Apprenticeship and Industry Training

Metal Fabricator (Fitter)

Curriculum Guide

026 (2022)

Alberta

Apprenticeship and Industry Training

ALBERTA ADVANCED EDUCATION

Metal Fabricator (Fitter): apprenticeship education program curriculum guide

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Metal Fabricator (Fitter)
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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 Metal Fabricator (Fitter) apprenticeship education program is an individual who will be able to:

- apply all applicable Codes and Regulations with reference to materials, its uses and safety
- understand and apply the principles of drafting, how drawings originate, and how to correctly interpret the information given - the use of each type and the related work orders, materials lists, etc.
- work with shop fabrication, preparation, lay-out, assembly or repair of structural and miscellaneous components and vessel fabrication
- perform a satisfactory operation with oxy-fuel or electric arc welding/cutting equipment in order to facilitate this work
- be proficient in the safe use and maintenance of hand and power tools
- be familiar with the work of other tradesmen in affiliated trades
- perform the necessary functions required to fabricate, assemble vessel, structural and miscellaneous metal work, within the scope of a structural steel and/or vessel fabricating or manufacturing facility or shop
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Alberta's apprenticeship education 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. J. Gillen	Calgary
Mr. N. Carrington	Calgary
Mr. P. Devine	Edmonton
Mr. C Welcher	Calgary
Mr. J. Petruska	Strathmore
Mr. T. Cooley	Calgary
Mr. J. Ganczar	Nisku
Mr. G. Hunter	Edmonton
Mr. H. Swankhuizen	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 education 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 education 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 Metal Fabricator (Fitter) trade apprenticeship technical training:

Northern Alberta Institute of Technology Souch Campus

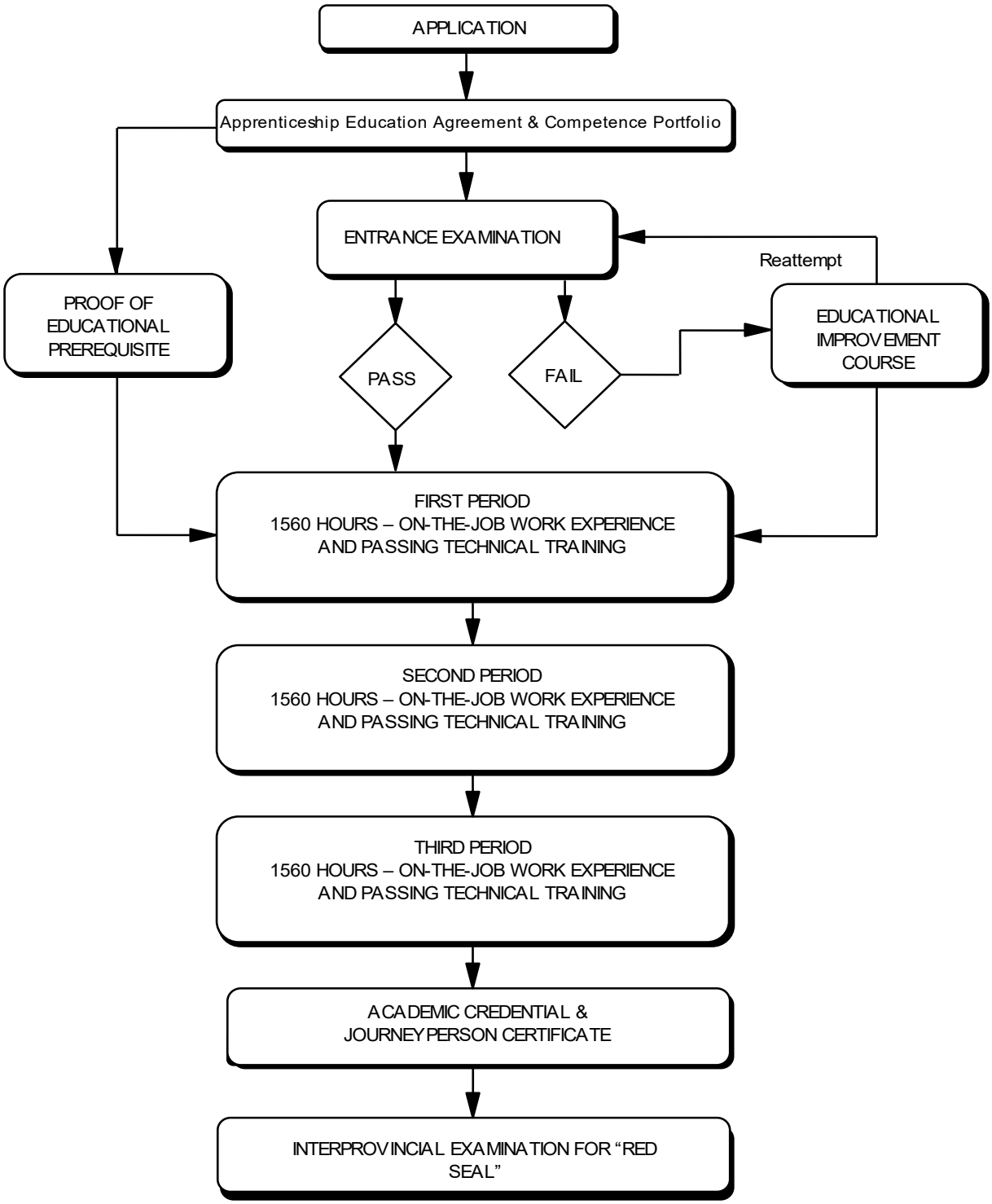
Procedures for Recommending Revisions to the Curriculum Guide

