SKILLEDTRADES BC

PROGRAM OUTLINE

Metal Fabricator (Fitter)

The latest version of this document is available in PDF format on the SkilledTradesBC website
www.skilledtradesbc.ca

To order printed copies of Program Outlines
or learning resources (where available)
for BC trades contact:

Crown Publications, Queen's Printer
Web: www.crownpub.bc.ca
Email: crownpub@gov.bc.ca
Toll Free 1 800 663-6105

SKILLED TRADES BC

METAL FABRICATOR (FITTER)
HARMONIZED PROGRAM OUTLINE

APPROVED BY INDUSTRY

OCTOBER 2016

BASED ON

NOA 2012

AND

CCDA HARMONIZATION

RECOMMENDATIONS 2015

Developed by
SkilledTradesBC
Province of British Columbia

TABLE OF CONTENTS

Section 1

INTRODUCTION

Metal Fabricator (Fitter)

Foreword

This Program Outline is for use in Metal Fabricating industry apprenticeship training classes sponsored by SkilledTradesBC and will be used as a curriculum planning guide for instructors in the formal classroom portions of apprenticeship training.

Practical demonstration and student participation should always be integrated with classroom sessions.

Safe working practices, though not always specified in each of the competencies and learning tasks, are an implied part of the program and should be stressed throughout the apprenticeship.

Achievement Criteria set a common minimum standard for training providers to measure achievement of practical competencies. Where Achievement Criteria are specified, the apprentice must achieve the specifications, safety standards and timeframes described.

Competencies that are solely theory-based will be assessed through a multiple choice test(s) for which the apprentice must achieve a minimum score of 70%.

This Program Outline includes a list of recommended reference textbooks that are available to support the learning objectives and the minimum shop requirements needed to support instruction.

SAFETY ADVISORY

Be advised that references to the WorkSafeBC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com). Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.

Acknowledgements

Subject Matter Experts retained in 2013 to assist in reviewing the Program Outline to address the 2012 NOA updates:

- Robert Finlayson — Kwantlen Polytechnic University
- John Folkers — Weldco Beales
- Nathan Van Seters — Intercontinental Truck Body
- Henry Ostermann — British Columbia Institute of Technology (BCIT)
- John Sutton — Thompson Rivers University (TRU)
- Dave Marcinew — Canron Western Constructors
- Al White — Teck Resources Ltd. (accompanied by Sean Horton)

In 2015, Subject Matter Experts were convened to review and re-sequence the Metal Fabricator trade as part of the Pan-Canadian Harmonization Initiative. The following are the Subject Matter Experts who participated in this review:

- Larry Meier — British Columbia Institute of Technology (BCIT)
- Kevin Neustaedter — Coquitlam Steel Products Ltd.
- Nick Williams — Marcon Metal Fab
- Steve Binning — Eagle Iron Ltd.
- Matt Horst — Coastal Pacific Crane & Hoist Engineering Ltd.
- James Cai — British Columbia Institute of Technology (BCIT)

In 2016, Subject Matter Experts were convened to review the BC Occupational Analysis Chart (OAC) and Program Outline with respect to the Pan-Canadian Harmonization Initiative changes. The following are the Subject Matter Experts who participated in this review:

- Mike MacIntosh — Int. Assn. of Bridge, Structural, Ornamental & Reinforcing Iron Workers
- Peter Thomas — British Columbia Institute of Technology (BCIT)
- Stephen Plain — College of New Caledonia (CNC)
- Brad Harder — Penticton Fabricating
- Dave Marcinew — Canron Western Constructors
- Eric Bohne — Int. Assn. of Bridge, Structural, Ornamental & Reinforcing Iron Workers
- Gord Lane — Teck Resources Ltd.
- Kevin Neustaedter — Coquitlam Steel Products Ltd.
- Rick Fenwick — Solid Rock Steel
- Rodney Morris — George Third & Son
- Don Smith — British Columbia Institute of Technology (BCIT)

SkilledTradesBC would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Metal Fabrication occupation.

Committee members and consultation groups involved with prior editions of the BC Program Outline can be found in the Previous Contributors section in the appendices at the end of this document.

How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Program Credentialing Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
Training Topics and Suggested Time Allocation	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the relative weightings of various competencies of the occupation on which assessment is based
Program Content	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors	Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Appendix – Glossary of Acronyms			Defines program specific acronyms	

