



**Skilled  
Trades**  
Ontario

**Métiers  
spécialisés**  
Ontario

Apprenticeship  
Curriculum Standard

Construction Boilermaker

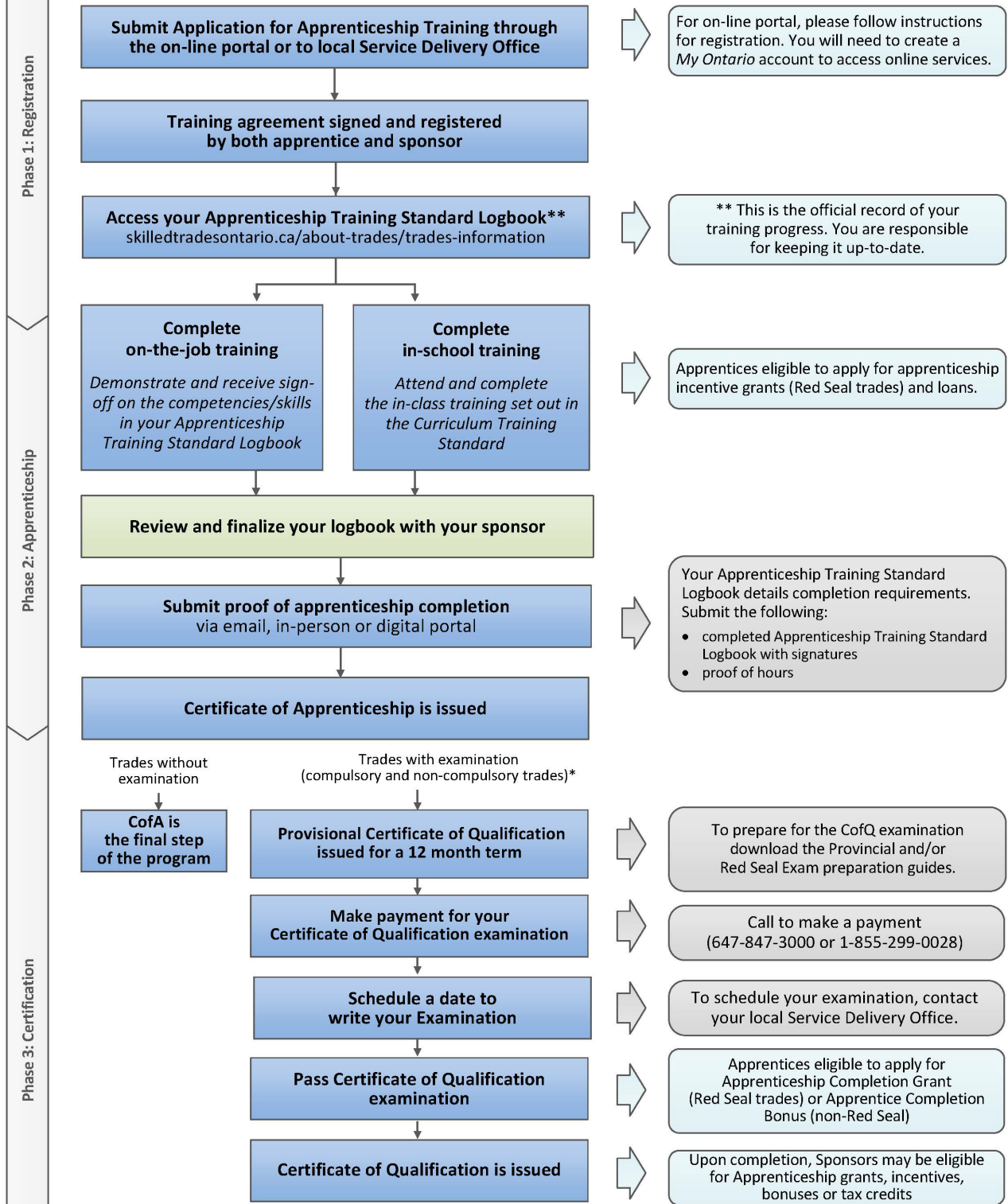
Level 1

428A

2008



# Apprenticeship Pathway to a Certificate of Qualification



\* For a list of trades subject to a certification examination, visit: [skilledtradesontario.ca](http://skilledtradesontario.ca)

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**Please Note:** This Standard has been revised to reflect the visual identity of Skilled Trades Ontario (STO) which replaced the Ontario College of Trades on January 1, 2022. The content of this Standard may refer to the former organization; however, all trade specific information or content remains relevant and accurate based on the original date of publishing.

Please refer to STO's website: [skilledtradesontario.ca](http://skilledtradesontario.ca) for the most accurate and up to date information. For information about BOSTA and its regulations, please visit [\*\*Building Opportunities in the Skilled Trades Act, 2021 \(BOSTA\)\*\*](#).

Any updates to this publication are available on-line; to download this document in PDF format, please follow the link: [Skilled Trades Ontario.ca](http://Skilled Trades Ontario.ca).

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*Maintained with transfer to Skilled Trades Ontario 2008 (V100)*

## **Preface**

This curriculum standard for the Construction Boilermaker trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

This is the first level of 3 levels of training. The Reportable Subjects Summary chart (located on page 3) summarizes the training hours for each reportable subject.

The curriculum identifies the learning that takes place in-school. The in-school program focuses primarily on the theoretical knowledge and the essential skills required to support the performance objectives of the Apprenticeship Training Standards.

Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on a work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to verify that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

Please refer to Skilled Trades Ontario website ([www.skilledtradesontario.ca](http://www.skilledtradesontario.ca)) for the most accurate and up-to-date information about Skilled Trades Ontario. For information on *Building Opportunities in the Skilled Trades Act, 2021 (BOSTA)* and its regulations, please visit [Building Opportunities in the Skilled Trades Act, 2021, S.O. 2021, c. 28 - Bill 288 \(ontario.ca\)](http://www.skilledtradesontario.ca/building-opportunities-in-the-skilled-trades-act-2021-s.o.-2021-c.-28-bill-288)

## **Pre-requisites**

In order to advance to Level 2 of the apprenticeship program, an individual must have completed all of the units outlined in Level 1. Similarly, in order to advance to Level 3 of the program, an individual must have completed all of the units outlined in Level 1 and 2.

