

Apprenticeship and Industry Training

Boilermaker

Apprenticeship Course Outline

0381 (2018)

Alberta 



Apprenticeship
and Industry
Training

ALBERTA ADVANCED EDUCATION

Boilermaker course outline

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**Boilermaker
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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 Boilermaker Provincial Apprenticeship Committee.

The graduate of the Boilermaker apprenticeship program is a certified journeyman who will be able to:

- understand the principles of drafting; how drawings originate, their purpose and how to correctly interpret the information therein
- understand the use of each type of drawing, part work order sketches, materials lists and specification sheets
- layout from drawings to material; pattern development and template making
- relate to all applicable Codes and Regulations with reference to materials specifications, uses and safety for vessels of all types and the acceptable methods of construction for pressure vessels
- relate to metallurgy, structural shapes, plate, pipe and pipe fittings with respect to vessel components, ropes, wire and fibre types, uses of pipe and its respective fittings and materials used with pressure vessels, both metallic and non-metallic
- use hand tools and powered equipment in a proper and safe manner
- calculate material quantities
- perform an operation with oxyfuel or electric arc welding equipment
- plans lifts to ensure that safe rigging and hoisting practices are followed to avoid personal injury as well as damage to equipment and property
- relate to work of other tradespeople in affiliated trades
- perform assigned tasks in accordance with quality and production standards required by industry

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

Boilermaker PAC Members at the Time of Publication

Mr. L. Norman	Leduc	Presiding Officer
Mr. T. Brisson	Morinville	Employer
Mr. G. Tardif	Sherwood Park	Employer
Mr. K. Thiessen	Edmonton	Employer
Mr. E. Velichko	Spruce Grove	Employer
Mr. J. Fletcher	Edmonton	Employee
Mr. R. Reid	Morinville	Employee
Mr. P. Scherba	Edmonton	Employee

Alberta Government

Alberta Advanced Education 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 institutions deliver Boilermaker apprenticeship technical training:
Northern Alberta Institute of Technology (Souch Campus)

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Boilermaker Provincial Apprenticeship Committee.

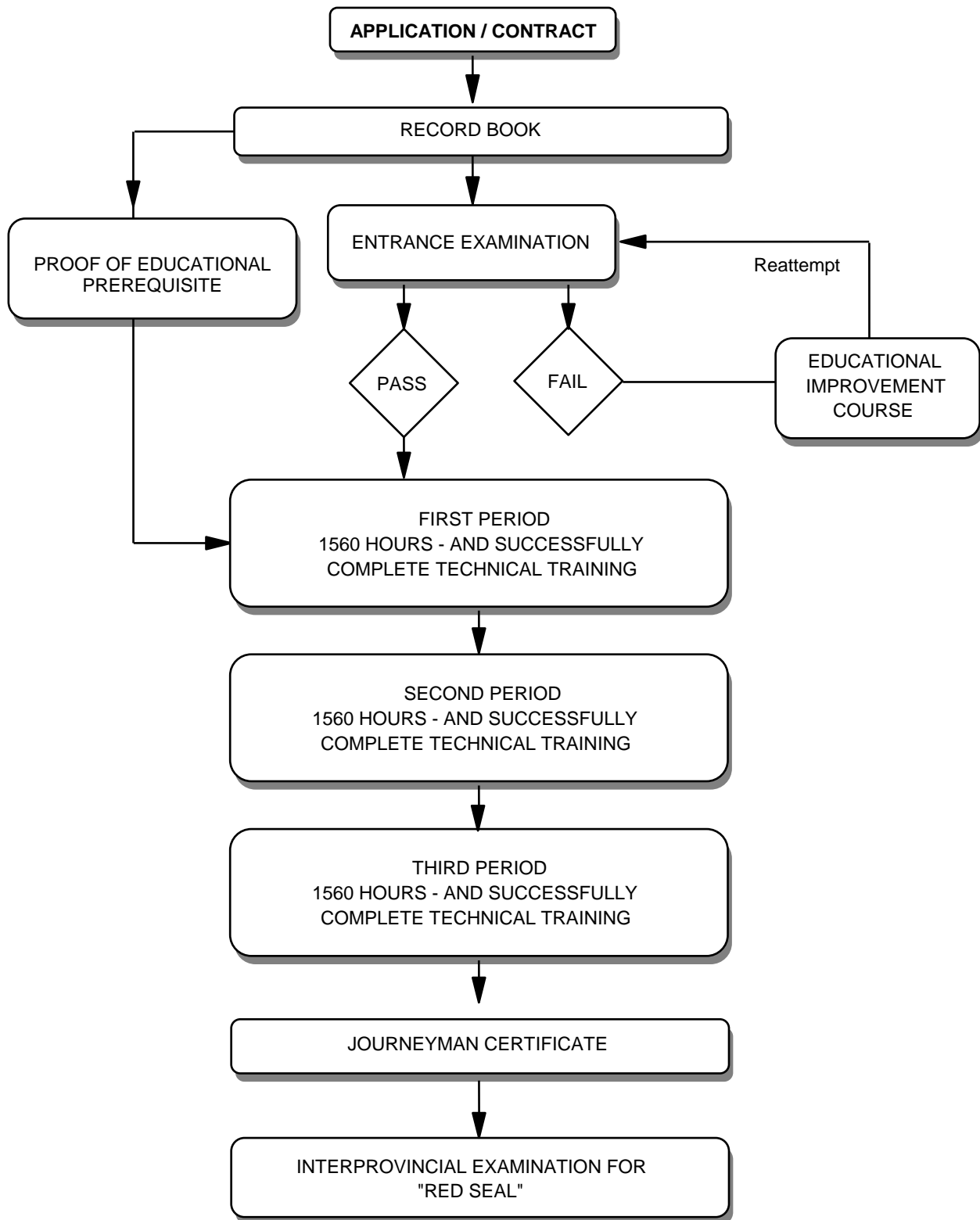
This course outline was approved on November 3, 2017 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