Section 2

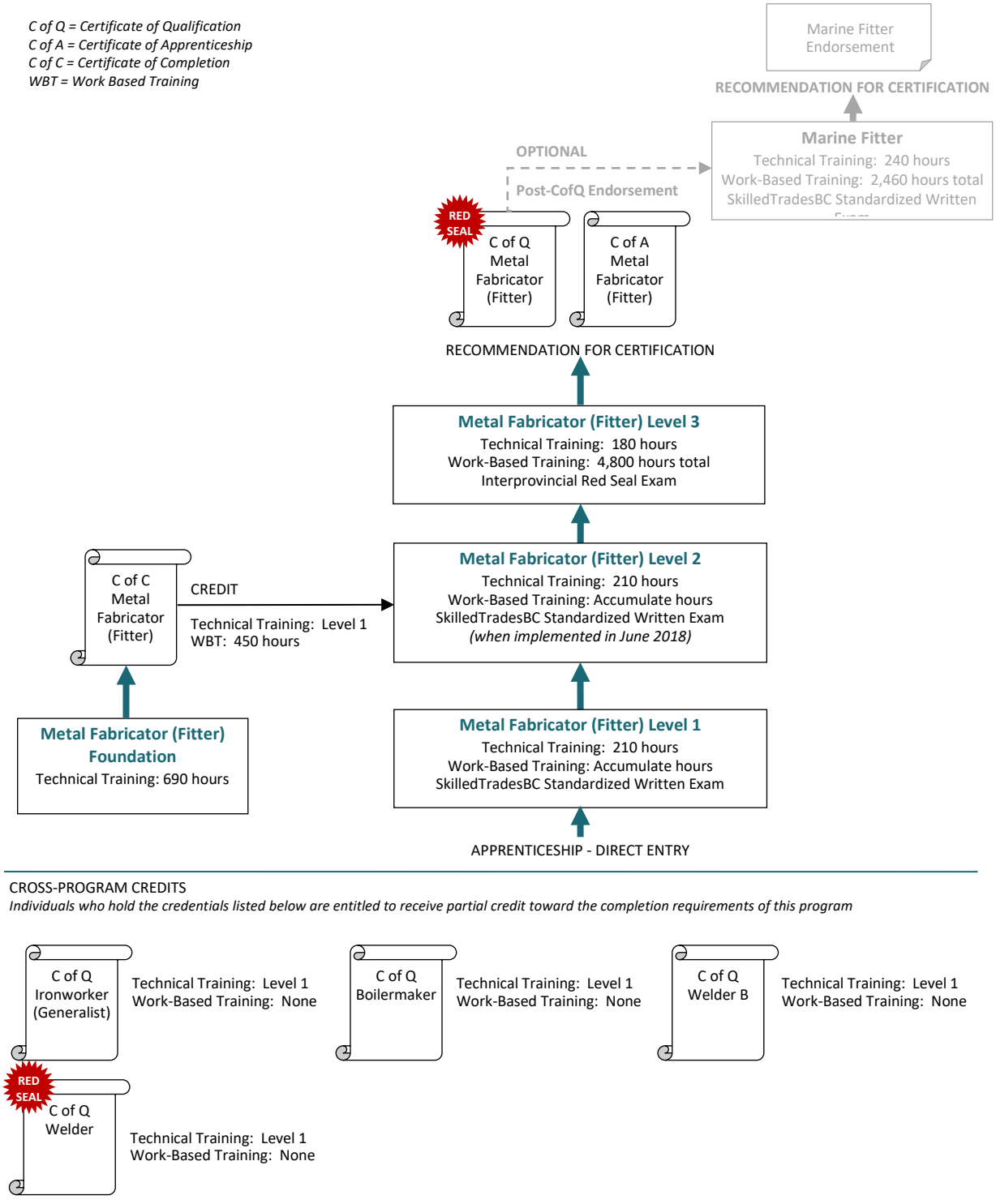
PROGRAM OVERVIEW

Metal Fabricator (Fitter)

Program Credentialing Model

Apprenticeship Pathway with Optional Endorsement

This graphic provides an overview of the Metal Fabricator (Fitter) apprenticeship pathway.



Occupational Analysis Chart

METAL FABRICATOR (FITTER)

Occupation Description: "Metal Fabricator" means a person who interprets drawings and is involved in the development, layout, marking, cutting (e.g., burning, sawing, shearing), hole punching, rolling, bending, drilling, shaping, forming, straightening, fitting and assembling, reaming, bolting, welding, testing, inspecting, painting, rigging, and handling of structural and mechanical fabrications constructed from plates and structural shapes of ferrous and non-ferrous metals in the Metal Fabrication Trade.

Metal Fabricators typically work in the following industries: shipbuilding, aerospace, oil and gas, commercial and residential buildings, mechanical, mining, architectural structural steel, transportation, infrastructure, bridges, and forestry.

Line (GAC)	Competency	Code	Levels
PERFORM SAFETY-RELATED FUNCTIONS (A)	Maintain safe work environment	A1	1, 2, 3
USE TOOLS AND EQUIPMENT (B)	Use hand, power, layout and measuring tools and equipment	B1	1
	Use stationary machinery	B2	1
	Use thermal cutting and welding equipment	B3	1, 2
	Use access equipment	B4	1
	Use computer numerical controlled (CNC) equipment	B5	2, 3
INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS (C)	Interpret blueprints	C1	1, 2, 3
	Interpret structural steel drawings	C2	1, 2, 3
PERFORM QUALITY CONTROL (D)	Perform inspection	D1	1
	Verify structural measurements, welds and layout	D2	2, 3
	Track structural materials, consumables and parts for traceability	D3	2, 3
	Apply principles of metallurgy	D4	1, 2
	Control distortion	D5	1, 2, 3

