

Apprenticeship and Industry Training

Sheet Metal Worker

Apprenticeship Course Outline

011 (2017)



Apprenticeship
and Industry
Training

ALBERTA ADVANCED EDUCATION CATALOGUING IN PUBLICATION DATA

Sheet Metal Worker: apprenticeship course outline

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**Sheet Metal Worker
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COURSE OUTLINE

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyman or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeymen, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of the Sheet Metal Worker Provincial Apprenticeship Committee.

The graduate of the Sheet Metal Worker apprenticeship training is a certified journeyman who will be able:

- supervise, train and coach apprentices.
- use and maintain hand and power tools to the standards of competency and safety required in the trade.
- apply the correct principles of sheet metal pattern development using triangulation, parallel line, and radial line development.
- read and use blueprints and specifications to estimate, fabricate and install sheet metal items.
- fabricate and install, safely and efficiently, fume and dust exhaust systems, ventilation, heating and air-conditioning systems and equipment for restaurants, hospitals, dairies, breweries, etc.
- know, and be able to apply their knowledge of the advantages and limitations of various types of sheet metal used in the trade including non-metallic materials such as plastics.
- know, and be able to apply their knowledge of the installation, and service of gas piping systems, HVAC appliances and equipment in accordance with local, provincial and national standards for the industry.
- apply standards and regulations of propane and natural gas in order to provide the maximum of safety.
- co-ordinate sheet metal work with other trades on the job site.
- do all sheet metal related tasks expected of a certified journeyman.

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the Board can set up a local apprenticeship committee. The Board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the Board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the Board

Provincial Apprenticeship Committees (PAC)

The Board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- make recommendations to the board about:
 - standards and requirements for training and certification in their trade
 - courses and examinations in their trade
 - apprenticeship and certification
 - designation of trades and occupations
 - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the Board

Sheet Metal Worker PAC Members at the time publication

Mr. G. Provencher	Grande Prairie	Presiding Officer
Mr. K. Broadbent	Lethbridge	Employer
Mr. R. Deveau	Calgary	Employer
Mr. M. Kaiser	Calgary	Employer
Mr. C. Challand	Rimbey	Employee
Mr. J. Morrow	Calgary	Employee
Mr. E. Palmerchuk	Calmar	Employee

Alberta Government

Alberta Advanced Education and works with industry, employer 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 employers
- 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, employers, 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.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act*.

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Occupational Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force 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 (a division of Alberta Human Services) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.humanservices.alberta.ca

Technical Training

Apprenticeship technical training is delivered by the technical institutes and colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place a strong emphasis on safety that complements safe workplace practices towards the development of a culture of safety for all trades.

The technical institutes and colleges work with Alberta's Apprenticeship and Industry Training Board, industry committees 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 course outlines established by industry and provide technical training to apprentices.

The following technical training providers deliver Sheet Metal Worker trade apprenticeship training:

Northern Alberta Institute of Technology	Southern Alberta Institute of Technology
Grande Prairie Regional College	

Procedures for Recommending Revisions to the Course Outline

Advanced Education and prepared this course outline in partnership with the Sheet Metal Worker Provincial Apprenticeship Committee.

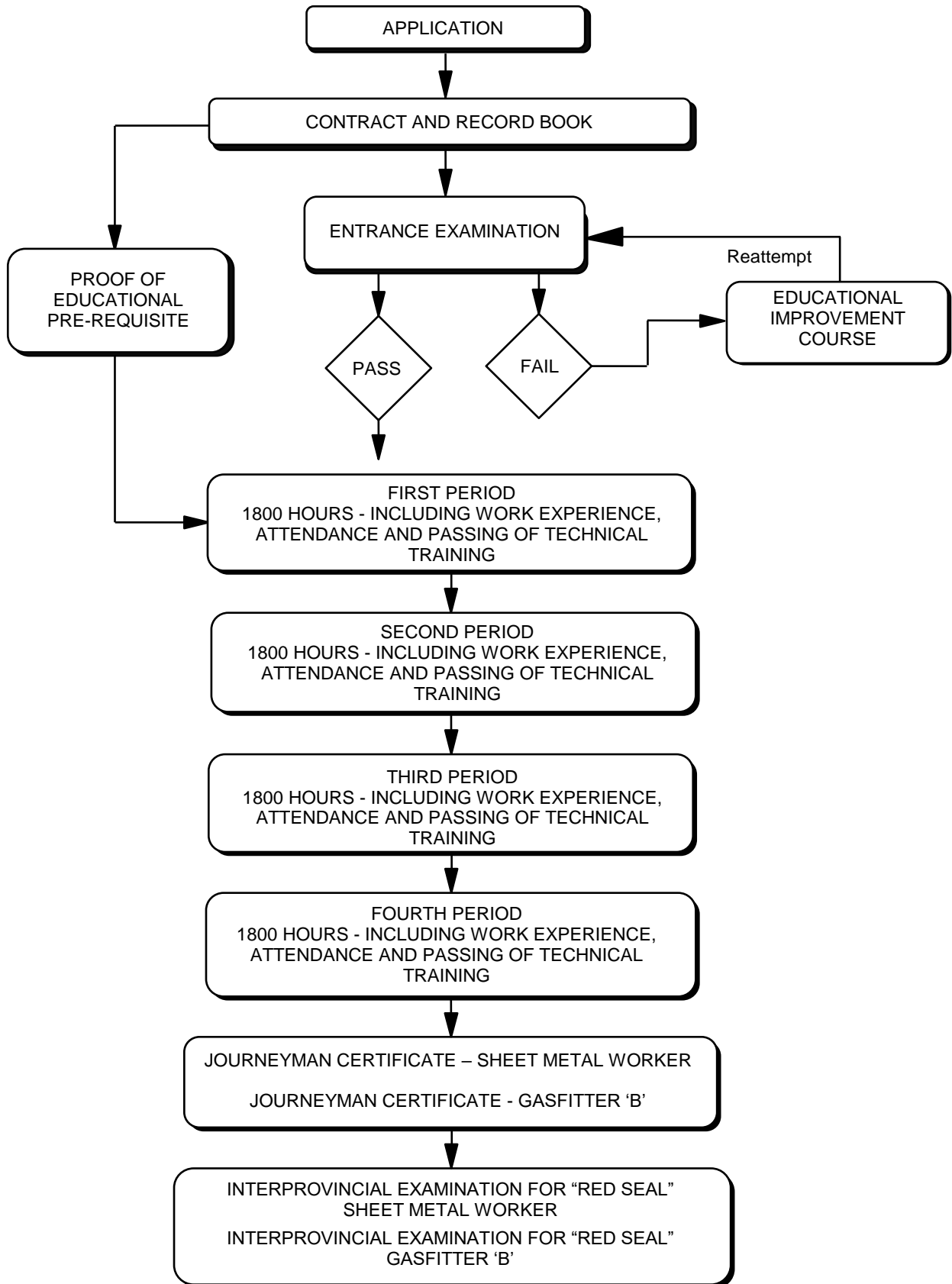
This course outline was approved on December 16, 2016 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