## **Hours Disclaimer** (if applicable)

It is agreed that Training Delivery Agents (TDAs) may need to make slight adjustments (with cause) according to particular apprentice needs and may deviate from the unit sequencing and the prescribed practical and theoretical hours shown within the standard. However, all TDAs will comply with the hours at the reportable subject level.

## **Suggested Equipment for Training Delivery Agencies**

The listing of tools on page 47 and page 48 does not list minimum quantities based on the understanding that the delivering TDA is in the best position to determine the need based on its delivery methodology.

Personal and Safety Equipment: Personal protective equipment is at the discretion of the TDA who must conform to Ontario Provincial Health and Safety Regulations.

# Level 1

**Reportable Subject Summary – Level 1**

<b>Number</b>	<b>Reportable Subjects</b>	<b>Hours Total</b>	<b>Hours Theory</b>	<b>Hours Practical</b>
S0481	Plant Systems and Ancillary Components I	24	24	0
S0482	Trade Environment	21	18	3
S0483	Rigging and Hoisting I	27	23	4
S0484	Prints and Layouts I	63	59	4
S0485	Trade Tools and Equipment	39	17	22
S0486	Applied Trade Calculations I	15	15	0
S0487	Welding and Cutting I	51	19	32
	<b>Total</b>	<b>240</b>	<b>175</b>	<b>65</b>



Number:	S0481		
Title:	<b>Plant Systems and Ancillary Components I</b>		
Duration:	Total Hours: 24	Theory: 24	Practical: 0
Content:	S0481.1	Introduction to Pressure Vessels	
	S0481.2	Pressure Vessel Components and Fittings	

**Evaluation & Testing:**

Assignments related to theory and appropriate application skills  
Final exam at end of term  
Periodic quizzes

**Instructional and Delivery Strategies:**

Lecture and assignment work

**Reference Materials:**

Ashton, Bruce J., Garby, Ronald G., IPT's Metal Trades Handbook, IPT Publishing and Training Ltd. 1993.

**Recommended Minimum Equipment:**

- Overhead, VCR, DVD, Television, Chalkboard

Number:	S0481.1		
<b>Title:</b>	<b>Introduction to Pressure Vessels</b>		
Duration:	Total Hours: 8	Theory: 8	Practical: 0
Cross-Reference to Training Standard: 6010.01, 6010.02			

### General Learning Outcome

Upon successful completion the apprentice modular is able to describe the introductory fundamentals and function of pressure vessel systems in accordance with the government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes and Content

- 1.1 Identify the Boilermaker's involvement, safety hazards and safe working procedures in the identified heavy industry sites:
  - Nuclear generating stations
  - Hydro generating stations
  - Fossil fuel generating stations
  - Oil refineries
  - Pulp and paper mills
  - Steel plants
- 1.2 Identify water tube boilers with reference to the position of tubes and drums.
- 1.3 Identify the fire tube boiler with respect to the position of a furnace.
- 1.4 Explain the working principle of water tube and firetube boilers.
- 1.5 Describe the types of fired vessels.
- 1.6 Describe shell and tube sheet construction.
- 1.7 Identify boiler tubes.
- 1.8 Describe the function of a firebox.
- 1.9 Explain the purpose of stays.
- 1.10 Explain the purpose of buckstays.
- 1.11 Describe the scope and limitations of the ASME boiler and pressure vessel code.

- 1.12 Identify platforms, ladders, walkways and other typical structures related to boilers.
- 1.13 Describe the working principle of heat exchanger.
- 1.14 State the reason for heat exchanger baffles.
- 1.15 Explain heat exchanger sizing and type designation.
- 1.16 Describe shell and tube sheet construction.
- 1.17 Identify platforms, ladders, walkways and other typical structures related to heat exchangers.
- 1.18 Describe the working principle of distillation towers.
- 1.19 Identify platforms, ladders, walkways and other typical structures related to distillation towers.
- 1.20 Describe the basic types of storage tanks.
- 1.21 Identify platforms, ladders, walkways and other typical structures related to tanks.
- 1.22 Identify equipment used in basic tank erection.
- 1.23 Identify the safe and efficient basic tank erection practices.

**Summary of Recommended Equipment for Level 1**

- Overhead, VCR, DVD, Television, Chalkboard

Number:	S0481.2		
<b>Title:</b>	<b>Pressure Vessel Components and Fittings</b>		
Duration:	Total Hours: 16	Theory: 16	Practical: 0
Cross-Reference to Training Standard Performance Objectives: 6010.01, 6010.02			

### General Learning Outcome

Upon successful completion the apprentice is able describe the types, application and construction features of pressure vessels in accordance with the government safety regulations, manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes and Content

- 2.1 Identify selected pressure vessel components and describe their functions including:
- Heads
  - Manways
  - Nozzles
  - Davits
  - Trays,
  - Domes
  - Hand holes
  - Repads
  - Ductwork
  - Demisters
  - Vortex breakers
  - Catwalks and ladders
- 2.1 Describe the function of selected fittings:
- Vortex breaker
  - Demister
  - Repad
  - Plug
- 2.3 Describe the difference among pressure vessel heads.
- Elliptical
  - Dished
  - Hemispherical

- 2.4 Describe mounting of a Davit.
- Vertical opening
  - Horizontal opening.
- 2.5 Describe the shapes and minimum standard dimensions of hand-hole openings.
- 2.6 Calculate the minimum diameter used for a circular manhole opening.
- 2.7 Explain the use of a steam-dome and tray fittings.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
70%	0%	30%

Number:	S0482		
Title:	<b>Trade Environment</b>		
Duration:	Total Hours: 21	Theory: 18	Practical: 3
Content:	S0482.1	Communication	
	S0482.2	Apprenticeship Trade Unions and Product Information	

**Evaluation & Testing:**

Assignments related to theory and appropriate application skills.

Final exam at end of term.

Periodic quizzes.