*

SKILLED TRADES BC

HARMONIZED PROGRAM OUTLINE
Program Overview

HANDLE MATERIALS E	Organize specialty materials and products E1	Calculate mass for structural steel E2	Apply rigging practices E3	Operate material handling equipment E4	
	3	1	1	1	
PERFORM TRADE MATH AND LAYOUT F	Perform line development F1	Calculate bending allowances and stretch outs F2	Calculate diagonals, volume, mass and capacity F3		
	1 2 3	1 2 3	1 2 3		
FORM MATERIALS G	Form material using plate rolls G1	Form material using shape rolls G2	Form material using a brake press G3	Form material using computer numerical controlled (CNC) brake press G4	Fabricate plate G5
	2	2 3	2 3	2 3	1 2 3
FABRICATE COMPONENTS H	Construct templates and jigs H1	Construct sub-components H2	Determine proper sequence for assembly and welding H3	Assemble sub-components and components H4	Set fabricated component in place H5	Fabricate structural components H6
	1 2 3	2 3	2 3	2 3	2 3	1 2 3
PERFORM WELDING ACTIVITIES I	Apply weld symbols I1	Use welding processes I2				
	1 2 3	1 2				
COMPLETE PROJECT J	Determine finishing process J1	Prepare material for finishing J2				
	3	3				

Training Topics and Suggested Time Allocation: Level 1

Metal Fabricator (Fitter) – Level 1

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**PERFORM SAFETY-RELATED FUNCTIONS**	**3%**	**85%**	**15%**	**100%**
A1	Maintain safe work environment		✓	✓	
Line B	**USE TOOLS AND EQUIPMENT**	**14%**	**50%**	**50%**	**100%**
B1	Use hand, power, layout and measuring tools and equipment		✓	✓	
B2	Use stationary machinery		✓	✓	
B3	Use thermal cutting and welding equipment		✓	✓	
B4	Use access equipment		✓	✓	
Line C	**INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS**	**24%**	**50%**	**50%**	**100%**
C1	Interpret blueprints		✓	✓	
C2	Interpret structural steel drawings		✓	✓	
Line D	**PERFORM QUALITY CONTROL**	**6%**	**75%**	**25%**	**100%**
D1	Perform inspection		✓	✓	
D4	Apply principles of metallurgy		✓		
D5	Control distortion		✓	✓	
Line E	**HANDLE MATERIALS**	**6%**	**85%**	**15%**	**100%**
E2	Calculate mass for structural steel		✓		
E3	Apply rigging practices		✓	✓	
E4	Operate material handling equipment		✓		
Line F	**PERFORM TRADE MATH AND LAYOUT**	**24%**	**50%**	**50%**	**100%**
F1	Perform line development		✓	✓	
F2	Calculate bending allowances and stretch outs		✓	✓	
F3	Calculate diagonals, volume, mass and capacity		✓	✓	
Line G	**FORM MATERIALS**	**8.5%**	**50%**	**50%**	**100%**
G5	Fabricate plate		✓	✓	
Line H	**FABRICATE COMPONENTS**	**8.5%**	**50%**	**50%**	**100%**
H1	Construct templates and jigs		✓	✓	
H6	Fabricate structural components		✓	✓	
Line I	**PERFORM WELDING ACTIVITIES**	**6%**	**50%**	**50%**	**100%**

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
I1	Apply weld symbols		✓	✓	
I2	Use welding processes		✓	✓	
	Total Percentage for Metal Fabricator (Fitter) Level 1	**100%**			

Training Topics and Suggested Time Allocation: Level 2

Metal Fabricator (Fitter) – Level 2

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**PERFORM SAFETY-RELATED FUNCTIONS**	**3%**	**70%**	**30%**	**100%**
A1	Maintain safe work environment		✓	✓	
Line B	**USE TOOLS AND EQUIPMENT**	**5%**	**70%**	**30%**	**100%**
B3	Use thermal cutting and welding equipment		✓	✓	
B5	Use computer numerical controlled (CNC) equipment		✓	✓	
Line C	**INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS**	**29%**	**60%**	**40%**	**100%**
C1	Interpret blueprints		✓	✓	
C2	Interpret structural steel drawings		✓	✓	
Line D	**PERFORM QUALITY CONTROL**	**5%**	**60%**	**40%**	**100%**
D2	Verify structural measurements, welds and layout		✓	✓	
D3	Track structural materials, consumables and parts for traceability		✓	✓	
D4	Apply principles of metallurgy		✓		
D5	Control distortion		✓	✓	
Line F	**PERFORM TRADE MATH AND LAYOUT**	**19%**	**50%**	**50%**	**100%**
F1	Perform line development		✓	✓	
F2	Calculate bending allowances and stretch outs		✓	✓	
F3	Calculate diagonals, volume, mass and capacity		✓	✓	
Line G	**FORM MATERIALS**	**14%**	**60%**	**40%**	**100%**
G1	Form material using plate rolls		✓	✓	
G2	Form material using shape rolls		✓	✓	
G3	Form material using a brake press		✓	✓	
G4	Form material using computer numerical controlled (CNC) brake press		✓	✓	
G5	Fabricate plate		✓	✓	
Line H	**FABRICATE COMPONENTS**	**17%**	**70%**	**30%**	**100%**
H1	Construct templates and jigs		✓		
H2	Construct sub-components		✓	✓	
H3	Determine proper sequence for assembly and welding		✓		
H4	Assemble sub-components and components		✓	✓	
H5	Set fabricated component in place		✓		
H6	Fabricate structural components		✓	✓	
Line I	**PERFORM WELDING ACTIVITIES**	**8%**	**70%**	**30%**	**100%**