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

Boilermaker 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 Boilermaker Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification



Boilermaker Training Profile

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

SECTION ONE

STANDARD WORKPLACE SAFETY
24 HOURS



A

Safety Legislation,
Regulations & Industry Policy
in the Trades
8 Hours

B

Climbing, Lifting, Rigging and
Hoisting
8 Hour

C

Hazardous Materials and
Fire Protection
2 Hours

D

Apprenticeship Training
Program
2 Hours

E

Confined Space Entry
2 Hours

F

Communication Skills
2 Hours

SECTION TWO

HOISTING DEVICES AND ROPES
38 HOURS



A

Ropes
10 Hours

B

Hoisting Devices and
Accessories
10 Hours

C

Hoisting Communication
8 Hours

D

Wire Rope And Attachments
10 Hours

SECTION THREE

DRAWINGS, LAYOUT AND TRADE SPECIFIC MATERIALS
58 HOURS



A

Trade Specific Materials
12 Hours

B

Materials Preparation and
Assembly
8 Hours

C

Drawing Standards
20 Hours

D

Fundamentals of Layout
18 Hours

SECTION FOUR

WELDING AND CUTTING
60 HOURS



A

Electric Arc Welding
25 Hours

B

Oxy-Fuel Cutting
25 Hours

C

Steel Production
10 Hours

SECTION FIVE

TOOLS, PRESSURE VESSELS, TANKS AND BOILERS
60 HOURS



A

Math Concepts
28 Hours

B

Hand and Power Tools
16 Hours

C

Pressure Vessels, Tanks
and Boilers
16 Hours

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

SECTION ONE

**BLOCK AND TACKLE AND
 HOISTING PRACTICES**
 52 HOURS



A	B	C
Block and Tackle 20 Hours	Wire Rope Drums 6 Hours	Hoisting Practices 20 Hours
D		
Aerial Access Equipment and Scaffolds 6 Hours		