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

Sheet Metal Worker Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th 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. Recommendations for change will be placed on the agenda for regular meetings of the Sheet Metal Worker Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification



Sheet Metal Worker Training Profile

FIRST PERIOD

(10 Weeks 30 Hours Per Week – Total of 300 Hours)

SECTION ONE

SAFETY, TOOLS AND EQUIPMENT
54 HOURS



A	B	C
Safety Legislation, Regulations & Industry Policy in the Trades 2 Hours	Climbing, Lifting, Rigging, & Hoisting 2 Hours	Hazardous Materials & Fire Protection 2 Hours
D	E	F
Apprenticeship Training Program 2 Hours	Sheet Metal Safety 2 Hours	Ladders, Scaffolds and Lifts 3 Hours
G	H	I
Welding Safety 4 Hours	Hand and Power Tools 5 Hours	Bench Machines 3 Hours
J	K	L
Floor, Portable and Power Shop Equipment 6 Hours	Materials, Valves, Welded Pipe and Fittings 8 Hours	Joints, Seams, Fasteners, Sealants and Insulation 4 Hours
M	N	
Plastic Pipe and Tube 7 Hours	Electrical Safety 4 Hours	

SECTION TWO

DUCT CONSTRUCTION USING SIMPLE AND CONICAL LINE PATTERN DEVELOPMENT
132 HOURS



A	B	C
Geometry and Calculations 20 Hours	Pattern Development 16 Hours	Conical Layout and Projects 10 Hours
D	E	F
Welding and Cutting Process 4 Hours	Soldering and Brazing 8 Hours	Rectangular Duct System Fabrication 74 Hours

SECTION THREE

RESIDENTIAL HVAC DRAWINGS
52 HOURS



A	B	C
Orthographic Projection 8 Hours	Pictorial Drawings 9 Hours	Drawing Components 8 Hours
D	E	
HVAC Drawings 15 Hours	Residential HVAC Components and Material Takeoff 12 Hours	

SECTION FOUR

RESIDENTIAL HVAC INSTALLATION
62 HOURS



A	B	C
Residential Heating Systems and Equipment 12 Hours	Installation Codes 10 Hours	Principles of Indoor Air Quality 18 Hours
D		
Indoor Air Quality Equipment 22 Hours		

SECOND PERIOD
(10 Weeks 30 Hours Per Week – Total of 300 Hours)

SECTION ONE

**FABRICATION USING
 PARALLEL LINE PATTERN
 DEVELOPMENT**
 96 HOURS



A	B	C
Parallel Line Pattern Development 23 Hours	Transitional Fitting Fabrication 5 Hours	Round Fitting Fabrication 54 Hours
D		
Mild Steel Gas Metal Arc Welding (GMAW) 14 Hours		

SECTION TWO

LIGHT COMMERCIAL HVAC
 62 HOURS



A	B	C
Multi Equipment Systems 21 Hours	Smoke and Fire Containments 10 Hours	Roofing and Building Penetrations 6 Hours
D	E	F
Pumps 4 Hours	Boiler Controls 12 Hours	Natural Ventilation 3 Hours
G		
Energy Efficient Buildings 6 Hours		

SECTION THREE

**HVAC HEATING APPLIANCE
 INSTALLATION**
 142 HOURS



A	B	C
Electricity and Electrical Meters 9 Hours	Pilot, Thermocouples and Thermopiles 5 Hours	Wiring Diagrams 16 Hours
D	E	F
Matter, Density and Relative Density 5 Hours	Pressure and Atmosphere 5 Hours	Properties of Gas 12 Hours
G	H	I
Temperature and Heat 3 Hours	Gas System Components 12 Hours	Pipe Sizing 9 Hours
J	K	L
Gas Piping 10 Hours	Pipe Installation and Pressure Testing 9 Hours	Appliance Venting and Installer Responsibilities 16 Hours
M	N	
Furnace Commissioning and Maintenance 19 Hours	Propane Storage and Handling Systems 12 Hours	

THIRD PERIOD
(10 weeks 30 Hours per Week – Total of 300 Hours)