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
I1	Apply weld symbols		✓	✓	
I2	Use welding processes		✓	✓	
	Total Percentage for Metal Fabricator (Fitter) Level 2	**100%**			

Training Topics and Suggested Time Allocation: Level 3

Metal Fabricator (Fitter) – Level 3

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**PERFORM SAFETY-RELATED FUNCTIONS**	**3%**	**70%**	**30%**	**100%**
A1	Maintain safe work environment		✓	✓	
Line B	**USE TOOLS AND EQUIPMENT**	**6%**	**60%**	**40%**	**100%**
B5	Use computer numerical controlled (CNC) equipment		✓	✓	
Line C	**INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS**	**24%**	**50%**	**50%**	**100%**
C1	Interpret blueprints		✓	✓	
C2	Interpret structural steel drawings		✓	✓	
Line D	**PERFORM QUALITY CONTROL**	**7%**	**60%**	**40%**	**100%**
D2	Verify structural measurements, welds and layout		✓		
D3	Track structural materials, consumables and parts for traceability		✓		
D5	Control distortion		✓	✓	
Line E	**HANDLE MATERIALS**	**3%**	**80%**	**20%**	**100%**
E1	Organize specialty materials and products		✓	✓	
Line F	**PERFORM TRADE MATH AND LAYOUT**	**23%**	**50%**	**50%**	**100%**
F1	Perform line development		✓	✓	
F2	Calculate bending allowances and stretch outs		✓	✓	
F3	Calculate diagonals, volume, mass and capacity		✓	✓	
Line G	**FORM MATERIALS**	**14%**	**50%**	**50%**	**100%**
G2	Form material using shape rolls		✓	✓	
G3	Form material using a brake press		✓	✓	
G4	Form material using computer numerical controlled (CNC) brake press		✓	✓	
G5	Fabricate plate		✓	✓	
Line H	**FABRICATE COMPONENTS**	**14%**	**40%**	**60%**	**100%**
H1	Construct templates and jigs		✓	✓	
H2	Construct sub-components		✓	✓	
H3	Determine proper sequence for assembly and welding		✓	✓	
H4	Assemble sub-components and components		✓	✓	
H5	Set fabricated component in place		✓	✓	
H6	Fabricate structural components		✓	✓	
Line I	**PERFORM WELDING ACTIVITIES**	**3%**	**70%**	**30%**	**100%**
I1	Apply weld symbols		✓	✓	

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line J	**COMPLETE PROJECT**	**3%**	**80%**	**20%**	**100%**
J1	Determine finishing process		✓	✓	
J2	Prepare material for finishing		✓	✓	
	Total Percentage for Metal Fabricator (Fitter) Level 3	**100%**			

Section 3

PROGRAM CONTENT

Metal Fabricator (Fitter)

Level 1

Metal Fabricator (Fitter)

Line (GAC): A PERFORM SAFETY-RELATED FUNCTIONS

Competency: A1 Maintain safe work environment

Objectives

To be competent in this area, the individual must be able to:

- Describe safe work rules and procedures.
- Describe fire prevention methods and precautions.
- Describe requirements for working in confined spaces.

LEARNING TASKS	CONTENT

1. Describe first aid and emergency procedures	• Site orientation
	• Safety bulletins
	• Initial first aid procedures
	  ○ First aid stations
	  ○ Muster stations
	  ○ Eye wash stations
	  ○ Fire extinquisher
	• Limits of untrained persons
	• Location of first aid attendant and their responsibilities
	• Recognition of emergency circumstances
	  ○ Unconsciousness
	  ○ Cardio pulmonary emergency
	  ○ Severe bleeding
	  ○ Burns
	• Report hazards
	  ○ Company policy
	  ○ OH&S requirements
	• Communications
	• Accident reporting procedures
	• Field level risk assessment (FLRA)
	• Job hazard assessment (JHA)

2. Describe communication equipment	• Applications
	• Operational procedures
	• Types
	  ○ Radios
	  ○ Cell phones
	  ○ Computers
	• Care
	  ○ Maintenance
	  ○ Storage

LEARNING TASKS	CONTENT
3. Describe chain of command	• Professionalism • Respectful communication

4. Describe safe practices, equipment and processes	• Personal Protective Equipment (PPE)
	  ○ Eye protection
	• Body mechanics
	  ○ Lifting and carrying loads
	• Housekeeping
	• Confined space
	• Access and egress
	  ○ Flash screens
	  ○ Barriers
	• Air quality
	  ○ Respiratory equipment
	• Tools and equipment
	• Mobile equipment
	• Lock out and isolation
	• Electrical and mechanical hazards
	  ○ Pinch points

5. Describe safety precautions	• Power operated machinery
	  ○ Safe operating capacity
	  ○ Starting and stopping
	  ○ Emergency shut off
	  ○ Calibration
	  ○ Securing material
	  ○ General maintenance
	• Hand and power operated tools
	• Fire hazards
	• Flammable liquids, gases and metals
	  ○ Oily rags
	  ○ Paper or wood products
	  ○ Electrical apparatus