**Instructional and Delivery Strategies:**

- Guest speakers from management, unions, workplace training, product representatives
- Guest speakers and plant tours (choice of some of the following):
  - steel fabrication shops (vessel and structural)
  - rolling mills (available types)
  - operational job sites (with permitting authority)
  - foundries (when and where time permits)
- Videos

**Recommended Minimum Equipment:**

- Computers
- Radio Communication Devices
- Phones

Number:	S0482.1		
<b>Title:</b>	<b>Communication</b>		
Duration:	Total Hours: 15	Theory: 12	Practical: 3
Cross-Reference to Training Standard Performance Objectives: 6013, 6004.03			

### General Learning Outcome

Upon successful completion the apprentice is able to apply effective communication techniques using communication media related to apprenticeship, trade unions and product information in the boilermaker trade.

### Learning Outcomes and Content

- 1.1 Write a letter of application for employment.
- 1.2 Identify types of work-orders and their content.
  - Quantity and quality of product,
  - Customer I.D
  - Graphic support
  - Time and material availability
  - Responsibilities
- 1.3 Interpret and explain technical –administrative procedures.
- 1.4 Describe the trade related documents.
  - Invoices
  - Purchase orders
  - Shipping and receiving slips
  - Requisition orders
  - Accounts payable
  - Personal and company cheques
- 1.5 Use communication media used between management and workers.
  - Computer
  - Phone
  - Radio Communication

- 1.6 Demonstrate effective communication with co-workers.
- Apply active listening techniques
  - Apply problem solving techniques
  - Manage conflict
  - Identify relevant Mentoring and Coaching Skills
- 1.7 Write a brief report on the following topics.
- Outline the progress of a fabrication or assembly project
  - Job Safety Analysis (JSA)



Number:	S0482.2		
<b>Title:</b>	<b>Apprenticeship, Trade Unions and Product Information</b>		
Duration:	Total Hours: 6	Theory: 6	Practical: 0
Cross-Reference to Training Standard: 6003.03, 6010.01, 6010.02, 6013			

### General Learning Outcome

Upon successful completion the apprentice is able to explain information related to apprenticeship, trade unions and product environment in the boilermaker trade.

### Learning Outcomes and Content

- 2.1 Explain the role of management and production representatives.
- 2.2 Define the role and mission of the Labour Union organization.
- 2.3 Describe major role and responsibilities of the Service Delivery Branch, Programs Branch and Regional offices.
- 2.4 Identify production environments among local metal fabrication and assembly shops.
- 2.5 Assess the capabilities and specifications of machinery and metal fabrication and assembly shops.
- 2.6 Identify and describe an erection site at a typical power generating plant.
- 2.7 Describe the assembly sequences involving the erection of a power boiler as observed during the excursion tour.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
65%	5%	30%

Number:	S0483		
Title:	<b>Rigging and Hoisting I</b>		
Duration:	Total Hours: 27	Theory: 23	Practical: 4
Content:	S0483.1	Wire Rope and Block and Tackle	
	S0483.2	Work Platforms, Scaffolding and Fall Arrest Systems	
	S0483.3	Hand Signals	

**Evaluation & Testing:**

Assignments related to theory and appropriate application skills.

Final exam at end of term.

Periodic quizzes.

**Recommended Minimum Equipment:**

- Wire rope and block and tackle
- Fall arrest System

Number:	S0483.1		
<b>Title:</b>	<b>Wire Rope and Block and Tackle</b>		
Duration:	Total Hours: 15	Theory: 11	Practical: 4
Cross-Reference to Training Standard: 6009.01, 6009.02, 6009.03, 6009.04			

### General Learning Outcome

Upon successful completion the apprentice is able to explain and practice general rigging including wire rope, and block and tackle, formulas for safe working loads, and slings and chokers according to government safety regulations and manufacturer's recommendations and specifications.

### Learning Outcomes and Content

- 1.1 Identify Inside Diameter (I.D.) of:
  - Hooks
  - Clips
  - Shackles
- 1.2 Name types of wire rope clips.
- 1.3 Using formula, determine the number of clips required.
- 1.4 State the differences of shackle pin diameter and size of its bow.
- 1.5 Determine the types of loading recommended for shoulderless eye bolts.
- 1.6 Use formulas to calculate the working load limits for all parts.
- 1.7 Define the design significance of Grommet Slings.
- 1.8 Describe the preferred application for a Double Wrap Basket Hitch.
- 1.9 Determine the centre of gravity for types of loads.
  - Structural members of a different designation,
  - Regular plates
  - Irregular shapes of plates
  - Assemblies
- 1.10 Define the choker stress formula.
- 1.11 Apply the Working Load Limit (W.L.L.) to various load and sling configurations.

- 1.12 Use slings, chokers and general rope hardware tables and charts.
- 1.13 Identify and perform knot tying and splicing procedures.
- 1.14 Describe the introductory information for cranes as applied to rigging of wire rope and block and tackle.
- 1.15 Determine the Working Load Limit (W.L.L.) that can be lifted with a given rigging arrangement.

Number:	S0483.2		
Title:	<b>Work Platforms, Scaffolding and Fall Arrest Systems</b>		
Duration:	Total Hours: 6	Theory: 6	Practical: 0
Cross-Reference to Training Standard:	6001.01, 6001.02, 6001.03, 6001.04		

## General Learning Outcome

Upon successful completion the apprentice is able to explain the use of ladders, scaffolding and work platforms in accordance with government safety regulations, manufacturer's recommendations and specifications and approved Industry Standards.