SECTION ONE

GTAW WELDING AND PLASMA CUTTING
54 HOURS



A
 Computerized Layouts and Plasma Cutting
 15 Hours

B
 Gas Tungsten Arc Welding (GTAW)
 15 Hours

C
 Aluminum Fabrication
 9 Hours

D
 Stainless Steel Fabrication
 15 Hours

SECTION TWO

DUCT CONSTRUCTION USING TRIANGULATION PATTERN DEVELOPMENT
130 HOURS



A
 Triangulation Pattern Development
 36 Hours

B
 Medium Pressure Duct Fabrication
 94 Hours

SECTION THREE

COMMERCIAL HVAC
116 HOURS



A
 Air Flow
 6 Hours

B
 Heat Loss and Gain
 18 Hours

C
 Residential HVAC Design
 10 Hours

D
 Commercial Duct Design
 10 Hours

E
 Multi Zone Equipment
 10 Hours

F
 Job Takeoffs
 18 Hours

G
 Commercial Installation
 18 Hours

H
 Mechanical Air Movement and Control
 6 Hours

I
 Commercial HVAC Systems
 11 Hours

J
 Commercial and Industrial Indoor Air Quality
 9 Hours

FOURTH PERIOD
(10 Weeks 30 Hours per Week – Total of 300 Hours)

SECTION ONE

ADVANCED FABRICATION
106 HOURS



A	B	C
Simple and Advanced Radial Line Pattern Development 20 Hours	Pattern Development Short Cuts 3 Hours	Specialty GMAW Welding 9 Hours
D	E	F
Cladding and Lagging 3 Hours	Specialized Fabrication Procedures 68 Hours	Architectural and Custom Sheet Metal 3 Hours

SECTION TWO

COMMERCIAL AND INDUSTRIAL HVAC
40 HOURS



A	B	C
Industrial Exhaust Systems 6 Hours	Commercial Kitchen Exhaust Systems 6 Hours	Industrial Drawings 9 Hours
D	E	F
Specifications and Schedules 6 Hours	Estimating, Pricing and Bidding Procedures 9 Hours	Jobsite Supervision 4 Hours

SECTION THREE

REFRIGERATION
52 HOURS



A	B
Refrigerant and Oil Handling 16 Hours	Split Systems 36 Hours

SECTION FOUR

DIAGNOSTICS AND INDUSTRY NETWORKS
102 HOURS



A	B	C
Electronic Ignition Systems 16 Hours	System Controls and Schematics 18 Hours	Commercial HVAC Equipment Commissioning and Maintenance 15 Hours
D	E	F
Testing and Troubleshooting 30 Hours	Troubleshooting Commercial and Industrial HVAC Systems 10 Hours	Air Balancing 6 Hours
G	H	I
Workplace Coaching Skills 2 Hours	Alberta's Industry Network 2 Hours	Interprovincial Standards Red Seal Program 3 Hours

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training

**FIRST PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE**

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

SECTION ONE:..... SAFETY, TOOLS AND EQUIPMENT..... 54 HOURS

A. Safety Legislation, Regulations & Industry Policy in the Trades 2 Hours

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 employer'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 employers 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 employers 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 2 Hours

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 2 Hours

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..... 2 Hours**Outcome: *Manage an apprenticeship to earn journeyman certification.***

1. Describe the contractual responsibilities of the apprentice, employer and Alberta Apprenticeship and Industry Training.
2. Describe the purpose of the apprentice record book.
3. Describe the procedure for changing employers during an active apprenticeship.
4. Describe the purpose of the course outline.
5. Describe the procedure for progressing through an apprenticeship.
6. Describe advancement opportunities in this trade.

E. Sheet Metal Safety 2 Hours**Outcome: *Apply safe work practices while working in the Sheet Metal trade.***

1. Describe handling of sharp edges on sheet metal projects.
2. Describe hazards associated with sheet metal tooling and equipment.

F. Ladders, Scaffolds and Lifts 3 Hours**Outcome: *Use ladders, scaffolds and man lifts.***

1. Describe the use of ladders.
2. Describe the use of scaffolds.
3. Describe the use of lifts.

G. Welding Safety 4 Hours**Outcome: *Follow safety procedures in welding.***

1. Identify hazards associated with welding.
2. Describe Personal Protective Equipment (PPE) used for welding.
3. Identify oxy-fuel outfit components.
4. Describe the handling of oxy-fuel equipment.

H. Hand and Power Tools 5 Hours**Outcome: *Use hand tools.***

1. Identify types of hand tools.
2. Describe types of hand tools.
3. Identify types of power tools.
4. Describe types of power tools.
5. Use hand and power tools.

I. Bench Machines 3 Hours**Outcome: *Use bench machines.***

1. Use rotary machines.
2. Use bench machines for punching, shearing and forming.
3. Use stakes and stakeholders.

J. Floor, Portable and Power Shop Equipment 6 Hours**Outcome: Use floor, portable and power equipment.**

1. Use portable equipment and accessories.
2. Use sheet metal floor machines.
3. Set up a power shear.
4. Use a power shear.
5. Calculate bend allowance and mean diameters for various thicknesses of metal.
6. Set up a power roll.
7. Operate a power roll.

K. Materials, Valves, Welded Pipe and Fittings..... 8 Hours**Outcome: Describe materials, valves, welded pipe and fittings.**

1. Describe properties of metals.
2. Describe ferrous and non-ferrous sheet metal materials.
3. Describe alternate sheet metal materials.
4. Identify types of valves.
5. Describe fundamental valve design variations and their applications.
6. Identify types, markings, designations and pressure rating for welded pipe fittings.
7. State requirements, methods and torque measurements for bolt ups.
8. Identify types, markings, designations, temperature and pressure ratings of flanged fittings and gaskets.
9. Describe the fabrication process for welded pipe and fittings to the tack-up stage.