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

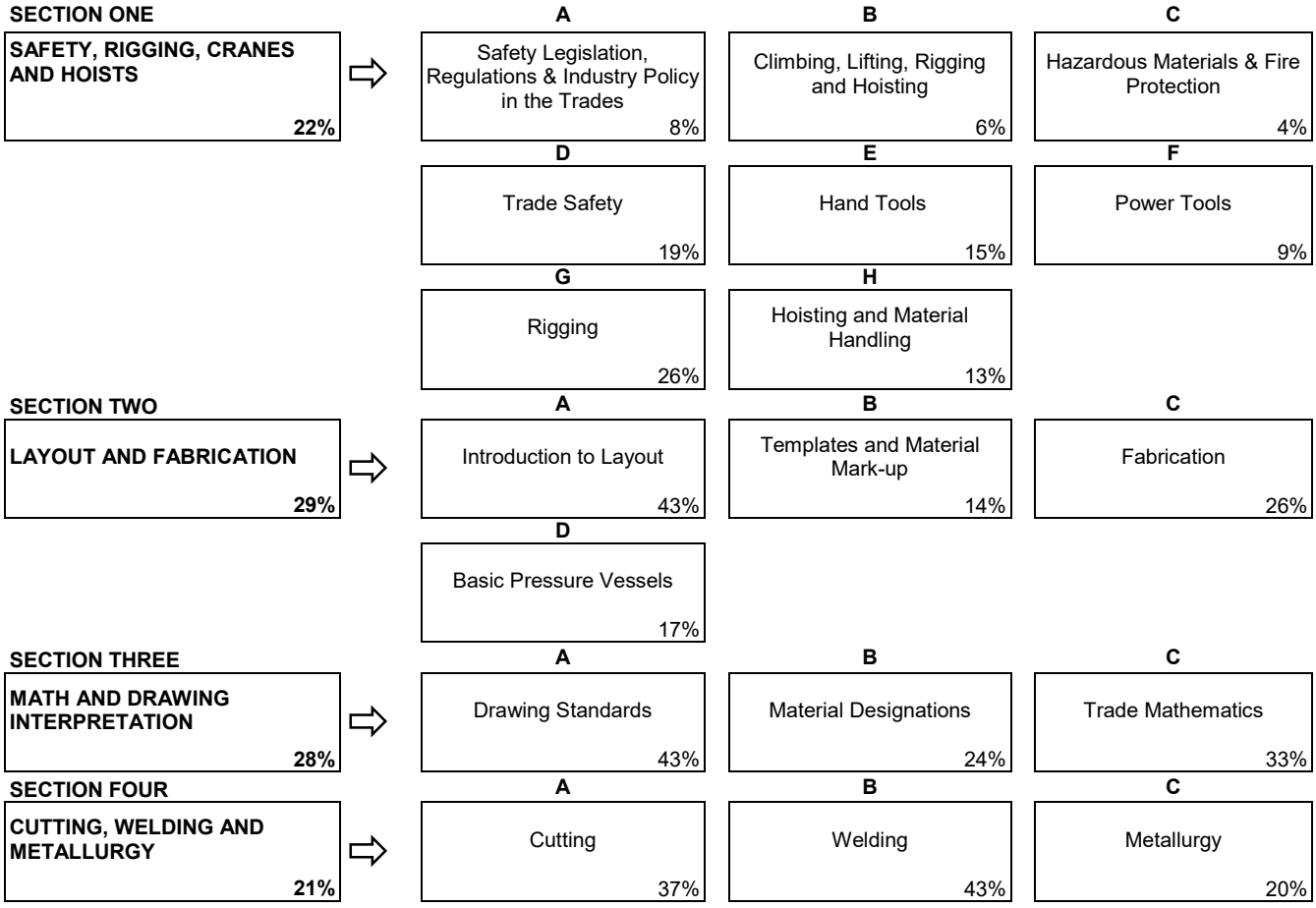
Registrar of Apprenticeship Programs
c/o Apprenticeship Delivery and Industry Support Services
Apprenticeship Delivery and Industry Support
Advanced Education
19th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