6. Describe the standard classifications of fires and fire extinguishers	• Classes of fires • Types of extinguishers • Prevention methods

7. Describe handling and storage of hazardous and toxic materials	• Workplace Hazardous Materials Identification System (WHMIS)
	  ○ Waste disposal
	  ○ Material Safety Data Sheets (MSDS)

LEARNING TASKS	CONTENT
8. Define key terms used in the Workers Compensation Act	• Applicable terms
9. Describe applications of the Occupational Health and Safety Regulations of WorkSafeBC	• Applicable regulation (WorkSafe parts 1-19)
10. Describe applications of the federal Occupational Safety and Health Regulations	• Applicable regulation (Bill C-45)

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B1 Use hand, power, layout and measuring tools and equipment

Objectives

To be competent in this area, the individual must be able to:

- Describe and maintain measuring, layout and hand tools.
- Describe the procedures for using various specialized measuring tools.
- Describe and maintain bench and hand grinders.
- Describe and maintain handheld power tools.
- Describe the use of nibblers.

LEARNING TASKS	CONTENT

1. Describe and maintain hand tools	• Hammers
	• Wrenches
	• Clamps
	• Drill bits
	• Files
	• Drift pins
	• Chisels
	• Care
	  ○ Maintenance
	  ○ Storage

2. Describe and maintain layout tools	• Layout tools
	• Specialty tools
	• Care
	  ○ Maintenance
	  ○ Storage
	  ○ Calibration
	  ○ Specialized measuring tools

3. Describe and maintain grinders	• Types
	• Applications
	• Safety considerations
	• Care
	  ○ Maintenance
	  ○ Storage

LEARNING TASKS	CONTENT
4. Use grinders	• Procedures • Manufacturer's specifications • Deburr edges • Bevel plate edge • Remove plate corner radius square corners

5. Describe and maintain power and pneumatic tools	• Applications
	• Safety considerations
	• Operational procedures
	• Types and features
	• Care
	  ○ Maintenance
	  ○ Storage

6. Use magnetic drill	• Marking • Centering • Reaming

7. Describe and maintain nibbler	• Safety considerations
	• Applications
	• Types
	• Capacity
	  ○ Type and thickness
	  ○ Material characteristics
	• Cut considerations

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B2 Use stationary machinery

Objectives

To be competent in this area, the individual must be able to:

- Explain safety considerations for stationary machinery.
- Use and maintain stationary machinery.

LEARNING TASKS	CONTENT
1. Describe stationary machinery	• Applications • Safety considerations • Components • Machine operation • Operational procedures • Inspection • Types • Care and maintenance • Documentation/administration

2. Describe brake press	• Safety
	  ○ Lockout/isolation
	• Capacity plate
	• Types of forming operations
	• Electric controls and settings
	• Machine actuation
	  ○ Hydraulic
	  ○ Mechanical
	  ○ Manual
	• Maintenance
	• Components

3. Use brake press	• Inspection • Start up • Shut down • Settings • Programming
4. Describe plate rolls	• Applications • Components • Machine capacity • Maintenance

LEARNING TASKS	CONTENT

5. Use plate rolls	• Safety
	• Process
	• Inspection
	• Set up
	• Rolling
	  ○ Reverse
	  ○ Commercial

6. Describe pedestal grinders	• Capacity/RPM
	• Maintenance
	  ○ Mounting wheel
	  ○ Addressing and truing wheel
	  ○ Proper washers and tightening

7. Use pedestal grinders	• Safety
	• Process
	• Inspection
	• Set up
	• Sharpen
	  ○ Cold chisel
	  ○ Centre punch
	  ○ Twist drill

8. Describe the components and procedures of the plate shear	• Applications
	• Safety considerations
	• Components
	• Machine operation
	• Procedure
	  ○ Automated and manual controls
	  – Foot control
	  ○ Rake angle
	  ○ Blade clearance
	  ○ Back gauge
	• Capacity

9. Use the plate shear	• Shear • Backstop • Shadow line

LEARNING TASKS	CONTENT

10. Describe band saws	• Applications
	• Advantages and disadvantages
	• Safety considerations
	• Components
	• Types
	• Automatic feed
	• Machine operation
	• Procedure
	• Blades
	  ○ Types
	  ○ Styles
	  ○ Tooth pitch
	  ○ Rake
	• Capacity

11. Use band saws	• Structural shapes
	  ○ Seam
	  ○ Part orientation
	  ○ Stack cutting/nested cuts
	• Shop tolerances
	• Cuts
	  ○ Mitre
	  ○ Square
	  ○ Compound

12. Describe ironworker	• Applications
	• Safety considerations
	• Types
	  ○ Mechanical
	  ○ Hydraulic
	• Components
	• Automatic feed
	• Machine operation
	• Procedure
	  ○ Back stops
	  ○ Gauges
	  ○ Jigs
	• Capacity