L. Joints, Seams, Fasteners, Sealants and Insulation 4 Hours**Outcome: Fabricate seams, edges and joints.**

1. Identify seams, edges, locks and joints.
2. Identify sheet metal fasteners.
3. Identify caulking, sealants and insulations used in sheet metal fabrication.
4. Perform joining, seaming, fastening, sealing and insulation processes.

M. Plastic Pipe and Tube 7 Hours**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.

N. Electrical Safety 4 Hours

Outcome: ***Apply arc flash safety and lockout and tag-out on a jobsite.***

1. Identify safe work practices to protect from arc flash hazards.
2. Describe lockout/tag-out procedures.
3. Identify safe work practices to prevent electrical shock.

**SECTION TWO:..... DUCT CONSTRUCTION USING SIMPLE AND..... 132 HOURS
CONICAL LINE PATTERN DEVELOPMENT**

A. Geometry and Calculations 20 Hours

Outcome: ***Use geometry and calculations.***

1. Draw bisecting lines, arcs and angles.
2. Use drafting equipment to construct various lines.
3. Construct a circle and label its parts.
4. Construct shapes using drafting equipment.
5. Demonstrate calculation skills including conversion and linear measurement.
6. Demonstrate calculation skills including volumes and capacities.

B. Pattern Development..... 16 Hours

Outcome: ***Develop simple patterns for sheet metal projects.***

1. Identify methods of pattern development.
2. Describe principles of pattern development.
3. Identify simple layout items.
4. Develop simple net patterns.

C. Conical Layout and Projects 10 Hours

Outcome: ***Fabricate conical items.***

1. Describe principles of conical layout.
2. Identify conical layout items.
3. Develop conical layout patterns.
4. Fabricate conical items.

D. Welding and Cutting Processes..... 4 Hours

Outcome: ***Use welding and cutting processes in sheet metal fabrication.***

1. Describe electric welding processes.
2. Describe the use of oxy acetylene (OAW) and oxy-fuel equipment.
3. Use a hand held plasma cutter.
4. Use a resistance spot welder.

E. Soldering and Brazing 8 Hours

Outcome: *Use soldering processes in sheet metal fabrication.*

1. Describe soft soldering, brazing and their applications.
2. Describe the safety precautions associated with soldering and brazing.
3. Describe the soldering process.
4. Describe the brazing process.
5. Fabricate and test assigned project.

F. Rectangular Duct System Fabrication 74 Hours

Outcome: *Fabricate a rectangular HVAC duct line using simple layout.*

1. Fabricate rectangular duct fittings.
2. Fabricate rectangular flex connectors.
3. Assemble fittings to form duct lines.
4. Apply installation codes and standards to residential construction.
5. Install a rectangular duct line.
6. Install supplied round fittings to a rectangular duct line.

SECTION THREE: RESIDENTIAL HVAC DRAWINGS 52 HOURS

A. Orthographic Projection 8 Hours

Outcome: *Develop orthographic drawings for sheet metal fabrication.*

1. Identify orthographic views.
2. Draw orthographic views from isometric drawings.
3. Draw orthographic drawings of sheet metal components.

B. Pictorial Drawings 9 Hours

Outcome: *Develop pictorial drawings for sheet metal and gas line fabrication.*

1. Identify pictorial drawings.
2. Draw isometric drawings from orthographic projections.
3. Draw isometric drawings of sheet metal components.
4. Produce sketches of components in sheet metal fabrication.
5. Identify piping symbols.
6. Draw and label orthographic single-line drawings.
7. Draw and label isometric single-line piping drawings.

C. Drawing Components 8 Hours

Outcome: *Interpret drawings.*

1. Identify fundamental information found on a drawing.
2. Identify common symbols used in drawings and legends.
3. Identify abbreviations commonly used in drawings.

D. HVAC Drawings 15 Hours

Outcome: *Interpret mechanical drawings.*

1. Interpret supply air ducting from a drawing.
2. Interpret return air ducting from a drawing.
3. Interpret exhaust air from a drawing.
4. Interpret HVAC equipment from a drawing.
5. Interpret line schematics from a drawing.

E. Residential HVAC Components and Material Takeoff 12 Hours

Outcome: *Install residential duct systems.*

1. Describe supply air components of an HVAC system.
2. Describe return air components of an HVAC system.
3. Describe components of an under slab heating system.
4. Describe components used to exhaust and support combustion.
5. Describe components used to ventilate residential buildings.
6. Describe how system components effect air movement in low pressure duct systems.
7. Describe zoning components related to low pressure duct systems.
8. Describe the process for developing a material takeoff list.
9. Develop a material takeoff list from a drawing.

SECTION FOUR:RESIDENTIAL HVAC INSTALLATION 62 HOURS

A. Residential Heating Systems and Equipment 12 Hours

Outcome: *Install residential duct systems.*

1. Identify components of furnaces.
2. Identify accessories related to residential HVAC systems.
3. Describe residential distribution systems.
4. Describe residential air requirements.
5. Describe various heating appliances.

B. Installation Codes 10 Hours

Outcome: *Interpret codes and regulations that apply to sheet metal and gas line installations.*

1. Identify codes and regulations.
2. Describe various heating appliance installation codes and regulations.

C. Principles of Indoor Air Quality 18 Hours

Outcome: *Control Indoor Air Quality (IAQ) in residential HVAC installations.*

1. Describe how IAQ affects the human body.
2. Describe how heat is produced and transferred.
3. Describe relative humidity and how it is measured.
4. Describe ventilation air requirements for residential construction.

5. Describe air particulate and its effect on comfort and equipment.
6. Identify how air circulation and noise affect comfort.
7. Describe the effects of IAQ on structures and personal comfort.
8. List the methods to correct poor IAQ.
9. Describe the methods used to control bacteria, germ, and volatile organic compounds.
10. Measure temperature and relative humidity and apply the effects on IAQ.