## Learning Outcomes and Content

- 2.1 Describe the fundamentals of using ladders.
- Ladder angle limits
  - Ensure secure footing
  - Determine the required height
  - Define correct positioning
  - Guard area in vicinity of ladder
  - Tie-off the ladder as required
  - Load limits
  - Maintenance and storage
  - Materials used to construct ladders
  - Code reference: OHS A
  - Canadian Standards Association (C.S.A) Certification and Duty Ratings
- 2.2 Explain the fundamentals of using scaffolding.
- OHS A requirements (construction)
  - Identify when scaffolding requires engineering
  - Methods of assembly and disassembly
  - Recognizing hazards and obstructions
  - Leveling
  - Bracing and tying-off
  - Guarding the work area
  - Installing the planking and railings
  - Personal protective equipment
  - Recognize load limits

- Inspect scaffolding
- Perform maintenance
- Storage of scaffolding and planks
- Code reference: OHSA

2.3 Explain the fundamentals of work platforms.

- Assembly and disassembly procedures
- Overhead protection requirements
- Maintain logbook of inspections, problem/repairs
- Guard work area
- Use of railings and kickboards
- Personal protective equipment
- Check working load limits
- Inspect work platforms for damaged materials
- Maintain work platforms
- Use recommended storage methods
- Code reference: OHS Act Chap. O.1 Section 31

2.4 Describe the features and use of a Fall Arrest System.

- Fall Arrest Equipment
  - Full body harness
  - Web lanyard
  - Shock absorber
  - Rope grab
  - Lifeline and anchor
  - Locking snap hooks
  - CSA Standards
- Use of Fall Arrest Equipment
  - Protection from falls above 3 meters
  - Snug fitting
  - Use all hardware and straps correctly fastened
  - Use of recommended fall lines
  - Specified attachment and anchoring of fall lines
  - Recommended maintenance and storage of fall arrest system

Number:	S0483.3		
Title:	<b>Hand Signals and Radio Communication Signals</b>		
Duration:	Total Hours: 6	Theory: 6	Practical: 0
Cross-Reference to Training Standard:	6009.02		

### General Learning Outcome

Upon successful completion the apprentice is able to explain and perform the International Standards of Hand Signals and describe audio communication signals for hoisting operations in accordance with Construction Safety Association of Ontario (CSAO) guidelines.

### Learning Outcomes and Content

- 3.1 Identify the Construction Safety Association of Ontario (CSAO) hand signals for hoisting operations.
- Load up
  - Load down
  - Load up slowly
  - Load down slowly
  - Boom up
  - Boom down
  - Boom down slowly
  - Boom up load down
  - Boom down load up
  - Everything slowly
  - Use whip line
  - Use main line
  - Travel forward
  - Turn right
  - Turn left
  - Shorten hydraulic boom
  - Extend hydraulic boom
  - Swing load
  - Stop
  - Close clam
  - Open clam
  - Dog everything

3.2 Explain and perform the CSAO hand signals for hoisting operations.

- Load up
- Load down
- Load up slowly
- Load down slowly
- Boom up
- Boom down
- Boom down slowly
- Boom up load down
- Boom down load up
- Everything slowly
- Use whip line
- Use main line
- Travel forward
- Turn right
- Turn left
- Retract hydraulic boom
- Extend hydraulic boom
- Swing load
- Stop
- Close clam
- Open clam
- Close clam
- Open clam
- Dog everything

3.3 Explain the application of bell, horn and radio audio communication signals.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
70%	0%	30%



Number:	S0484		
Title:	<b>Prints And Layouts I</b>		
Duration:	Total Hours: 81	Theory: 77	Practical: 4
Content:	S0484.1	Basic Drafting	
	S0484.2	Introduction to Layout	
	S0484.3	Basic Materials	

**Evaluation & Testing:**

Assignments related to theory and appropriate application skills.

Final exam at end of term.

Periodic quizzes.

**Instructional and Delivery Strategies:**

Lecture and assignment work with welding procedures and codes.

**Reference Materials:**

Jacobs, Grant E., IPT's Guide to Blueprint Interpretation IPT Publishing and Training Ltd. 2001 and revised in 2003.

Ashton, Bruce J., Garby, Ronald G., IPT's Metal Trades Handbook, IPT Publishing and Training Ltd. 1993.

**Recommended Minimum Equipment:**

- Drafting tables, chairs, t-squares
- Pipe cutting equipment
- Pipe threading equipment

Number:	S0484.1		
<b>Title:</b>	<b>Basic Drafting</b>		
Duration:	Total Hours: 27	Theory: 27	Practical: 0
Cross-Reference to Training Standard: 6003.01, 6003.02			

### General Learning Outcome

Upon successful completion the apprentice is able to interpret and correlate information from prints including material, identification of parts, orientation and layout of structure or parts of a structure, using drafting techniques.

### Learning Outcomes and Content

- 1.1 Develop construction print drawing principles using drafting equipment.
- 1.2 Read drawings, prints or sketches and fold and protect them for use.
- 1.3 Read and interpret the use of signs, symbols and abbreviations as may be required.
- 1.4 Identify line types and uses; analyze the lettering and where it is used relative to the associated terminology.
- 1.5 Identify the correct placement of dimensions applying the unidirectional system.
- 1.6 Recognize the style of lettering with reference to sizing and placement.
- 1.7 Describe title block, scale, contract numbers, section same and different sheets, revisions, parts and identification marking
- 1.8 Give the main reason for a sectional view.
- 1.9 Explain the terms cutting-plane line and section lining.
- 1.10 List three types of sections.
- 1.11 List two requirements for a multi-view projection.
- 1.12 Give examples of parts, which need one or two views only.
- 1.13 State the difference between a primary and secondary auxiliary views.
- 1.14 Define the right and left hand views.

- 1.15 Name two advantages for using partial views.
- 1.16 Define the principle of orthographic projection.
- 1.17 Explain the principle and applications of an isometric projection.
- 1.18 Describe materials and techniques used in freehand sketching.
- 1.19 Sketch information freehand to convey to other workers, how to produce subject items.
- identify available materials and techniques used
  - identify subject items such as small tanks, frames, stands, brackets
- 1.20 Identify the signs, symbols and abbreviations on drawings compiled from C.S.A./A.S.A Standards and used on fired or unfired pressure vessels and storage tanks.
- identify materials preparation, structural and plate, vessels, tank, power boilers, heat exchangers, precipitators
- 1.21 Interpret basic welding symbols and abbreviations:
- identify weld, supplementary symbols, specifications, groove and weld dimensions, contour, method of finish, single and double breaks in arrow line, standard rules for reading welding symbols, location of symbols on drawings

Number:	S0484.2		
<b>Title:</b>	<b>Introduction to Layout</b>		
Duration:	Total Hours: 18	Theory: 18	Practical: 0
Cross-Reference to Training Standard: 6003.01, 6003.02			

## General Learning Outcome

Upon successful completion the apprentice is able to describe and develop layouts for basic geometry and simple plate structure in accordance with manufacturer's recommendations and approved industry standards.