SECTION TWO

**DRAWING INTERPRETATION
 AND COMPONENT
 FABRICATION**
 132 HOURS



A	B	C
Drawing Interpretation 30 Hours	Component Layout 22 Hours	Component Fabrication 20 Hours
D	E	F
Metal Cutting 30 Hours	Welding 26 Hours	Fibreglass 4 Hours

SECTION THREE

**EQUIPMENT, METALLURGY AND
 HEAT TREATMENT**
 56 HOURS



A	B	C
Geometry 20 Hours	Electric and Pneumatic Tools 6 Hours	Measuring Instruments 4 Hours
D	E	F
Shop Equipment 6 Hours	Metallurgy 10 Hours	Heat Treatment 10 Hours

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

SECTION ONE

CRANES AND HOISTING SYSTEMS
35 HOURS



A	B	C
Block and Winch Systems 16 Hours	Cranes 14 Hours	Jacking Equipment 2 Hours
D		
Engineered Lifts 3 Hours		

SECTION TWO

FABRICATION AND ERECTION DRAWINGS AND QUALITY CONTROL
34 HOURS



A	B	C
Fabrication and Erection Drawings 5 Hours	Testing and Inspection of Materials 8 Hours	Quality Control 8 Hours
D	E	F
Business Practices 10 Hours	Alberta's Industry Network 1 Hour	Workplace Coaching Skills 1 Hour
G		
Interprovincial Standards Red Seal Program 1 Hour		

SECTION THREE

FITTING AND FABRICATION
60 HOURS



A	B
Geometric Layout 30 Hours	Fitting Techniques 30 Hours

SECTION FOUR

BOILERS, CONDENSERS, EXCHANGERS AND TANKS
111 HOURS



A	B	C
Trade Mathematics 10 Hours	Boiler and Steam Generator Components 30 Hours	Condensers and Exchangers 30 Hours
D	E	
Tanks 30 Hours	Introduction to Heavy Industry 11 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
BOILERMAKER TRADE
COURSE OUTLINE**

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

SECTION ONE:..... STANDARD WORKPLACE SAFETY 24 HOURS

A. Safety Legislation, Regulations & Industry Policy in the Trades 8 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 8 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. Confined Space Entry..... 2 Hours

Outcome: Apply safe work procedures pertaining to confined space entry.

1. Describe confined space entry procedures.
2. Describe confined space entry legislation.

F. Communication Skills 2 Hours

Outcome: Demonstrate effective communication skills.

1. Demonstrate effective communication skills.

SECTION TWO: HOISTING DEVICES AND ROPES 38 HOURS

A. Ropes 10 Hours

Outcome: Demonstrate knowledge of the characteristics of ropes used for rigging.

1. Describe the construction of fibre and synthetic ropes.
2. Describe rope maintenance.
3. Describe working load limits formulas, factors and reductions for natural and synthetic ropes.
4. Describe the uses of knots, hitches and splices
5. Describe the strength reductions of knots, hitches and splices.
6. Tie knots and hitches.
7. Splice ropes.

B. Hoisting Devices and Accessories 10 Hours

Outcome: Hoist a load.

1. Describe types of mobile cranes.
2. Interpret manufacturer's specifications for hoisting equipment.
3. Calculate the centre of gravity for different types of loads.
4. Use tables and charts for sling and attachment selection.
5. Demonstrate sling configurations on loads for hoisting.
6. Demonstrate hitches used for hoisting materials.
7. Use slings, attachments and tag lines.
8. Hoist a load.

C. Hoisting Communication 8 Hours

Outcome: *Demonstrate hoisting communication techniques.*

1. Demonstrate hand signals used for moving equipment and hoisting.
2. Demonstrate voice communications for moving equipment and hoisting.

D. Wire Rope and Attachments 10 Hours

Outcome: *Perform rigging skills using wire rope and attachments.*

1. Describe wire ropes.
2. Describe wire rope faults and removal criteria.
3. Describe uses of rigging hardware, hooks and attachments.
4. Calculate working load limits.