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

Apprenticeship Route toward Academic Credential



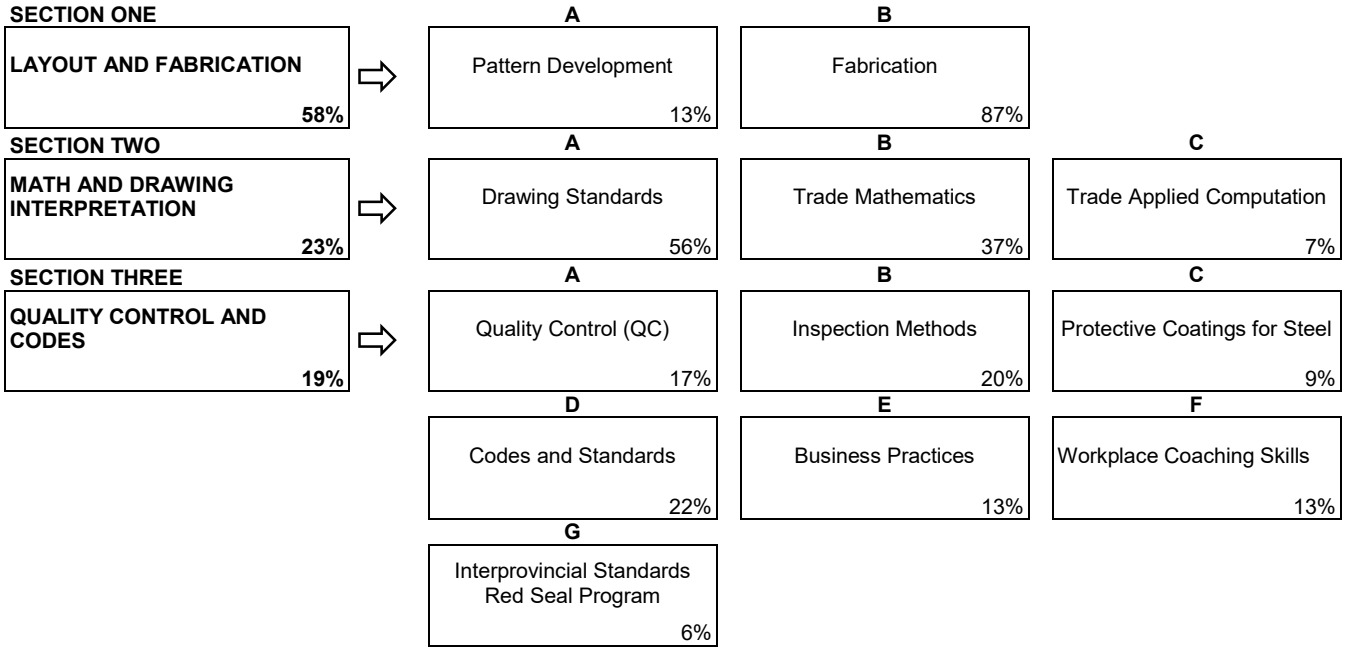
Metal Fabricator (Fitter) Training Profile
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)