## Learning Outcomes and Content

2.1 Identify, select and use types of basic measuring, checking and layout tools.

- Standard features
- Design characteristics
- Maximum obtainable accuracy
- Applications
- Correct method of use
- Correct handling
- Storage and maintenance procedures
- Required conditions of use

2.2 Perform basic geometrical constructions.

- Construct a line segment equal to a given line segment
- Construct an angle to a given angle
- Bisect a given angle, layout 30, 45, 60, degree angles
- Construct a line perpendicular to a given line through a given point on the line
- Bisect a given line segment
- Construct a line perpendicular to a given line through a given point outside the line
  - inscribe a circle in a given triangle
  - construct regular polygons with any number of flats
  - inscribe and circumscribe regular polygons
  - layout an angle
  - inscribe a given radius into right angle, acute angle and obtuse angle turns
  - bisect a given arc
  - construct an ellipse using three different methods

- 2.3          Develop a layout using basic geometric constructions on plate.
- 2.4          Develop a layout for the geometric construction of bolt circles, manholes, flanges and ellipses.

Number:	S0484.3		
<b>Title:</b>	<b>Basic Construction Materials</b>		
Duration:	Total Hours: 18	Theory: 14	Practical: 4
Cross-Reference to Training Standard: 6007.01, 6008.01, 6008.02			

### General Learning Outcome

Upon successful completion the apprentice is able to describe the features of basic construction materials used to fabricate pressure vessels and cut and thread pipe according to government regulations, manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes and Content

- 3.1 Identify structural shapes by their respective designations.
- 3.2 Explain specific dimensions of parts of structural shapes as per the designations.
- 3.3 Explain the meaning of nominal dimensions.
- 3.4 Explain the information, which must be given when ordering wide flange beams.
- 3.5 Explain the meaning of the terms camber and sweep.
- 3.6 Identify structural shapes.
  - HSS 101.6 x 101.6 x 7.95, W610 x 113, 18 x 42.7, S12 x 35
- 3.7 Define the classification of a steel plate with reference to thickness and width.
- 3.8 Describe the designations of a carbon steel plate.
  - ASTM A-285, CSA G40.21/M, ASTM A-283, A36, A515, A516
- 3.9 Explain the purpose and applications of clad steel and other cladding materials.
- 3.10 Identify and select welded bar gratings used for stairways and platforms.
  - Identify and select an expanded mesh and expanded mesh grating by its standard sizing.

- 3.11 Identify and differentiate the designation as applied for pipe and tube.
- 3.12 Describe the pipe schedules with reference to the old and new designation.
- 3.13 Differentiate between the imperial and metric designation of pipe.
- 3.14 Explain the difference among the following ASTM material designations.
- ASTM A53 and ASTM A120, and ASTM A106
- 3.15 Cut pipe to size using a pipe cutter and/or oxy/fuel cutting process.
- 3.16 Thread pipe using manual and mechanical process.
- 3.17 Identify NPT and NPS standard designation.
- 3.18 Define the terms bolt, stud and screw.
- 3.19 Describe threaded fasteners.
- Fixed fasteners
  - Aligning fasteners
- 3.20 Interpret nut and bolt markings.
- Physical properties
  - Type of material
- 3.21 Describe bolt grading.
- Select bolt grading as designated by SAE, ASTM and CSA
- 3.22 Identify standard designations for bolts.
- M20 x 2.5
  - 3/8 – 16NC
  - ASTM A325M
  - ASTM A490
- 3.23 Determine the bolt threads length for bolts and screws up to 6 inches in length.
- 3.24 Determine the wrench sizes with related reference to the bolt major diameter.
- 3.25 Identify selected standard thread.
- 9/16 – 18 UNF-2B
  - 1 3/4 - 15 UN-2A
  - M30 x 3

- 3.26 Describe the differences between the American Standard Unified Thread and the Metric Thread.
- 3.27 Identify pipe fittings and describe their function.
- Nozzles
  - Couplings, tees
  - Elbows
  - Flanges (including slip-on and welding neck)
  - Blanking plates, plugs, valves
- 3.28 List the pressure ratings used for forged steel flanges.
- 3.29 Identify standard designations for
- 4"-LWNRF-300#
  - 3"-S.O.F.-600#
  - 90°-2"-LRE
- 3.30 Explain the meaning of a specification given as short radius elbow.
- 3.31 Name the valve used to prevent backflow.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
70%	0%	30%



Number:	S0485		
<b>Title:</b>	<b>Trade Tools and Equipment</b>		
Duration:	Total Hours: 39	Theory: 17	Practical: 22
Content:	S0485.1	Basic Hand Tools	
	S0485.2	Instruments	
	S0485.3	Power Tools (Electric and Pneumatic)	
	S0485.4	Shop Equipment	

**Evaluation & Testing:**

Assignments related to theory and appropriate application skills.

Final exam at end of term.

Periodic quizzes.

**Reference Materials:**

Use of material samples and manufacturer's specifications (CD's, manuals, and internet)

**Recommended Minimum Equipment:**

- Spirit level
- Plumb bob
- Wrenches
  - spud wrench
  - sockets and extension drives
  - adjustable
  - combination
  - box end
  - set screw
  - torque
  - pipe
- Common hand tools,
  - clamps
  - bolt cutters
  - hacksaws
  - files
- punches and pins
  - connecting bar
  - bull pins
  - alignment bars
  - drift pins
  - centre punch
  - prick punch

- Squares
- Scribes,
- Dividers
- Chalk line
- Vises
- Trammel points
- Measuring tools
- Power tools (hand drills, electric grinders, air grinders, pedestal grinders, pneumatic chipping hammers)
- Disk grinder.
- Transit, instrument, stick, water level.
- Portable power tools (drills and reamers, tube expanders, wrenches, hammer drills, pipe threading and cutting equipment.
- Chisels, drills, bits, pedestal grinders, safety equipment.