D. Indoor Air Quality Equipment.....22 Hours

Outcome: *Install residential indoor air quality equipment.*

1. Describe the operation of air filtering methods and equipment.
2. Describe the operation of air ventilation methods and equipment.
3. Describe the operation of air circulation methods and equipment.
4. Describe the maintenance of IAQ equipment.
5. Install residential ventilator.
6. Commission a ventilator.

**SECOND PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE**

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

SECTION ONE:.....FABRICATION USING PARALLEL LINE PATTERN DEVELOPMENT 96 HOURS

A. Parallel Line Pattern Development23 Hours

Outcome: *Demonstrate parallel line layout procedures when fabricating sheet metal items.*

1. Define terms used in parallel line development.
2. Describe principles of parallel line development.
3. Identify items that can be laid out using parallel line pattern development.
4. Develop net patterns using parallel line development.
5. Develop net patterns for right and oblique cylinders.

B. Transitional Fitting Fabrication 5 Hours

Outcome: *Install transitional fittings.*

1. Describe a transitional fitting.
2. Fabricate a transitional fitting with a minimum one flat side from an appliance to plenum.

C. Round Fitting Fabrication54 Hours

Outcome: *Fabricate round fittings using parallel line pattern development.*

1. Describe seams used to fabricate round fittings.
2. Fabricate round fittings using parallel line pattern development.

D. Mild Steel GMAW Welding 14 Hours

Outcome: *Weld mild steel using Gas Metal Arc Welding (GMAW).*

1. Describe the GMAW process.
2. Set up GMAW equipment.
3. Perform GMAW techniques to various weld joints.
4. Perform GMAW on a round fitting.
5. Identify weld faults.
6. Repair weld faults.

SECTION TWO:..... LIGHT COMMERCIAL HVAC..... 62 HOURS

A. Multi Equipment Systems21 Hours

Outcome: *Interpret multifamily and multi equipment system drawings.*

1. Describe multi equipment systems.

2. Describe multifamily systems.
3. Identify components of a multi equipment system.
4. Identify components of a multi equipment system from a drawing.
5. Produce a material take off complete with shop drawings.

B. Smoke and Fire Containment..... 10 Hours

Outcome: *Install smoke and fire containment.*

1. Identify fire protection devices.
2. Describe installation requirements for fire protection devices.
3. Describe fire and smoke management.
4. Identify codes and regulations pertaining to smoke and fire containment devices.
5. Install fire dampers.
6. Install fire stop flaps.

C. Roofing and Building Envelope Penetrations 6 Hours

Outcome: *Apply weatherproofing techniques when penetrating building envelopes.*

1. Define roofing terms.
2. Describe advantages and disadvantages of different roofing materials.
3. Describe joints and seams used in roofing.
4. Describe types of flashings and components used in roof penetrations.
5. Describe procedures and precautions when performing roof penetrations.
6. Describe procedures and precautions when performing wall penetrations.

D. Pumps..... 4 Hours

Outcome: *Describe pumps for piping systems.*

1. Identify types of pumps.
2. Describe applications for pumps.
3. Describe factors affecting the operation of a pump.

E. Boiler Controls..... 12 Hours

Outcome: *Install and service gas fired boilers.*

1. Describe the operation of boilers.
2. Apply standards from CSA B149.1, ASME and CSA B51.
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.

F. Natural Ventilation 3 Hours

Outcome: *Install natural ventilation systems.*

1. Describe principles of natural ventilation.

2. Describe natural ventilation devices.
3. Describe natural ventilation openings and exhaust outlets.
4. Design natural ventilation systems used in agricultural and industrial building designs.
5. Describe Alberta Building Code standards as they apply to attics and crawl spaces.

G. Energy Efficient Buildings 6 Hours

Outcome: *Describe energy efficient building designs.*

1. Describe high efficiency and alternate energy systems.
2. Describe various energy programs and agencies.
3. Describe energy efficient construction techniques related to new and existing buildings.

SECTION THREE:HVAC HEATING APPLIANCE INSTALLATION 142 HOURS

A. Electricity and Electrical Meters 9 Hours

Outcome: *Use electrical measuring equipment.*

1. Explain electron flow.
2. Describe various electrical circuits.
3. Calculate Ohm's law.
4. Use electrical measuring equipment.
5. Identify types of test equipment.
6. Describe settings for electrical testing equipment.
7. Use test equipment to service appliances.

B. Pilots, Thermocouples and Thermopiles 5 Hours

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. Wiring Diagrams 16 Hours

Outcome: *Interpret wiring diagrams.*

1. Interpret millivolt wiring diagrams.
2. Interpret 24 volt wiring diagrams.
3. Interpret operation of equipment using diagrams.
4. Describe appliance sequence of operation.

D. Matter, Density and Relative Density 5 Hours

Outcome: *Apply concepts related to matter, densities and relative densities.*

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

E. Pressure and Atmosphere 5 Hours

Outcome: *Apply fundamentals of pressure, force and atmosphere.*

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.

F. Properties of Gas 12 Hours

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. Define terms relating to combustion in gas appliances.
6. Describe types of heat and units of heat measurement.
7. Describe types of burners used in gas appliances.
8. Calculate combustion air requirements for heating appliances.
9. Describe the products of complete and incomplete combustion.
10. Identify impurities found in fuel gas.

G. Temperature and Heat 3 Hours

Outcome: *Apply knowledge of the heat transfer process relative to gasfitter and sheet metal trades.*

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.

H. Gas System Components 12 Hours

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. Describe temperature sensing devices.
9. Describe furnace line and control voltage devices.
10. Describe combustion related components.
11. Apply standards for CSA B149.1.