Second Period
(8 Weeks 30 Hours per Week - Total of 240 Hours)

		A	B	C
SECTION ONE				
MATERIAL HANDLING, EQUIPMENT OPERATIONS **25%**	⇨	Equipment Operations 73%	Hoisting and Material Handling 20%	New Technology 7%
SECTION TWO		**A**	**B**	
LAYOUT AND FABRICATION **26%**	⇨	Pattern Development 35%	Fabrication 65%	
SECTION THREE		**A**	**B**	**C**
MATH AND DRAWING INTERPRETATION **23%**	⇨	Drawing Standards 44%	Welding Abbreviations and Symbols 15%	Trade Mathematics 41%
SECTION FOUR		**A**	**B**	**C**
CUTTING, WELDING AND METALLURGY **26%**	⇨	Cutting 44%	Welding 37%	Metallurgy 19%

Third Period
(8 Weeks 30 Hours Per Week - Total of 240 Hours)



FIRST PERIOD TECHNICAL TRAINING
METAL FABRICATOR (FITTER) TRADE
CURRICULUM GUIDE

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

SECTION ONE:..... SAFETY, RIGGING, CRANES AND HOISTS 22%

A. Safety Legislation, Regulation & Industry Policy in the Trades 8%

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 workers 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 6%

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 4%

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. Trade Safety 19%

Outcome: Apply safe work practices.

1. Demonstrate maintenance procedures for tools.
2. Describe procedures for responding to and documenting incidents and accidents.
3. Describe lock-out and tag-out procedures.
4. Explain the effects of electricity and precautions used to prevent injury.

E. Hand Tools 15%

Outcome: Use hand tools for fabricating metal.

1. Describe safety precautions for hand tools.
2. Identify hand tools for fabricating metal.
3. Identify layout and measuring tools and their uses.
4. Identify clamping tools and their uses.
5. Identify cutting tools and their uses.
6. Use taps and dies to make threads.

F. Power Tools 9%

Outcome: Use power tools for fabricating metal.

1. Describe the operating procedures for metal forming and shaping tools.
2. Describe the operating procedures for metal cutting power tools.
3. Describe the application of electrical, hydraulic and pneumatic tools.
4. Operate bench, pedestal, angle and straight grinders.
5. Operate portable power drills, twist drills and drill presses.

G. Rigging 26%

Outcome: Apply rigging practices.

1. Define rigging terms.
2. Demonstrate tying knots and hitches.
3. Describe sling, wire rope and chain lifting configurations.
4. Calculate working load limit (WLL) of rigging equipment.
5. Use wire rope, synthetic slings and chains.
6. Inspect rigging and hoisting equipment for damage.

H. Hoisting and Material Handling 13%

Outcome: Demonstrate hoisting and material handling procedures.

1. Describe the differences between hoisting and lifting.
2. Identify cranes and their capacities.
3. Describe safety procedures for forklifts, work platforms and ladders.
4. Describe transfer tables and conveyors.

