describe procedures to fabricate a mitre elbow.
2. Calculate cut angle and cutback for mitred fittings.
3. Fabricate a compound mitre elbow.

C. Applied Piping Isometrics 14%

Outcome: Fabricate a piping system.

1. Develop a materials list.
2. Calculate elevations and measurements for piping system.
3. Fabricate a piping system.

D. Builder's Level 6%

Outcome: Locate elevations using a builder's level.

1. Describe the types of builder's levels.
2. Define builder's level terminology.

3. Describe the use of builder's level.
4. Use a builder's level to locate elevations.
5. Complete a survey record sheet.

E. Dummy Leg 19%

Outcome: Construct a dummy leg.

1. Explain the applications of dummy legs.
2. Describe the difference between direct layout and template development.
3. Calculate the minimum length of pipe required for a dummy leg.
4. Develop a template for a dummy leg.
5. Fabricate a dummy leg.

FOURTH PERIOD TECHNICAL TRAINING
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SECTION ONE:.....HIGH PRESSURE STEAM AND CONDENSATE SYSTEMS 19%

A. High Pressure Steam Boilers 13%

Outcome: Install and maintain high pressure steam boilers.

1. Describe types of high-pressure boilers.
2. Describe types of steam generators.
3. Describe the equipment and materials of high-pressure steam boilers.
4. Describe installation procedures on high-pressure steam boilers.
5. Explain maintenance requirements for high-pressure steam boilers.

B. High Pressure Steam Systems..... 13%

Outcome: Install and maintain high pressure steam systems.

1. Describe the operation of a high pressure steam system.
2. Describe equipment and materials specified in high pressure steam system referencing codes.
3. Describe the piping specified in high pressure steam system referencing codes.
4. Describe code-specified installation requirements of high pressure steam systems.
5. Explain maintenance requirements with high pressure steam systems.
6. Troubleshoot a high-pressure steam system.

C. Condensing Steam Systems 16%

Outcome: Install and maintain condensing and non-condensing steam systems.

1. Describe the operations of condensing and non-condensing steam systems.
2. Describe the equipment of condensing and non-condensing steam systems.
3. Describe code-specified installation procedures of condensing and non-condensing steam systems.
4. Explain maintenance requirements for condensing and non-condensing steam systems.

D. Exhaust and Cascading Steam Systems 9%

Outcome: Install and maintain exhaust and cascading steam systems.

1. Describe the operation of exhaust and cascading steam systems.
2. Describe the equipment of exhaust and cascading steam systems.
3. Describe code-specified installation procedures of exhaust and cascading steam systems.
4. Explain maintenance requirements for exhaust and cascading steam systems.

E. High Pressure Boiler Trim 13%

Outcome: Install and maintain high pressure boiler trim.

1. Describe the operation of trim for a high-pressure steam boiler referencing codes.
2. Describe the components of boiler trim.
3. Describe the installation of boiler trim referencing codes.
4. Explain maintenance procedures on boiler trim.
5. Re-build a sight glass.

F. Auxiliary Equipment 9%

Outcome: Install and maintain auxiliary equipment on high-pressure systems.

1. Describe auxiliary equipment on high pressure systems.
2. Describe the operation of auxiliary equipment on high pressure systems.
3. Describe code-specified installation procedures of auxiliary equipment on high pressure systems.
4. Describe types of steam traps used for high pressure steam systems.
5. Explain maintenance requirements for auxiliary equipment.

G. Pressure Vessels 9%

Outcome: Install and maintain pressure vessels.

1. Describe applications for pressure vessels in power, process and heating plants.
2. Describe fired and unfired pressure vessels referencing codes.
3. Describe the trim for bi-phase and liquid filled vessels.
4. Explain the maintenance requirements for pressure vessels.

H. High Temperature Hot Water (HTHW) Systems 9%

Outcome: Install and maintain HTHW systems.

1. Describe equipment used in HTHW systems referencing codes.
2. Describe the operation of HTHW systems referencing codes.
3. Describe installation procedures of HTHW systems.
4. State water treatment requirements for HTHW systems.
5. Explain maintenance requirements for HTHW systems.

I. Cooling Towers and Heat Exchangers 9%

Outcome: Install and maintain cooling towers and heat exchangers.

1. Describe types of heat exchangers referencing codes.
2. Describe trim for heat exchangers referencing codes.
3. Explain maintenance requirements on heat exchangers.
4. Describe types of cooling towers.
5. Describe trim for cooling towers.

6. List sources of water for cooling towers and heat exchangers.
7. Explain maintenance requirements on cooling towers.

SECTION TWO: ..... PROCESS PIPING SYSTEMS 15%

A. Fire Protection Systems 11%

Outcome: Install and maintain fire protection systems.

1. Describe types of fire protection systems.
2. Describe applications of fire protection systems.
3. Identify codes associated with fire protection requirements.

B. Heating, Ventilation, Air Conditioning and Refrigeration (HVACR) Systems 24%

Outcome: Identify the operation of HVACR systems.