Number:	S0485.1		
Title:	<b>Basic Trade Tools</b>		
Duration:	Total Hours: 19	Theory: 9	Practical: 10
Cross-Reference to Training Standard: 6000.01, 6000.02, 6000.03, 6000.04			

### General Learning Outcome

Upon successful completion the apprentice is able to operate and maintain basic hand tools according to government safety regulations, manufacturer's recommendations and approved industry standards.

### Learning Outcomes and Content

On successful completion, the apprentice is able to:

- 1.1 Describe the safe operation and maintenance of hand tools.
- Spirit level
  - Plumb bob
  - Sockets and extension drives
  - Wrenches
    - structural offset -spud wrench
    - adjustable
    - combination
    - open end
    - box end
    - set screw – Allen
    - torque
    - pipe
  - Hammers
  - Chisels (sharpening, removal of mushroomed or fractured head)
  - Screw driver
  - Pliers
  - Clamps
  - Bolt cutters
  - Hacksaws
  - Files
  - Punches and pins
    - Connecting bar
    - bull pins
    - line up bars -drift pins
    - centre punch
    - prick punch

- Squares scribes
  - Dividers
  - Chalk line
  - Vises
  - Trammel points
  - Measuring tools
- 1.2 Recognize safety hazards related to general shop safety.
- 1.3 Perform operations in a safe manner in accordance with the Health and Safety Act and the rules and regulations of specific facilities.
- 1.4 Safely operate and maintain power tool.
- Hand drills
  - Electric grinders
  - air grinders
  - Pedestal grinders
  - Pneumatic chipping hammers
- 1.5 Safely and efficiently operate pneumatic (air) and/or electrically powered portable and stationary drilling equipment.
- 1.6 Identify and use twist drills.
- 1.7 Operate and maintain reaming equipment.
- 1.8 Use and maintain threading equipment for the production of internal and external threads.
- 1.9 Use a disc grinder.
- Clean torch-cut edges
  - Remove tacks/scabs
  - Cut off discs
  - Using wire brush remove layers of paint, rust
  - Sand
- 1.10 Mount grinder wheels on a pedestal and portable grinder.
- 1.11 Perform selected operations using a grinder.
- Grind carbon steel of various shapes to remove metal, scale, slag and burrs.
  - Regrind chisels, punches, screw drivers and drifts to the correct size and geometry.
  - Buff surfaces.
- 1.12 Use powder actuated tools.
- 1.13 Demonstrate precision measuring using a micrometer (Metric and Imperial).

Number:	S0485.2		
<b>Title:</b>	<b>Instruments</b>		
Duration:	Total Hours: 8	Theory: 2	Practical: 6
Cross-Reference to Training Standard: 6000.01, 6000.04, 6003.04			

### **General Learning Outcome**

Upon successful completion the apprentice is able to perform measurements with instruments according to job requirements, manufacturer's recommendations and specifications.

### **Learning Outcomes and Content**

- 2.1 Set up transit and tripod.
  - Connect transit to tripod
  - Set up over a given point
  - Level and focus
  
- 2.2 Using a transit, measure elevation, distance, vertical angle, horizontal angle (triangulate)
  
- 2.3 Demonstrate and transfer elevation points using a water level.

Number:	S0485.3		
Title:	<b>Power Tools (Electric and Pneumatic)</b>		
Duration:	Total Hours: 4	Theory: 2	Practical: 2
Cross-Reference to Training Standard:	6000.03		

### General Learning Outcome

Upon successful completion the apprentice is able to describe and use portable power tools according to government safety regulations, manufacturer's recommendations and approved industry standards.

### Learning Outcomes and Content

- 3.1 Describe the safe use of selected portable power tools.
- Drills and reamers
  - Tube expanders (identification only)
  - Impacts (wrenches and hammer drills)
  - Pipe threading and cutting equipment
- 3.2 Use selected portable power tools following the recommended safety procedures.
- Drills and reamers
  - Tube expanders (identification only)
  - Impacts (wrenches and hammer drills)
  - Pipe threading and cutting equipment

Number:	S0485.4		
<b>Title:</b>	<b>Shop Equipment</b>		
Duration:	Total Hours: 8	Theory: 4	Practical: 4
Cross-Reference to Training Standard: 6000.01, 6000.02, 6000.03, 6003.04			

### General Learning Outcome

Upon successful completion the apprentice is able to describe the construction features and demonstrate the safe use of shop equipment according to government safety regulations, manufacturer's recommendations.

### Learning Outcomes and Content

- 4.1 Describe types of drilling machines.
- 4.2 Describe set-up procedures for drilling machines.
  - list set-up procedures
- 4.3 Describe drills and drilling tools.
  - identify drills and drilling tools
- 4.4 Describe drill bit geometry and sharpening procedures.
- 4.5 Determine drilling speeds and feeds.
- 4.6 Sharpen drill bits.
- 4.7 Set up a drill press and drill multi-diameter holes
  - Drill multi-diameter holes from 1/8" to 2" to an accuracy of 1/32".
- 4.8 Perform selected operations on an Ironworker.
  - Set up and punch holes in plate, angles, channels and I beams
  - Shear angles at 45° and 90° with heel inside and outside
  - Shear flat bar, rounds and square bar
  - Notch and cope plate and structural shapes
  - Cut to an accuracy of 1/16" for length and within 2° for angle cuts
- 4.9 Determine the correct methods of positioning dies for specific operations.
- 4.10 Describe the construction features and application of powder actuated tools.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
30%	40%	30%



Number:	S0486		
<b>Title:</b>	<b>Applied Trade Calculations I</b>		
Duration:	Total Hours: 15	Theory: 15	Practical: 0
Content:	S0486.1 Basic Mathematics		

**Evaluation & Testing:**

Assignments related to theory and appropriate application skills.

Final exam at end of term.

Periodic quizzes.