I. Pipe Sizing.....9 Hours

Outcome: *Size a gas line system.*

1. Identify the type of gas and pressure.
2. Identify the type 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 system using different piping materials.
6. Apply standards for CSA B149.1.

J. Gas Piping 10 Hours

Outcome: *Connect gas piping.*

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 fabrication steps for threading and grooving pipe.
4. Describe black malleable fittings and joining methods.
5. Describe copper pipe and joining methods.
6. Describe stainless steel flexible coated gas pipe.
7. Demonstrate threading, bending, joining and flaring of gas piping.
8. Describe installation codes found in the applicable gas code.
9. Demonstrate cutting and joining of stainless steel flexible coated piping.

K. Pipe Installation and Pressure Testing9 Hours

Outcome: *Install and test a gas line 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.
4. Compile a materials list for a gas line.
5. Apply standards for CSA B149.1.
6. Install a gas line.
7. Test a gas line.

L. Appliance Venting and Installer Responsibilities 16 Hours

Outcome: *Install appliance venting.*

1. Define terms in appliance venting.
2. Describe types of vents used for gas appliances.
3. Describe installation rules, codes and procedures for types of vents.
4. Describe minimum distances and code requirements for direct-vented appliances.
5. Describe types of vents and flue dampers including operation and code requirements.
6. Determine vent sizes using manufactures specification and applicable codes.
7. Install appliance venting.

M. Furnace Commissioning and Maintenance 19 Hours

Outcome: *Perform furnace commissioning.*

1. Perform furnace start-up procedures following manufacturer’s specifications.
2. Verify operation of furnaces.
3. Describe maintenance of furnaces.

N. Propane Storage and Handling Systems 12 Hours

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 B149.1 & B149.2.
6. Calculate size and placement of components.

**THIRD PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE**

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

SECTION ONE:GTAW WELDING AND PLASMA CUTTING 54 HOURS

A. Computerized Layouts and Plasma Cutting 15 Hours

Outcome: *Use computerized plasma cutting equipment.*

1. Describe types of computerized cutting equipment.
2. Input duct fitting information to a plasma cutting machine.
3. Operate a plasma cutting machine.
4. Cut a medium pressure duct project on a plasma table.

B. Gas Tungsten Arc Welding (GTAW) 15 Hours

Outcome: *Join projects using Gas Tungsten Arc Welding equipment.*

1. Describe safety precautions associated with GTAW.
2. Set-up and operate the equipment for GTAW.
3. Produce GTAW welds on mild steel, aluminum and stainless steel.
4. Troubleshoot welding problems associated with GTAW.

C. Aluminum Fabrication 9 Hours

Outcome: *Fabricate items using aluminum.*

1. Describe fabrication considerations when working with aluminum.
2. Fabricate an aluminum project with welded seams.

D. Stainless Steel Fabrication 15 Hours

Outcome: *Fabricate items using stainless steel.*

1. Describe types of stainless steels and their applications.
2. Describe fabrication considerations when cutting and forming stainless steel.
3. Construct a stainless steel project with GTAW joints.
4. Demonstrate finishing techniques on a stainless steel project.

**SECTION TWO: DUCT CONSTRUCTION USING 130 HOURS
TRIANGULATION PATTERN DEVELOPMENT**

A. Triangulation Pattern Development 36 Hours

Outcome: *Demonstrate triangulation layout procedures when fabricating sheet metal items.*

1. Define terms used in triangulation.
2. Identify objects that can be fabricated using triangulation.

3. Identify principles of triangulation.
4. Develop patterns using triangulation.

B. Medium Pressure Duct Fabrication94 Hours

Outcome: ***Fabricate a medium pressure duct system.***

1. Describe how duct is classified according to velocity and pressure.
2. Describe the mechanical duct connections and duct sealant procedures as they apply to different pressure classifications.
3. Describe considerations incorporating Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards when fabricating fittings used in various pressure duct systems.
4. Develop patterns and fabricate two way Plenum Transitions for a medium pressure duct line.
5. Develop patterns and fabricate Transition Change Elbows for a medium pressure duct line.
6. Develop patterns and fabricate Rectangular Elbows with turning vanes for a medium pressure duct line.
7. Develop patterns and fabricate Rectangular to Round Transition for a medium pressure duct line.
8. Fabricate Pipe Tees and Conical Tees for a medium pressure duct line from plasma cut supplied patterns.
9. Fabricate Round Pipe Reducers for a medium pressure duct line from plasma cut supplied patterns.
10. Fabricate Round Y Branches for a medium pressure duct line from plasma cut supplied patterns.
11. Fabricate Round Tapering Offsets for a medium pressure duct line from plasma cut supplied patterns.
12. Fabricate fittings for a medium pressure duct system with welded joints and seams.
13. Assemble a medium pressure duct line.
14. Install a sealed medium pressure duct line.
15. Perform a pressure test on a medium pressure duct line.

SECTION THREE: COMMERCIAL HVAC..... 116 HOURS

A. Air Flow..... 6 Hours

Outcome: ***Test systems for air flow.***

1. Describe air flow.
2. Describe common air flow testing instruments.
3. Describe common air flow terms and their relationship to air flow movement.
4. Describe various components of HVAC systems and their effects on air flow noise.

B. Heat Loss and Heat Gain 18 Hours

Outcome: ***Perform heat loss and heat gain calculations.***

1. Describe heat loss and heat gain calculations.
2. Describe heat loss and heat gain design considerations.
3. Perform heat loss and heat gain calculations using Heating Refrigeration Air Conditioning Institute (HRAI) methods.