SECTION THREE:DRAWINGS, LAYOUT AND TRADE SPECIFIC MATERIALS 58 HOURS

A. Trade Specific Materials 12 Hours

Outcome: *Apply knowledge of basic materials.*

1. Describe structural shapes and their designations.
2. Define camber and sweep.
3. Describe the classification of steel plate with reference to thickness and width.
4. Describe the applications of clad steel and other cladding materials.
5. Describe grating and its applications.
6. Describe expanded mesh and its applications.
7. Describe bolts, studs and screws and their applications.
8. Calculate bolt, stud and screw thread lengths.
9. Describe characteristics and applications of tube.
10. Describe characteristics and applications of pipe.
11. Describe pipe fittings and their applications.
12. Describe cutting/threading of pipe using manual and mechanical process.
13. Perform pipe cutting using mechanical processes.

B. Material Preparation and Assembly 8 Hours

Outcome: *Describe material preparation and assembly.*

1. Describe material markup.
2. Describe the purpose and application of templates.
3. Describe methods used to identify fabricated components and assemblies.

C. Drawing Standards 20 Hours

Outcome: *Compose a sketch based on a set of drawings.*

1. Describe types of drawings.
2. Describe drawing components.

3. Describe pictorial drawings.
4. Describe drawing conventions.
5. Describe drawing views and their applications.
6. Describe right and left hand views.
7. Interpret symbols and abbreviations.
8. Compose a sketch.

D. Fundamentals of Layout 18 Hours

Outcome: *Perform layout skills.*

1. Use measuring, checking and layout tools.
2. Perform geometrical constructions.
3. Produce templates using parallel line development.
4. Layout bolt circles, manholes, flanges and ellipses.

SECTION FOUR: WELDING AND CUTTING 60 HOURS

A. Electric Arc Welding 25 Hours

Outcome: *Use welding equipment.*

1. Use PPE and safety equipment specific to welding.
2. Describe types of arc welding machines and their operations.
3. Describe the numerical definitions of electrodes and heat settings.
4. Describe expansion, contraction and distortion resulting from welding.
5. Identify common weld faults.
6. Weld stringer beads.

B. Oxy-fuel Cutting 25 Hours

Outcome: *Use oxy-fuel cutting equipment.*

1. Use PPE and safety equipment specific to oxy-fuel cutting.
2. Describe the oxy-fuel cutting process.
3. Describe components of oxy-fuel cutting equipment.
4. Describe the purpose of a manifold system.
5. Describe types of flames and their uses.
6. Describe troubleshooting procedures for oxy-fuel equipment and operations.
7. Describe handling, transporting and storing of cylinders.
8. Describe hazardous situations.
9. Describe expansion, contraction and distortion resulting from cutting.
10. Demonstrate fire prevention and controls.
11. Demonstrate the set-up and shutdown of oxy-fuel equipment.
12. Demonstrate the setting of oxy-fuel pressures, balancing and flame adjustments.
13. Demonstrate manual cutting.

C. Steel Production 10 Hours

Outcome: ***Describe the properties of metal elements.***

1. Describe ferrous and non-ferrous metals.
2. Describe the five groups of steel and their properties and applications.
3. Describe elements present in steel and their effects.
4. Describe the types of carbon steel.
5. Describe the physical and mechanical properties of carbon steel.
6. Describe the production of cast iron, carbon steel, alloy steel and stainless steel.
7. Describe the forming of steel products.
8. Describe the American Iron and Steel Institute (AISI) classification system.

SECTION FIVE:..... TOOLS, PRESSURE VESSELS, TANKS AND BOILERS 60 HOURS

A. Math Concepts 28 Hours

Outcome: ***Perform calculations on practical applications using various units of measurement.***

1. Describe metric and imperial measurement systems.
2. Convert measurements between the metric and imperial measurement systems.
3. Perform trade-related calculations involving decimals and fractions.
4. Perform trade-related calculations using perimeter, area and volume formulas.

B. Hand and Power Tools 16 Hours

Outcome: ***Use hand tools, power tools, pneumatic tools and stationary equipment.***

1. Use hand tools.
2. Maintain hand tools
3. Use power tools.
4. Maintain power tools.
5. Use pneumatic tools and accessories.
6. Maintain pneumatic tools and accessories.
7. Use stationary equipment.
8. Maintain stationary equipment.