**Reference Materials:**

Use of material samples and manufacturer's specifications (CD's, manuals, and internet)

Number:	S0486.1		
<b>Title:</b>	<b>Basic Mathematics</b>		
Duration:	Total Hours: 15	Theory: 15	Practical: 0
Cross-Reference to Training Standard: 6003.01, 6007.01			

### General Learning Outcome

Upon successful completion the apprentice is able to apply basic mathematics to solve trade related problems according to the specifications for specific pressure system applications.

### Learning Outcomes and Content

- 1.1 Solve problems applying mathematical principles.
  - Addition
  - Estimating
  - Subtraction
  - Multiplication
  - Division
  - Perform order of operation
  
- 1.2 Solve problems applying the principles:
  - Whole numbers
  - Decimal numbers
  - Fractional numbers
  - Mixed numbers
  
- 1.3 Compute perimeters of selected shapes.
  - Rectangles
  - Squares
  - Triangles
  - Circles
  
- 1.4 Solve linear measurement problems.
  
- 1.5 Perform arithmetic operations with length.
  
- 1.6 Perform arithmetic operations with weights and capacities.
  
- 1.7 Perform arithmetic operations with volumes.

- 1.8 Express units of area measure.
- 1.9 Express units of volume measure.
- 1.10 Perform combining calculation on practical applications using various units of measure.
- 1.11 Use basic geometry to explain the use of transits.
- 1.12 Compute conversions from Imperial to Metric and visa versa.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
70%	0%	30%

Number:	S0487		
Title:	<b>Welding and Cutting I</b>		
Duration:	Total Hours: 54	Theory: 19	Practical: 32
Content:	S0487.1	Flame Cutting	
	S0487.2	Shielded Metal Arc Welding	
	S0487.3	Basic Metallurgy	

**Evaluation & Testing:**

Assignments related to theory and appropriate application skills.

Final exam at end of term.

Periodic quizzes.

**Reference Materials:**

Use of material samples and manufacturer's specifications (CD's, manuals, and internet)

Number:	S0487.1		
<b>Title:</b>	<b>Flame Cutting</b>		
Duration:	Total Hours: 20	Theory: 4	Practical: 16
Cross-Reference to Training Standard: 6005.01			

### General Learning Outcome

On successful completion, the apprentice is able to perform cutting on mild steel using oxyacetylene equipment according to government safety requirements, manufacturer's recommendations and approved industry standards.

### Learning Outcomes and Content

- 1.1 Describe the construction and sizes of oxygen and acetylene cylinders.
- 1.2 Explain the procedure for handling, transporting and storing cylinders and handling faulty cylinders.
- 1.3 Explain the construction and purpose of a manifold system.
- 1.4 Select correct fuel gases for manual and automatic flame cutting of carbon steel.
  - identify fuel gases used
- 1.5 Describe the purpose of a regulator.
- 1.6 Describe the basic construction and pressures involved for a single stage and double stage regulator.
- 1.7 Explain, adjust and balance regulators.
- 1.8 Explain the construction of hoses and the procedure for repair and maintenance.
  - Identify types and application of hoses and fittings
  - Describe the construction features of hoses and fittings
  - Describe the repair procedures for hoses and fittings
- 1.9 Describe the design, construction and operating principles of cutting tips.
- 1.10 Describe, select and maintain tips.
- 1.11 Explain how to place and secure cylinders.

- 1.12 Explain how to clear and check cylinder valves.
- 1.13 Attach regulators safely and correctly.
- 1.14 Attach hoses and explain reason for cleaning new hoses.
- 1.15 Attach the barrel and tip.
- 1.16 Explain the procedure for checking for leaks.
- 1.17 Check to ensure regulators used for correct purpose.
- 1.18 Demonstrate safe set-up procedures.
- 1.19 List the reasons for backfires and flashbacks.
- 1.20 Define flame propagation.
- 1.21 Ignite the torch using the recommended striker.
- 1.22 Explain and demonstrate the types of flames and uses.
- 1.23 Demonstrate the shut down process.
  - list procedure for shut down
- 1.24 Perform cutting procedures for:
  - Manual straight line and bevel cutting on plate steel.
  - Manual cuts on various structural steel shapes
  - Manual circle cutting
  - Manual hole piercing
  - Manual radial cutting
- 1.25 Perform removal of weldments/bolts using oxy-acetylene cutting equipment.
  - Bolt head
  - Lifting lug

Number:	S0487.2		
<b>Title:</b>	<b>Shielded Metal Arc Welding</b>		
Duration:	Total Hours: 20	Theory: 4	Practical: 16
Cross-Reference to Training Standard:	6006.01, 6006.02, 6006.03, 6006.04, 6006.05		

### **General Learning Outcome**

On successful completion, the apprentice is able to perform Shielded Metal Arc Welding procedures on pressure vessels and related components according to the ASME – Boiler and Pressure Vessel Code requirements and in accordance with a Welding Procedure Specification (WPS).

### **Learning Outcomes and Content**

- 2.1 Define open circuit and arc voltage.
- 2.2 Define alternating current and direct current.
- 2.3 Define resistance.
- 2.4 Explain duty cycle.
- 2.5 Define reverse and straight polarity.
- 2.6 Explain the heat distribution using reverse or straight polarity.
- 2.7 Explain voltage loss.
- 2.8 Describe the basic components and operation of an alternating current transformer.
- 2.9 Describe the basic components and operation of an A.C. – D.C. rectifier.
- 2.10 Describe the basic component and operation of an A.C. generator.
- 2.11 List the advantages and disadvantages of the various types of welding machines.
- 2.12 Explain the maintenance required for welding machines.
- 2.13 Describe cable construction and sizing.
- 2.14 Describe the types of electrode holders and the maintenance required.