C. Residential HVAC Design 10 Hours

Outcome: *Design a residential HVAC system.*

1. Select equipment to match load calculation.
2. Design a residential air distribution system.

D. Commercial Duct Designs 10 Hours

Outcome: *Design a small commercial HVAC system.*

1. Select correct size and type of equipment.
2. Design a small commercial air distribution system using the Sheet Metal & Air Conditioning Contractors’ National Association (SMACNA) standards.
3. Identify additional regulatory bodies and training.

E. Multi Zone Equipment 10 Hours

Outcome: *Install multi zone equipment.*

1. Identify residential multi zone equipment.
2. Identify light commercial multi zone equipment.
3. Identify large commercial multi zone equipment.

F. Job Takeoffs..... 18 Hours

Outcome: *List all parts of an HVAC installation.*

1. Generate a material list from a large commercial HVAC drawing.
2. Develop strategies to complete a mechanical room from drawings and onsite measurements.

G. Commercial Installation 18 Hours

Outcome: *Install a commercial duct line in a ceiling.*

1. Identify considerations when installing a commercial duct line.
2. Identify considerations when penetrating commercial walls, floors, and ceilings.
3. Apply installation codes and standards to commercial construction.
4. Generate a complete material list from a light commercial HVAC drawing.
5. Install components of a commercial duct line from a drawing.

H. Mechanical Air Movement and Control 6 Hours

Outcome: *Install air handling devices.*

1. Describe various fan and blower terminology.
2. Identify various fan configurations and describe their characteristics.
3. Interpret fan performance graphs and curves.
4. Describe air controlling devices and their application.

I. Commercial HVAC Systems 11 Hours

Outcome: *Install commercial HVAC systems.*

1. Describe the operation of commercial heating systems.

2. Describe the operation of commercial cooling systems.
3. Describe the operation of make-up air systems.
4. Describe the operation of exhaust systems.
5. Describe the operation of ventilation systems.

J. Commercial and Industrial Indoor Air Quality (IAQ)9 Hours

Outcome: *Use air filtration and noise reduction methods when installing HVAC equipment.*

1. Describe sound attenuation and the methods used in reducing sound transmission.
2. Describe materials used in sound attenuation and their application.
3. Describe the effects of sound attenuation on air flow.
4. Describe the purpose and types of various air filtering devices.
5. Describe air cleaning techniques.
6. Identify air cleaning equipment.
7. Describe methods used to measure filter efficiency.
8. Describe methods used to control humidity.
9. Describe methods used to control bacteria, germ, and volatile organic compounds.

**FOURTH PERIOD TECHNICAL TRAINING
SHEET METAL WORKER TRADE
COURSE OUTLINE.**

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

SECTION ONE: ADVANCED FABRICATION 106 HOURS

A. Radial Line Pattern Development 20 Hours

Outcome: *Demonstrate radial line layout procedures when fabricating sheet metal items.*

1. Define the terms used in radial line pattern development.
2. Identify objects that can be fabricated using radial line pattern development
3. Identify principles of radial line pattern development.
4. Develop patterns using radial line pattern development.

B. Pattern Development Short Cuts 3 Hours

Outcome: *Use pattern development short cuts.*

1. Describe a net pattern for a square to round reducer using rollation.
2. Describe a net pattern for a round to round reducer using rollation.
3. Describe slip technique.
4. Describe the techniques necessary to calculate a mitre at a job site.

C. Specialty Gas Metal Arc Welding (GMAW) 9 Hours

Outcome: *Perform GMAW on aluminum and stainless steel.*

1. Describe safety precautions associated with the GMAW process.
2. Set-up equipment for GMAW (MIG) process.
3. Produce finished stainless steel welds using the GMAW process.
4. Weld aluminum using the GMAW process.

D. Cladding and Lagging 3 Hours

Outcome: *Install cladding and lagging on industrial piping systems and vessels.*

1. Describe cladding and lagging material.
2. Describe applications for cladding and lagging.
3. Describe installation techniques.
4. Explain shortcuts used for developing patterns.

E. Specialized Fabrication Procedures 68 Hours

Outcome: *Fabricate advanced sheet metal projects.*

1. Set up a power brake.
2. Operate a power brake.
3. Interpret shop drawings.

4. Fabricate opposed and parallel multiple blade volume dampers.
5. Fabricate equipment plenums or equipment casings with 2 inch duct liner and perforated metal with an inlet, outlet and access door.
6. Fabricate a specialty metals project using radial line pattern development.
7. Fabricate stainless and aluminum GMAW welded projects.
8. Fabricate a project using a shortcut method.

F. Architectural and Custom Sheet Metal 3 Hours

Outcome: ***Fabricate architectural and custom sheet metal components.***

1. Identify custom kitchen accessories.
2. Identify custom signage applications.
3. Describe custom architectural and structural applications.
4. Describe decorative sheet metal applications.

SECTION TWO:..... COMMERCIAL AND INDUSTRIAL HVAC..... 40 HOURS

A. Industrial Exhaust Systems..... 6 Hours

Outcome: ***Install commercial and industrial extraction systems.***

1. Describe collection and extractions systems.
2. Describe material types and construction methods used in collection and extraction systems.
3. Apply sizing techniques for a collection and extraction system.

B. Commercial Kitchen Exhaust Systems 6 Hours

Outcome: ***Install a commercial kitchen exhaust system.***

1. Describe the purpose and components of a commercial kitchen exhaust system.
2. Interpret codes and regulations for designing and installing commercial kitchen exhaust systems.
3. Describe grease removal devices and their applications.
4. Size a grease filter for a commercial kitchen canopy.
5. Calculate make up air requirements for a commercial kitchen installation.
6. Select equipment and components for a commercial kitchen exhaust system.

C. Industrial Drawings 9 Hours

Outcome: ***Interpret industrial drawings.***

1. Interpret industrial plant drawings.
2. Identify industrial air handling equipment from a drawing.
3. Identify industrial material handling equipment from a drawing.