LEARNING TASKS	CONTENT

13. Use ironworker	• Structural shapes
	• Shop tolerances
	• Cuts
	  ○ Mitre
	  ○ Square
	  ○ Compound

14. Describe drill presses	• Applications
	• Safety considerations
	• Types
	  ○ Bench top
	  ○ Floor
	  ○ Radial arm
	  ○ Sensitive
	  ○ Magnetic base
	• Components and tools
	• Capacity
	  ○ Type and thickness
	  ○ Material characteristics
	  ○ Drill considerations
	• Procedure
	  ○ Set up
	  ○ Speed/feed rate
	  ○ Material
	  ○ Hole dimensions
	  ○ Cutter/drill bit
	  ○ Sharpening

LEARNING TASKS

15. Describe the thread cutting machine

CONTENT

- Applications
- Safety considerations
- Types
  - Manual
  - Electric
  - Hydraulic
- Components
  - Carriage
  - Chucks
- Procedure
  - Speed/feed rates
  - Die installation
  - Mounting material in chuck
  - Ream/cut pipe
    - Round stock
    - Pipe
- Capacity
  - Type and thickness
  - Material characteristics
  - Thread considerations
- Maintenance

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B3 Use thermal cutting and welding equipment

Objectives

To be competent in this area, the individual must be able to:

- Describe various thermal cutting methods.
- Describe welding equipment.
- Use oxy-fuel cutting equipment.

LEARNING TASKS	CONTENT
1. Describe various thermal cutting processes	• Oxy-fuel • Air arc • Plasma • Manual and Semi-automatic • Maintenance • Advantages and disadvantages

2. Identify oxy-fuel cutting and welding equipment	• Safety considerations
	• Operational considerations
	• Components
	  ○ Consummables
	  ○ Maintenance

3. Use oxy-fuel cutting equipment	• Set up and shutdown • Operation • Maintenance • Storage
4. Identify plasma arc cutting equipment	• Advantages and disadvantages • Safety considerations • Capacity/material • Components • Types of gases

LEARNING TASKS	CONTENT

5. Describe air-arc cutting (AAC)	• Applications
	• Advantages and disadvantages
	• Capacity
	• Components
	• Safety considerations
	• Procedures
	• Trouble shooting
	  ○ Slag
	  ○ Carbon deposit
	  ○ Control

Achievement Criteria

Performance — The learner will be able to correctly set up and operate oxy-fuel cutting equipment to produce a profile burned coupon.

Conditions — Shop projects will be completed in a training provider facility, given:

- 1/2" plate material
- Tools and equipment
- A prescribed time limit

Criteria — The learner will be evaluated on:

- Project completion within 4 hours
- Accuracy and tolerances (+/- 1/16")
  - Circles
  - Squares
  - Triangles
  - Bevels
  - Slots
  - Guided cuts
- Cut edge quality
- Manual cleaning processes (only)

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B4 Use access equipment

Objectives

To be competent in this area, the individual must be able to:

- Select and identify ladders, scaffolds and platforms.
- Identify motorized access platforms.

LEARNING TASKS	CONTENT

1. Select and identify ladders	• Applications
	• Operational procedures
	• Regulations
	• Types of ladders
	  ○ Step
	  ○ Extension
	  ○ Single straight
	• Care
	  ○ Maintenance
	  ○ Storage

2. Select and identify scaffolds and platforms	• Regulations
	• Scaffold types
	  ○ Fixed frame system
	  ○ Tube and clamp
	  ○ System
	• Platform types
	  ○ Scissor lift
	  ○ Aerial boom lift
	  ○ Zoom boom
	  ○ Fixed platform
	• Care
	  ○ Maintenance
	  ○ Storage

Line (GAC): C INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS

Competency: C1 Interpret blueprints

Objectives

To be competent in this area, the individual must be able to:

- Describe an orthographic drawing.
- Sketch multi-view drawings of objects using isometric and orthographic projection.
- Identify standard symbols and abbreviations on drawings.
- Sketch detail, auxiliary and section views.
- Interpret specifications.
- Interpret welding symbols.
- Describe advantages and disadvantages of CAD drawings.

LEARNING TASKS	CONTENT

1. Identify the alphabet of lines	• Types
	  ○ Object
	  ○ Hidden
	  ○ Centre
	  ○ Extension
	  ○ Dimension
	  ○ Cutting plane
	  ○ Break
	  ○ Section

2. Describe the principles of orthographic and isometric projection	• Views • Projection method • Auxiliary • Section
3. Draw and dimension orthographic sketches of simple objects	• Rules and principles for dimensioning • Drawing units
4. Make an isometric drawing of a given object	• Orientation • Development of construction lines • Drawing to scale • Non-isometric features
5. Draw auxiliary views of features on simple objects	• Proportion • Orientation • Dimensioning

LEARNING TASKS	CONTENT
6. Draw section views of simple objects	• Cutting plane axis and orientation • Scale • Types of lines • Dimensioning
7. Interpret standard symbols and abbreviations	• Symbols • Abbreviations • Notes • Marks
8. Interpret welding symbols	• Reference line • Arrow side/other side • Reading sequence • Weld symbols • Joint profile
9. Describe CAD drawings	• Advantages and disadvantages • Uniformity • Scale • Object presentation

Line (GAC): C INTERPRET PLANS, DRAWING AND SPECIFICATIONS

Competency: C2 Interpret structural steel drawings

Objectives

To be competent in this area, the individual must be able to:

- Interpret structural steel drawing.
- Draw views.
- Construct a bill of material.
- Develop a simple estimate.