- 2.15 Describe cable lugs, quick connectors, and ground clamps.
- 2.16 Describe the controls on a welding machine.
- 2.17 Explain the arc characteristics in relation to the different voltage and amperage settings.
- 2.18 Explain the numerical definitions of electrodes.
- 2.19 Interpret from drawings joint edge preparation requirements and joint tolerances.
- 2.20 Weld stringer beads.
- Weld on mild steel in the flat position, using E6010 and E7018 filler material, with 1/8, and 5/32 rod.
- 2.21 Weld lap joints.
- Weld on mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8, and 5/32 rod.
- 2.22 Weld butt joints.
- Weld on mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8, and 5/32 rod.
- 2.23 Weld tee joints.
- Weld on mild steel, in the flat position, using E6010, E7024 and E7018 filler.
- 2.24 Weld corner joints.
- Weld on mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8 and 5/32 rod.
- 2.25 Perform a fillet weld to install a metal pad.
- Weld a metal pad on 3/8" (9mm) mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8, and 5/32 rod.
- 2.26 Perform a fillet weld using a weaving pattern.
- Apply crescent, figure 8, and rotary motion
  - Create weaving pattern on mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8, and 5/32 rod.



- 2.27 Perform a single pass fillet weld.
- Weld on mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8, and 5/32 rod.
- 2.28 Perform a multiple pass fillet weld.
- Weld on mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8, and 5/32 rod.
- 2.29 Perform a single pass corner joint weld.
- Weld on mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8, and 5/32 rod.
- 2.30 Perform a multiple pass corner joint weld.
- Weld on mild steel, in the flat position, using E6010, E7024 and E7018 filler material, with 1/8 and 5/32 rod.
- 2.31 Demonstrate safe welding procedures.

Number:	S0487.3		
Title:	<b>Basic Metallurgy</b>		
Duration:	Total Hours: 8	Theory: 8	Practical: 0
Cross-Reference to Training Standard:	6006.04, 6007.04, 6007.05		

### General Learning Outcome

On successful completion, the apprentice is able to explain physical and mechanical metallurgy, including elements of materials, production processes, properties, and types of steel according to manufacturer's recommendations and specifications and approved industry standards.

### Learning Outcomes and Content

- 3.1 Describe the production of carbon steel, alloy steel and stainless steel with reference to furnaces in which they are produced.
- Basic oxygen furnaces
  - Open hearth furnaces
  - Electric furnaces
  - Induction furnaces
  - Vacuum furnaces
- 3.2 List the five elements, which are always present in steel.
- 3.3 Describe the significance of carbon in steel.
- 3.4 Describe the function of carbon, manganese, sulphur and silicon in steel.
- 3.5 Describe the effects of carbon and the other elements on the physical properties of steel and weld ability of steel.
- 3.6 Differentiate between ferrous and non-ferrous metals.
- 3.7 Describe the operation of a blast furnace and production of pig iron.
- 3.8 Describe the production of cast iron in the Cupola furnaces and the uses of cast iron.
- 3.9 Describe the characteristics of killed steel, rimmed steel and cast steel.

- 3.10 Define mechanical properties and selected physical properties of plain carbon steel:
- Define mechanical properties such as stress, strain, elasticity, ductility, toughness, yield point, yield strength, tensile strength, compression strength, elastic limit, brittleness, malleability, impact strength, elongation, torsion strength
  - Define physical properties such as colour, melting point, density, weight density, heat and electrical conductivity, coefficient of thermal expansion, specific heat, corrosion resistance
- 3.11 Describe how the amount of carbon in ferrous material determines whether a material is steel or a cast iron.
- 3.12 Describe how the amount of carbon in ferrous material determines whether a material is steel or a cast iron.
- 3.13 Name the five basic types of steels.
- 3.14 Explain how low-alloy, high-tensile steels differ from low carbon steels.
- 3.15 Determine the main advantage of low-alloy steel.
- 3.16 Describe the significance of AISI, ASTM and CSA steel designation systems.
- 3.17 Describe the applications of types of steel for a specific use.

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
30%	40%	30%

## APPENDIX A: Tools and Equipment List

Power Sources and Equipment		Quantity
SMAW (CC) (AC/DC) power source and equipment		1 per apprentice
Oxygen-fuel-acetylene/propane manual cutting equipment		1 per apprentice
Oxy-fuel-acetylene/propane semi-automatic cutting equipment		1 per 5 apprentices
Oxy-fuel-acetylene/propane heating torch and equipment		1 per 5 apprentices
Approved electrode storage oven		1 per shop
Compressed air supply (80-100 psi.)		1 per shop
Fabrication Machines		(1 each per shop)
Band saw	Weld-coupon bending apparatus	
Nibbler	Approved smoke extraction/air make-up unit	
Ironworker		
Pedestal grinders	Welding and fabricating shops must be well lit, appropriately heated and ventilated	
Cut-off abrasive wheel saw		
Weld-bevel preparation equipment for plate and pipe		
Basic Hand Tools and Equipment	Tool Crib to Cover Class Size	
Adjustable wrenches (various sizes)	Pliers (needle nose, slip joint)	
Allen wrenches (metric and imperial)	Positioners	
Bench vice	Pry bars	
Clamps (various sizes)	Punches	
Chalk-line	Screwdrivers (slot, Phillips, Robertson, various sizes)	
Cold chisels (various sizes)	Scribers	
Electric extension cords	Snips (heavy duty sheet metal cutting)	
Files (flat, half-round, rat-tail, bastard)	Soapstone markers	
Friction lighter	Socket sets (metric and imperial)	
Grinders, grinding and sanding disks (for carbon steel, aluminum and stainless steel)	Temperature indicating crayons	
Hacksaw	Tip cleaners	
Hammers (chipping, ball peen, claw, sledge, various sizes)	Toolboxes	
Hand shears	Tungsten sharpening grinders	
Layout table	Vice grips (various sizes and types)	
Magnets	Wire brushes (for carbon steel, aluminum and stainless steel)	
Metal markers	Wire cutters	
Pipe clamps	Work bench	
Pipe cutter	Wrench sets (open and closed ends, both metric and imperial)	
Pipe wrenches		

<b>Measuring Tools</b>	<b>Tool Crib to Cover Class Size</b>
Drafting equipment	Square
Combination square	Straight edge
Fillet gauges	Scriber
Spirit level	Micrometer
Vernier caliper	Tape measure

<b>Safety Equipment</b>	<b>Tool Crib to Cover Class Size</b>
Earplugs and muffs	Leather gloves
Face shields	Leather jackets
Fire blankets	Masks (particle, vapour)
Fire extinguishers	Respirators
Goggles	Safety glasses
Leather aprons	



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