D. Specifications and Schedules 6 Hours

Outcome: ***Interpret specifications and material schedules.***

1. Describe the purpose of engineered specifications.
2. Describe the relationship between specifications and drawings.
3. Identify information from an engineered specification.

4. Describe the purpose of divisions within engineered specifications.

E. Estimating, Pricing and Bidding Procedures 9 Hours

Outcome: Complete an HVAC bid.

1. Identify the categories of an estimate to a job take off.
2. Describe overhead labour costs and correction factors to a job take off.
3. Describe pricing strategies and their effect on the estimate.
4. Calculate a selling price and write a proposal.
5. Describe job costing and how it determines profit and loss.
6. Describe the process and methods used to tender projects.
7. Describe goals of a commercial or industrial estimate.
8. Describe the possible problems associated with creating an estimate.
9. Describe bonds associated with the sheet metal trade.

F. Job Supervision 4 Hours

Outcome: Organize tasks related to construction projects.

1. Identify the challenges of scheduling and coordinating.
2. Describe the procedure for ordering equipment and materials.
3. Identify the challenges of coordinating sub trades.
4. Identifying technology to aid in supervision.

SECTION THREE: REFRIGERATION..... 52 HOURS

A. Refrigerant and Oil Handling 16 Hours

Outcome: Demonstrate refrigerant and refrigeration oil handling practices.

1. Describe the evolution and properties of refrigerants.
2. Describe the evolution and properties of refrigerant oils.
3. Describe handling and storage of refrigerants and refrigeration oils.
4. Describe recovery and disposal of refrigerants and refrigeration oils.
5. Describe leak testing methods and instruments used.
6. Describe the evacuation process of split systems.
7. Demonstrate recovery and disposal of refrigerants.
8. Demonstrate recovery and disposal of refrigeration oils.
9. Demonstrate leak testing methods and instruments used.
10. Demonstrate the evacuation process of split systems.
11. Demonstrate maintenance procedures of recovery and evacuation equipment.

B. Split Systems 36 Hours

Outcome: Install split air conditioning systems.

1. Describe the operation of a split system.
2. Identify components of a split system.

3. Identify tools used for installation and diagnostics.
4. Identify tubing types, designations and pressure ratings.
5. Identify tube fitting types and joining techniques.
6. Describe the process for bending tubing.
7. Describe specialty tools and equipment used.
8. Install and leak test tube and pipe connections.
9. Describe system installation.
10. Install an evaporator.
11. Commission a split system.
12. Describe split system maintenance.

SECTION FOUR:DIAGNOSTICS AND INDUSTRY NETWORK..... 102 HOURS

A. Electronic Ignition 16 Hours

Outcome: *Repair electronic ignition systems up to 400 MBH.*

1. Describe the operation of ignition systems.
2. Describe routine maintenance for ignition systems.
3. Diagnose electronic ignition systems.

B. System Controls and Schematics..... 18 Hours

Outcome: *Install system accessories of appliances up to 400 MBH.*

1. Describe HVAC accessories and controls.
2. Interpret electrical schematics used in HVAC control systems.
3. Install HVAC accessories to a control system.

C. Commercial HVAC Equipment Commissioning and Maintenance..... 15 Hours

Outcome: *Perform start up procedures on commercial HVAC equipment up to 400 MBH.*

1. Describe the commissioning process for commercial HVAC equipment.
2. Describe maintenance of commercial HVAC equipment.

D. Testing and Troubleshooting 30 Hours

Outcome: *Repair HVAC systems up to 400 MBH.*

1. Describe instruments used for testing and troubleshooting HVAC equipment.
2. Describe annual fuel utilisation efficiency (AFUE) program.
3. Demonstrate procedures for an appliance efficiency test.
4. Describe the procedures for diagnosing faults in a gas furnace.
5. Diagnose a mal-functioning gas furnace.
6. Diagnose safety interlock problems on mid and high efficient furnaces.
7. Diagnose a mal-functioning HVAC accessory.
8. Diagnose gas train components.
9. Install gas train components.

10. Diagnose temperature sensing devices.
11. Diagnose line voltage devices.
12. Diagnose combustion related devices.
13. Install combustion related devices.

E. Troubleshooting Commercial and Industrial HVAC Systems..... 10 Hours

Outcome: ***Repair commercial and industrial HVAC equipment.***

1. Diagnose commercial and industrial HVAC equipment.
2. Demonstrate techniques used to start up, monitor the sequence of operation, and shut down commercial equipment and appliances.
3. Repair commercial and industrial HVAC equipment.

F. Air Balancing..... 6 Hours

Outcome: ***Perform air flow balancing.***

1. Identify the instruments used for air flow testing and balancing.
2. Measure the airflow on various outlets, grills and ductwork.
3. Describe the process for air balancing an HVAC system.
4. Balance a multi-outlet, single zone system using air balancing equipment.
5. Balance an HRV system.

G. Workplace Coaching Skills..... 2 Hours

Outcome: ***Use coaching skills when training an apprentice.***

1. Describe the process for coaching an apprentice.

H. Alberta's Industry Network..... 2 Hours

Outcome: ***Describe the role of the network of industry committees that represent trades and occupations in Alberta.***

1. Describe Alberta's Apprenticeship and Industry Training system.
2. Describe roles and responsibilities of the Alberta Apprenticeship and Industry Training Board, the Government of Alberta and post-secondary institutions.
3. Describe roles and responsibilities of the Provincial Apprenticeship Committees (PACs), Local Apprenticeship Committees (LACs) and Occupational Committees (OCs).

I. Interprovincial Standards Red Seal Program 3 Hours

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.



Apprenticeship and Industry Training

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