C. Pressure Vessels, Tanks and Boilers 16 Hours

Outcome: *Describe pressure vessels, tanks, boilers and their components.*

1. Define pressure vessel.
2. Describe types of pressure vessels.
3. Describe pressure vessel components and their functions.
4. Describe pressure and non-pressure components.
5. Describe access openings.
6. Describe watertube boilers and firetube boilers.
7. Describe heat exchangers and their components.
8. Describe distillation towers and their components.
9. Describe storage tanks and their components.
10. Describe the boilermaker's involvement in various heavy industrial sectors.

**SECOND PERIOD TECHNICAL TRAINING
BOILERMAKER TRADE
COURSE OUTLINE**

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

SECTION ONE: BLOCK AND TACKLE AND HOISTING PRACTICES 52 HOURS

A. Block and Tackle..... 20 Hours

Outcome: *Use block and tackle systems.*

1. Demonstrate methods of reeving.
2. Calculate mechanical advantage of block and tackle systems.
3. Calculate working load limits for rigging arrangements.

B. Wire Rope Drums 6 Hours

Outcome: *Use wire rope drums.*

1. Describe fleet angles required for grooved and smooth drums.
2. Describe spooling procedures.
3. Determine drum capacity.

C. Hoisting Practices..... 20 Hours

Outcome: *Apply hoisting techniques.*

1. Describe mobile equipment.
2. Describe load stress and precautions in the use of high lines.
3. Define the sling tension formula.
4. Determine working load limits for load and sling configurations.
5. Use rigging tables and charts.
6. Demonstrate hoisting signals.

D. Aerial Access Equipment and Scaffolds 6 Hours

Outcome: *Use temporary work platforms.*

1. Describe temporary work platform systems.
2. Set up temporary work platforms.

SECTION TWO: DRAWING INTERPRETATION AND COMPONENT FABRICATION..... 132 HOURS

A. Drawing Interpretation..... 30 Hours

Outcome: *Interpret drawings.*

1. Interpret drawings.

B. Component Layout22 Hours

Outcome: *Layout components.*

1. Describe abbreviations used in layout.
2. Apply geometric concepts for layout and fabrication of components.
3. Utilize material through pre-planning and nesting.
4. Develop templates using geometric construction and parallel and radial line development.
5. Layout components from drawings.

C. Component Fabrication.....20 Hours

Outcome: *Fabricate components.*

1. Fabricate components from drawings.
2. Fit and install fabricated components.

D. Metal Cutting30 Hours

Outcome: *Apply metal cutting techniques.*

1. Describe material expansion and contraction.
2. Describe cutting processes involved in cutting alloy steels and non-ferrous metals.
3. Describe cutting techniques and cutting faults.
4. Determine if metal conditions require specific cleaning methods.
5. Demonstrate flame-cutting skills.
6. Perform weld joint preparation.

E. Welding26 Hours

Outcome: *Apply welding techniques.*

1. Describe the properties, use and care of arc welding electrodes.
2. Describe the functions of slag and shielding gas in the welding process.
3. Explain welding machine selection based on task.
4. Describe other welding processes (GTAW, GMAW, FCAW and SAW).
5. Interpret standardized welding symbols.
6. Demonstrate carbon arc cutting.
7. Demonstrate welding techniques used to control distortion.
8. Demonstrate welding operations.

F. Fibreglass.....4 Hours

Outcome: *Describe fibre-reinforced plastics.*

1. Describe the uses of fibreglass in the boilermaker industry.
2. Describe the tools, resins and fibreglass materials required for lay-up and repairs.
3. Describe safe handling and storage of chemicals required for fibreglass operations.
4. Describe mixing ratios and procedures used in fibreglass operations.
5. Describe procedures for fibreglass lay-up and repair.

SECTION THREE:EQUIPMENT, METALLURGY AND HEAT TREATMENT..... 56 HOURS

A. Geometry20 Hours

Outcome: *Apply math concepts to solve geometry problems.*

1. Calculate squares and square roots of numbers.
2. Perform calculations using Pythagorean Theorem.
3. Solve problems involving percentages.
4. Perform calculations on practical applications.