1. State the principles of HVACR systems.
2. Describe types of HVACR systems.
3. Describe equipment and materials used on HVACR systems.
4. Describe types of refrigerants.
5. Describe types of mechanical refrigeration systems.
6. Explain maintenance requirements for HVACR systems.

C. Hydraulic Systems 9%

Outcome: Install and maintain hydraulic systems.

1. State the principle of a hydraulic system.
2. Describe equipment and materials used on hydraulic systems.
3. Describe installation procedures for hydraulic systems.
4. Explain maintenance requirements for hydraulic systems.

D. Fuel Systems 16%

Outcome: Install and maintain fuel systems.

1. Describe types of fuel systems.
2. Describe equipment and materials used on fuel systems.
3. Describe code-required installation procedures for fuel systems.
4. Explain maintenance requirements for fuel systems.

E. Waste Water Systems 8%

Outcome: Install and maintain waste water systems.

1. Describe types of waste water systems.
2. Describe equipment and materials used on waste water systems.
3. Describe code-required installation procedures for waste water systems.
4. Explain maintenance requirements for waste water systems.

F. Medical Gas Systems 8%

Outcome: Install and maintain medical gas systems.

1. Describe types of medical gas systems.
2. Describe equipment and materials used on medical gas systems.
3. Describe code-required installation procedures for medical gas systems.
4. Explain maintenance requirements for medical gas systems.

G. Heat Recovery Systems 16%

Outcome: Install and maintain heat recovery systems.

1. Describe types of heat recovery systems.
2. Describe equipment and materials used on heat recovery systems.
3. Describe code-required installation procedures for heat recovery systems.
4. Explain maintenance requirements for heat recovery systems.

H. Solar and Geothermal Exchange Systems 8%

Outcome: Install and maintain solar and geothermal exchange systems.

1. Describe types of solar and geothermal exchange systems.
2. Describe equipment and materials used on solar and geothermal exchange systems.
3. Describe code-required installation procedures for solar and geothermal exchange systems.
4. Explain maintenance requirements for solar and geothermal exchange systems.

SECTION THREE: .....JOB PLANNING AND CRITICAL LIFTS 28%

A. Workplace Coaching Skills 3%

Outcome: Use coaching skills when training an apprentice.

1. Describe the process for coaching an apprentice.

B. Interprovincial Standards Red Seal Program 3%

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.

C. Critical Lifts 31%

Outcome: Perform critical lifts.

1. Describe types of critical lifts.
2. List regulations required to perform a critical lift.
3. List requirements in completing a lift plan.
4. Use engineered lift drawings.
5. Perform a critical lift.

D. New Construction Job Planning 21%

Outcome: Plan for a new construction project.

1. State the purpose of a new construction plan.
2. Describe the documents required for a new construction plan.
3. List the procedural sequence of a new construction plan.
4. Create a new construction plan.

E. Commissioning, Turnover and Start-up 13%

Outcome: Facilitate commissioning, turnover and start-up procedures.

1. Describe methods of flushing and treating a system.
2. Explain procedures for commissioning a system.
3. Describe the commissioning equipment.
4. List corrective actions for deficiencies.
5. Examine a start-up and turnover package.

F. Maintenance Job Planning 18%

Outcome: Plan for a maintenance project.

1. State the purpose of a maintenance plan.
2. Describe the documents required in a maintenance plan.
3. List the procedural sequence of a maintenance plan.
4. Create a maintenance plan.

G. Quality Control 11%

Outcome: Apply quality control (Q.C) measures.

1. Define the terms Quality Control versus Quality Assurance.
2. Explain Q.C. roles and responsibilities.
3. Explain the methods of Q.C. used in the piping industry.
4. Define technical standards and codes.

SECTION FOUR: ..... REVISED DRAWINGS AND PROJECTS 38%

A. Rolling Offsets 27%

Outcome: Fabricate a rolling offset.

1. Describe types of rolling offsets.
2. Calculate rolling offsets.
3. Draw rolling offsets in isometric view.
4. Draw a rolling offset shop project.
5. Fabricate a rolling offset project.

B. Revised Drawing Packages 33%

Outcome: Interpret a revised drawing package.

1. Describe techniques used to identify amendments on revised drawings.
2. Cross reference drawing revisions.
3. Develop as-built drawings.
4. Develop test packages.

C. Reducing Tees 13%

Outcome: Fabricate an eccentric reducing tee.

1. Describe types of reducing tees.
2. Develop an eccentric reducing tee template.
3. Fabricate an eccentric reducing tee.

D. Lateral Wye Branches 13%

Outcome: Fabricate a concentric lateral wye branch.

1. Describe types of lateral wye branches.
2. Develop a concentric lateral wye template.
3. Fabricate a concentric lateral wye.

E. True Wye 14%

Outcome: Fabricate a true wye.

1. Describe types of true wyes.
2. Develop a true wye template.
3. Fabricate a true wye.

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