5. Explain procedures for storing and stacking materials.
6. Demonstrate signals for lifting and hoisting.
7. Demonstrate the procedures for rigging and hoisting.

SECTION TWO: .....LAYOUT AND FABRICATION..... 29%

A. Introduction to Layout 43%

Outcome: Demonstrate layout procedures.

1. Identify terms and symbols associated with drafting and layout.
2. Identify the components of a circle.
3. Layout geometric constructions using drafting and layout tools.
4. Construct an ellipse using the trammel method.
5. Describe principles of parallel line development.
6. Identify patterns for piping and square tubing cut on an angle.

B. Template and Material Mark-Up 14%

Outcome: Use templates and material mark-up procedures.

1. Describe symbols and abbreviations used in material mark-up and template development.
2. Describe the purpose of different markers.
3. Describe mark-up procedures for fabrication processes.
4. Describe types of and materials for templates.
5. Explain the procedures for establishing a square corner.
6. Describe material nesting.

C. Fabrication 26%

Outcome: Fabricate a structural component.

1. Identify the components of a steel structure.
2. Define terms associated with structural steel fabrication.
3. Describe the procedure for checking a fabricated component for squareness.
4. Fabricate a structural component.

D. Basic Pressure Vessels 17%

Outcome: Demonstrate vessel layout.

1. State the Canadian Standards Association (CSA) definition and general classifications of pressure vessels.
2. Identify the five types and functions of unfired pressure vessels.
3. Describe the components of a pressure vessel.
4. Define American Society of Mechanical Engineers (ASME) and American Society for Testing Materials (ASTM).
5. Identify the ASME sections detailing pressure vessel fabrication.
6. Define grain direction and how it relates to the forming process.

7. Calculate plate lengths for rolling cylinders.
8. Demonstrate vessel layout.

SECTION THREE: ..... MATH AND DRAWING INTERPRETATION 28%

A. Drawing Standards 43%

Outcome: Interpret drawings.

1. Identify the elements of a drawing.
2. Define running, group, conventional and standard dimensions.
3. Describe the purpose of the alphabet of lines.
4. Illustrate multi view, third angle, orthographic and isometric projections.
5. Describe care and storage of drawings.
6. Create drawings using drafting standards and techniques.
7. Interpret drawings using drafting standards and techniques.
8. Develop a material take-off from a structural drawing.

B. Material Designations 24%

Outcome: Identify the types and uses of construction materials.

1. Describe steel products and designations.
2. Calculate weight of structural shapes.
3. Describe types and grades of steel and alloys.
4. Explain procedures for sizing and ordering grating.
5. Describe dimensional properties of pipe.
6. Describe methods of manufacturing and marking pipe.
7. Describe types, uses and marking system of pipe fittings.
8. Identify types of fasteners used in structural and vessel industries.
9. Calculate bolt and stud lengths.

C. Trade Mathematics 33%

Outcome: Solve math problems.

1. Solve problems using whole numbers, fractions and decimals.
2. Convert between decimal and fractional values.
3. Solve ratio and direct/indirect proportion problems.
4. Solve perimeter, area and volume problems.
5. Convert between metric and imperial numbers.

SECTION FOUR: ..... CUTTING, WELDING AND METALLURGY..... 21%

A. Cutting 37%

Outcome: Demonstrate cutting processes.

1. Describe the construction and handling procedures of compressed gas cylinders.
2. Describe the construction and operating procedures of oxy-fuel systems.
3. Explain the purpose of a manifold system.
4. Describe the design, application and care of cutting tips.
5. List causes of backfires and flashbacks.
6. Identify cutting processes and equipment.
7. Operate oxy-fuel cutting systems.

B. Welding 43%

Outcome: Demonstrate welding processes.

1. Identify welding processes, equipment and accessories.
2. Define open circuit voltage, arc voltage, alternating current, direct current, resistance and polarity.
3. List the advantages and disadvantages of welding processes and components.
4. Describe the designations and properties of consumable electrodes.
5. Describe safety requirements specific to welding.