B. Electric and Pneumatic Tools..... 6 Hours

Outcome: *Operate power tools.*

1. Describe controlled bolting equipment.
2. Demonstrate the use of portable electric and pneumatic tools.

C. Measuring Instruments 4 Hours

Outcome: *Use measuring instruments.*

1. Describe new technologies.
2. Use transits and levels.
3. Use micrometers and calipers (metric and imperial).

D. Shop Equipment 6 Hours

Outcome: *Use shop equipment.*

1. Describe drilling equipment.
2. Describe drill bit geometry and sharpening procedures.
3. Describe power-rolling operations.
4. Describe press brake operations.
5. Calculate blank length before forming.
6. Use shearing and punching machines.
7. Use drilling equipment.
8. Use power saws.

E. Metallurgy 10 Hours

Outcome: *Describe the properties of metal.*

1. Describe metals and alloys.
2. Describe methods of determining the hardness of metals.
3. Describe how heat influences the internal structure of steel.
4. Describe the causes of distortion.
5. Describe methods of controlling and correcting distortion.
6. Describe the effects that carbon has on the cutting and welding of steel.
7. Describe the effects that alloys have on the cutting and welding of steel.
8. Describe the effects of hot and cold working of metals.

F. Heat Treatment..... 10 Hours

Outcome: *Describe heat treatment processes.*

1. Describe steel designation systems.
2. Describe the heat-affected zone (HAZ).
3. Describe preheat and postheat treatment processes.
4. Describe heat treatment processes in the manufacturing of steel products.

**THIRD PERIOD TECHNICAL TRAINING
BOILERMAKER TRADE
COURSE OUTLINE**

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

SECTION ONE:.....CRANES AND HOISTING SYSTEMS 35 HOURS

A. Block and Winch Systems 16 Hours

Outcome: *Use block and winch systems.*

1. Describe the determining factors used when setting up a block and winch system.
2. Perform calculations to determine hoisting system requirements and anchorage points.
3. Set up and use block and winch systems.

B. Cranes 14 Hours

Outcome: *Describe the use of cranes.*

1. Describe the assembly and disassembly procedures of conventional cranes.
2. Describe the effects of dynamic loading on cranes.
3. Describe factors effecting crane capacities.
4. Describe crane levelling procedures.
5. Describe hoisting operations.
6. Identify high capacity cranes and new technologies.

C. Jacking Equipment 2 Hours

Outcome: *Apply jacking techniques.*

1. Describe jack and roll equipment.
2. Describe cribbing procedures.
3. Perform jack and roll operations.

D. Engineered Lifts 3 Hours

Outcome: *Describe engineered lifts.*

1. Describe pre-lift and post-lift meetings.
2. Interpret engineered lift drawings.
3. Identify the requirements and regulations for a critical lift.

SECTION TWO:FABRICATION AND ERECTION DRAWINGS AND QUALITY CONTROL 34 HOURS

A. Fabrication and Erection Drawings 5 Hours

Outcome: *Interpret fabrication and erection drawings.*

1. Interpret fabrication and erection drawings.

B. Testing and Inspection of Materials..... 8 Hours

Outcome: *Describe material testing.*

1. Describe destructive testing.
2. Describe non-destructive testing.
3. Describe proof testing.

C. Quality Control 8 Hours

Outcome: *Describe quality assurance procedures.*

1. Describe procedures to ensure products meet specifications.
2. Describe inspections to ensure product compliance.
3. Describe factors contingent to efficient production.
4. Describe the preparation for shipment of a final product.

D. Business Practices 10 Hours

Outcome: *Demonstrate industry business practices.*

1. Identify general work-related documents.
2. Demonstrate computer skills.
3. Demonstrate effective listening and speaking skills.
4. Define the role and mission of the labour union organization.
5. Demonstrate respect in the workplace.

E. Alberta’s Industry Network 1 Hour

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).