LEARNING TASKS	CONTENT

1. Interpret a structural drawing	• Title block
	• Revisions
	• General layout
	  ○ Orientation of beam or column on given drawing paper
	• Material list
	  ○ Identification of main structural member(s)
	• Specifications

2. Draw section views	• Cutting plane axis and orientation • Scale • Types of lines • Dimensioning
3. Interpret standard symbols and abbreviations	• Centre line • Base line • Workpoint • Structural shapes

4. Describe a bill of material	• Location
	• Purpose
	• Format
	  ○ Item number
	  ○ Piece mark
	  ○ Quantity
	  ○ Description
	  ○ Length
	  ○ Weight
	  ○ Remarks

LEARNING TASKS	CONTENT
5. Develop a material list	• Simple structural drawing • Content • Structural shapes • Special instructions
6. Label and detail drawings	• Hole location • Cut details • Plate edge preparation • Dimensions

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D1 Perform inspection

Objectives

To be competent in this area, the individual must be able to:

- Describe types and applications of fabrication codes.
- Describe inspection and non-destructive inspection techniques.

LEARNING TASKS	CONTENT
1. Identify codes used in metal fabrication	• CSA S16 • CSA W59 • CSA G40.20 M • AWS 3.1 • AWS D1.1 • CSA G40.21 • CSA G40.12 • CSA W47.1 (steel) • CSA W47.2 (aluminum) • BC Building Code • Lloyds • API 650 • CISC • ASME • AISC • CWB W59 • ANSI

2. Describe critical inspections for fabrication	• Welding code tolerances
	• Material characteristics
	• Piece count
	• Miminum quality requirements
	• Mill materials
	  ○ Deformities
	  ○ Dimensional inaccuracy
	• Obvious omissions
	  ○ Welds
	  ○ Parts
	• Surface imperfections
	  ○ Spatter
	  ○ Gouges

LEARNING TASKS	CONTENT
	○ Sharp edges • Weld defects ○ Location ○ Weld size ○ Porosity ○ Undercut ○ Crater cracks • Fabrication defects ○ Distortion ○ Improper fit up ○ Piece alignment
3. Describe various non-destructive testing techniques	• Radiography - gamma and X-ray • Dye and fluorescent penetrants • Ultrasonic • Magnetic particle • Hydrostatic - air and water
4. Describe visual inspection techniques	• Material • Welds • Completed unit

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D4 Apply principles of metallurgy

Objectives

To be competent in this area, the individual must be able to:

- Describe the characteristics of various types of steels.
- Describe effects of heat on metals.
- Describe methods of relieving stress on metals.
- Describe standard types and methods of testing common metals.

LEARNING TASKS	CONTENT
1. Describe the basic ways of manufacturing steel	• Bessemer converter • Open hearth furnace • Crucible furnace • Electrical furnace
2. Describe the general characteristics of structural metals	• Elements • Grades • Regulatory organizations • CSA standard types • ASTM standard types
3. Describe important properties of types of metals	• Body centre cubic (BCC) • Face centre cubic (FCC) • Density • Tensile strength • Hardness • Ductility • Weldability • Chemical resistance • Atmospheric resistance • Heat resistance
4. Describe the effects of heat on metals	• Hardening • Tempering • Annealing • Normalizing • Distortion control

LEARNING TASKS	CONTENT
5. Identify standards processes for testing metals	• Charpy V notch • Rockwell • Brinnel • Tensile

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D5 Control distortion

Objectives

To be competent in this area, the individual must be able to:

- Describe the elements that contribute to distortion in fabrication.
- Describe how distortion can be observed and measured.

LEARNING TASKS	CONTENT
1. Identify fabricated assemblies where distortion must be considered	• Engine and mechanical bases • Pipe/flange connections • Drive units • Bolted connections • Spliced connections • Trial assemblies • Drilling operations • Heat straightening • Dowel connections during trial assembly

2. Describe stress that may develop in fabricated metal structures	• Types
	  ○ Longitudinal
	  ○ Transverse
	  ○ Angular
	  ○ Residual

3. Identify measures and controls to minimize distortion	• Sub-assemblies
	• Jigs and fixtures
	  ○ Strong back
	  ○ Clamps
	  ○ Braces
	• Welding sequences
	• Proper fit-up
	• Counter bending

Line (GAC): E HANDLE MATERIALS

Competency: E2 Calculate mass for structural steel

Objectives

To be competent in this area, the individual must be able to:

- Convert metric and imperial units.
- Calculate area and weights/mass of various plate shapes.