C. Metallurgy 20%

Outcome: Describe properties of metals.

1. Describe physical and chemical properties of metals.
2. Describe the chemical composition of steel.
3. Describe classification of steel.

SECOND PERIOD TECHNICAL TRAINING
METAL FABRICATOR (FITTER) TRADE
CURRICULUM GUIDE

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SECTION ONE:.....MATERIAL HANDLING AND EQUIPMENT OPERATIONS 25%

A. Equipment Operations 73%

Outcome: Operate fabrication equipment.

1. Identify types, operating procedures and capacities of stationary metal fabrication equipment.
2. Identify types, operating procedures and capacities of portable metal fabrication equipment.
3. Describe types of thread and threading procedures.
4. Describe metal forming.
5. Demonstrate metal forming practices.
6. Operate metal fabrication equipment.

B. Hoisting and Material Handling..... 20%

Outcome: Operate material handling equipment.

1. Explain the operation of air hoists, block and tackle chain falls, come-alongs and tirfors.
2. Operate air hoists, block and tackle chain falls, come-alongs and tirfors.

C. New Technology 7%

Outcome: Describe advancements in fabrication technology.

1. Describe advancements in fabrication technology.

SECTION TWO:.....LAYOUT AND FABRICATION..... 26%

A. Pattern Development..... 35%

Outcome: Apply principles of pattern development.

1. Explain principles of triangulation.
2. Create wraparound templates using parallel line development.
3. Create bending templates using radial line development.
4. Create stretch-out templates by applying bend allowance and mean diameter calculations.

B. Fabrication 65%

Outcome: Fabricate pressure vessels and structural steel.

1. Interpret principles of vessel layout and fabrication.
2. Apply principles of vessel layout and fabrication.
3. Interpret principles of metal forming.
4. Apply principles of metal forming.

5. Interpret principles for miscellaneous metal layout and fabrication.
6. Apply principles for miscellaneous metal layout and fabrication.
7. Interpret principles for structural steel layout and fabrication.
8. Apply principles for structural steel layout and fabrication.

SECTION THREE: ..... MATH AND DRAWING INTERPRETATION 23%

A. Drawing Standards 44%

Outcome: Interpret intermediate level drawings.

1. Interpret intermediate level drawings.

B. Welding Abbreviations and Symbols 15%

Outcome: Interpret welding symbols.

1. Identify welding symbols.
2. Explain parts of a welding symbol.
3. Define welding abbreviations.

C. Trade Mathematics 41%

Outcome: Solve intermediate level math problems.

1. Solve intermediate problems using whole numbers, fractions and decimals.
2. Solve intermediate problems concerning ratio and direct/indirect proportion.
3. Solve intermediate problems relating to perimeter, area and volume.
4. Calculate percentages including simple interest, discounts and successive discounts.

SECTION FOUR: ..... CUTTING, WELDING AND METALLURGY 26%

A. Cutting 44%

Outcome: Demonstrate intermediate level cutting processes.

1. Describe the equipment and operating procedures required for oxy-fuel, plasma and carbon arc cutting and gouging.
2. Demonstrate the equipment and operating procedures required for oxy-fuel, plasma and carbon arc cutting and gouging.
3. Demonstrate piercing and cutting of a bolt hole to size.
4. Prepare materials using joint configurations.

B. Welding 37%

Outcome: Demonstrate intermediate level welding processes.

1. Explain which welds apply to butt, lap, corner, edge and tee joints.
2. Explain causes of distortion.
3. Identify weld faults and their causes.
4. Describe the equipment, operating procedures and advantages of stud welding.

5. Describe the equipment, operating procedures and advantages of wire process welding.
6. Demonstrate joint preparation and tacking procedures of components.

C. Metallurgy 19%

Outcome: Describe properties of metal.