F. Workplace Coaching Skills 1 Hour

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

1. Describe the process for coaching an apprentice.

G. Interprovincial Standards Red Seal Program 1 Hour

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

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

SECTION THREE:FITTING AND FABRICATION 60 HOURS**A. Geometric Layout 30 Hours****Outcome: *Perform geometric layout.***

1. Interpret drawings to layout and fabricate square, round and elliptical holes.
2. Develop and utilize a template using geometry, parallel lines, radial lines and triangulation.

B. Fitting Techniques 30 Hours**Outcome: *Perform fitting techniques.***

1. Describe how to install a tangential nozzle.
2. Demonstrate layout and fit-up of vessel and structural components.
3. Demonstrate the fabrication and assembly of davits and hinges.

SECTION FOUR:BOILERS, CONDENSERS, EXCHANGERS AND TANKS..... 111 HOURS**A. Trade Specific Mathematics 10 Hours****Outcome: *Solve mathematical problems associated with practical trade applications using the Imperial and Metric measurement systems.***

1. Solve mathematical problems associated with practical trade applications.

B. Boiler and Steam Generator Components 30 Hours**Outcome: *Describe boiler and steam generator components.***

1. Describe erection and assembly procedures for boiler components.
2. Describe the working operation of water tube boilers.
3. Describe boiler tube installation procedures.
4. Describe steam generator components.
5. Describe the principle of tube expansion.
6. Describe tube-expanding procedures.
7. Define the purpose of tack tubes.
8. Demonstrate tube removal and repair.

C. Condensers and Exchangers 30 Hours**Outcome: *Describe condensers and exchangers.***

1. Describe types and designs of exchangers.
2. Describe exchanger components, fabrication and assembly.
3. Describe tube installation.
4. Describe tube-expanding procedures and sequences for condensers and exchangers.
5. Describe tube hole arrangement.
6. Describe the reason for grooved seats.
7. Identify the factors affecting the quality of an expanded joint.
8. Perform calculations for tube expansion.

9. Perform tube rolling.
10. Describe alternate tube-expansion methods.
11. Describe the procedures for repairing defects to exchangers.
12. Describe proof-testing procedures.
13. Describe tube bundle removal methods and equipment.
14. Remove a tube bundle, inspect it and replace it.
15. Reassemble heat exchanger components.
16. Describe tube-plugging methods.
17. Describe repair and maintenance procedures of alternate types of heat exchangers.

D. Tanks 30 Hours

Outcome: Describe tanks and tank erection procedures.

1. Describe types of tanks and their components.
2. Describe the standards and different types of materials used to fabricate tanks.
3. Outline the scope of standards API 620, API 650 and API 653.
4. State the general condition of tank foundations and list negative effects encountered during erection due to uneven surfaces.
5. Describe tools and procedures specific to tank fabrication.
6. Describe tank floor designs.
7. Describe the process to layout and fit up a typical tank floor.
8. Describe joint preparation, fitting and welding sequences for tanks and tank components.
9. Describe tank roof designs.
10. Describe tank roof fabrication.
11. Describe how to inspect and test tank bottom, shell and roof using non-destructive methods.
12. Describe inspection requirements for small and large tanks.
13. Describe cathodic protection.
14. Demonstrate tank shell fitting techniques.
15. Demonstrate the ability to layout and erect tank scaffolding.
16. Demonstrate the ability to layout and erect the first shell ring.

E. Introduction to Heavy Industry 11 Hours

Outcome: Describe heavy industries related to the Boilermaker trade.

1. Describe the production of electricity by hydroelectric generation.
2. Describe the components in a hydroelectric generating station.
3. Describe practices used in the erection of penstocks and surge tanks.
4. Describe nuclear generation.
5. Describe the components in a nuclear generating station.
6. Describe special procedures used when working on nuclear plants and components.
7. Describe the production of pulp and paper.
8. Describe the components in a pulp and paper mill.

9. Describe methods of oil extraction and production.
10. Describe the components of oil production.
11. Describe other industries related to the boilermaker trade.



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