1. Describe the effect of heating and cooling metal.
2. Describe bend, file, spark and hardness tests.
3. Describe steel colour changes during heating processes.
4. Explain the purpose of pre and post metal heating procedures.
5. Describe the effects of quenching on steel hardness measured in Brinnell or Rockwell scales.
6. Describe the effects of metal chemical composition on welding and cutting processes.
7. Describe how forging affects the grain size and structure of metal.
8. Describe methods for heat straightening different metal shapes and components.

THIRD PERIOD TECHNICAL TRAINING
METAL FABRICATOR (FITTER) TRADE
CURRICULUM GUIDE

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

SECTION ONE: LAYOUT AND FABRICATION 58%

A. Pattern Development 13%

Outcome: Apply principles of advanced pattern development.

1. Create stretch-out templates for true wye and lateral connections using parallel line development.
2. Create stretch-out templates for cones, pyramids and truncated frustums using radial line development.
3. Calculate slant height, true length, angle of stretch out, altitude to apex (when given frustum dimensions) and chord length for cones and frustums of cones.
4. Apply principles of triangulation when creating templates square to round transitions.

B. Fabrication 87%

Outcome: Implement advanced fabrication procedures for pressure vessels and structural steel.

1. Interpret principles of vessel layout and fabrication.
2. Apply principles of vessel layout and fabrication.
3. Interpret principles of metal forming.
4. Apply principles of metal forming.
5. Interpret principles for miscellaneous metal layout and fabrication.
6. Apply principles for miscellaneous metal layout and fabrication.
7. Interpret principles for structural steel layout and fabrication.
8. Apply principles for structural steel layout and fabrication.
9. Explain the importance of preparing joints and following welding procedures when constructing fabricated components.
10. Describe fabrication procedures using clad steels.
11. Apply code requirements when fabricating metal.

SECTION TWO: MATH AND DRAWING INTERPRETATION 23%

A. Drawing Standards 56%

Outcome: Interpret advanced drawings.

1. Interpret advanced drawings.
2. Use advanced drawings to check a fabricated component.

B. Trade Mathematics 37%

Outcome: Solve advanced level math problems.

1. Apply trigonometric functions.

2. Describe complementary angles using sine, cosine and tangent functions.
3. Solve practical application problems related to layout and fabrication.
4. Solve trade related problems involving areas, volumes, capacities, mass and linear measurements.

C. Trade Applied Computation 7%

Outcome: Prepare a project bid.

1. Prepare material take-offs.
2. Calculate labour and production costs.
3. Prepare a project bid.

SECTION THREE: .....QUALITY CONTROL AND CODES..... 19%

A. Quality Control (QC) 17%

Outcome: Describe purpose and methods of quality assurance and control.

1. Define quality assurance.
2. Define quality control.
3. Describe the elements of a QC system.
4. Explain the function of standards and codes.

B. Inspection Methods 20%

Outcome: Describe inspection methods.

1. Describe types and stages of inspection.
2. Describe non-conformances during each stage of inspection.
3. Describe the economic value of each stage of inspection.
4. Identify templates and gauges used for visual inspection.
5. Describe process for handling inspection reports.

C. Protective Coatings for Steel 9%

Outcome: Describe protective coatings for steel.

1. Describe protective coatings and methods of inspection.
2. Describe causes of rusting.
3. Describe preparation of metals prior to coating.
4. Describe the galvanizing process.

D. Codes, Standards and Design 22%

Outcome: Interpret industry codes, standards and design principles.

1. Interpret the American Petroleum Institute (API), Canadian Institute of Steel Construction (CISC), CSA and ASME codes as they relate to metal fabrication.
2. Define design stresses related to structural components and vessels.

E. Business Practices 13%

Outcome: Describe industry business procedures.

1. Interpret written orders and requests.
2. Describe workplace responsibilities.

F. Workplace Coaching Skills 13%

Outcome: Use coaching skills when training an apprentice.

1. Describe the process for coaching an apprentice.

G. Interprovincial Standards Red Seal Program 6%

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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