LEARNING TASKS	CONTENT

1. Select and use tools and equipment	• Load indicators
	• Calipers
	• Measuring tapes
	• Gauges
	  ○ Sheet
	  ○ Plate

2. Describe key terms and concepts necessary for correct calculation of plate weight	• Drawings
	• Manuals
	• Suppliers' catalogues
	• Plate shape
	  ○ Square
	  ○ Rectangular
	  ○ Triangular
	  ○ Circular
	• Plate weight constants
	• Dimensions required for calculation
	• Required formulas

3. Convert imperial dimensions to decimal values and vice versa	• Decimal expression in feet or inches • Inch and fraction to decimal of a foot • Convert between Imperial and Metric • Convert feet and inches to decimals • Rounding numbers
4. Calculate imperial weights and areas of plate shapes	• Plate shape • Appropriate formula • Required variables
5. Calculate metric weights and areas of plate shapes	• Plate shape • Appropriate formula • Required variables

LEARNING TASKS	CONTENT
6. Use a steel handbook to determine mass of structural shapes	• Beams • Channels • Angles

Line (GAC): E HANDLE MATERIALS

Competency: E3 Apply rigging practices

Objectives

To be competent in this area, the individual must be able to:

- Apply WorkSafeBC regulations.
- Describe safe rigging procedures.
- Apply rigging methods to lift loads.
- Develop a lift plan.

LEARNING TASKS	CONTENT
1. Apply WorkSafeBC regulations	• Responsibilities • Inspection requirements
2. Calculate the weight of loads	• Type of material • Weight/mass • Centre of balance
3. Identify rigging components	• Wire rope • Chain • Plate clamps • Tirfor jacks • Turn buckles • Hydraulic and screw jacks • Hooks • Shackles • Spreader bars • Cables • Chains • Come-a-longs • Magnets • Vacuum lifts
4. Calculate working load limits for rigging	• Breaking strength • Safety factor • Rigger's rule of thumb

LEARNING TASKS	CONTENT

5. Use cranes and hoists	• Types of cranes
	  ○ Overhead
	  ○ Gantry
	  ○ Hoist
	  ○ Jib
	• Centre of gravity
	• Lift points
	• Potential damage to object being lifted
	• Capacity of cranes

6. Describe communications	• Hand signals
	  ○ Boom signals
	  ○ Line signals
	• Radio communications

7. Describe safe procedures for disconnecting and removing rigging	• Dangers of load collapse or rollover • Tensioned chokers or Tirfors • Tag line • Balance
8. Describe and demonstrate rigging methods when moving loads	• Hoisting • Rotating (turning) • Rolling • Guiding • Aligning • Safety Considerations
9. Identify and use knots, bends and hitches	• Parts of a rope • Attaching to a fixed object • Tying down a load • Joining ropes together

Achievement Criteria

Performance — The learner will perform an inspection on a hoist and single sling configuration.

Conditions — The learner will be given:

- Jib crane complete with hoist
- Single sling configuration
- Access to codes and standards
- A prescribed time limit

Criteria — The learner will be evaluated on:

- Project completion within 1 hour
- In accordance with WorkSafe BC regulations

Line (GAC): E HANDLE MATERIALS

Competency: E4 Operate material handling equipment

Objectives

To be competent in this area, the individual must be able to:

- Select appropriate lifting aids and equipment for lifting jobs.
- Identify the laydown area requirements.

LEARNING TASKS	CONTENT
1. Describe material handling equipment	• Fork lift • Telehandler • Pallet jack • Carts • Conveyor • Dollies • Shop crane • Jib crane
2. Select appropriate lifting equipment	• Slings • Shackles • Spreader beams • Lugs • Lifting points and attachments • Turn buckles
3. Describe laydown area requirements for receiving materials	• Space availability • Level • Dry • Dunnage • Workflow coordination • Equipment lanes

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F1 Perform line development

Objectives

To be competent in this area, the individual must be able to:

- Define basic layout terms and sequences.
- Create patterns using parallel line development.

LEARNING TASKS	CONTENT
1. Define basic layout terms	• Seam • Mitre • Base line • Tangent • Stretch out • Battle line • Ordinate • Centre line

2 Develop geometric line construction	• Perpendicular
	• Bisect
	  ○ Line segment
	  ○ Arc
	• External radius
	• Segment
	  ○ Circle
	  ○ Line

3. Describe essential views for developing patterns	• Elevation • Plan
4. Define basic layout sequences	• Truncated rectangular pipe • Truncated round pipe • Pipe tee-joint • Offset-pipe tee-joint • Inclined (lateral) pipe joint • Multi-piece pipe elbow complete with branch

LEARNING TASKS	CONTENT

5. Layout various developed plate shapes	• Stretch out
	  ○ Half pattern
	  ○ Full pattern
	  ○ Hole pattern
	• Orientation
	• Ordinate sequencing
	• Angular and clock ray reference
	• Process mark plates
	• Bend sets and sweeps

6. Develop required patterns for various pipe connections	• Wrap around
	  ○ Internal
	  ○ External
	• Inside dimension (ID) vs. outside dimension (OD) or mean dimension (MD)
	• Layout of saddle, sweep or hole

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F2 Calculate bending allowances and stretch outs

Objectives

To be competent in this area, the individual must be able to:

- Determine stretch out lengths.
- Develop sketches of flat plate layout.

LEARNING TASKS	CONTENT

1. Use a scientific calculator	• Functions
	  ○ Add, subtract, multiply, divide
	  ○ Squares and square root
	  ○ Convert dimensions

2. Describe process terminology	• Inside dimensions • Mean dimensions • Bend allowance • Mean arc length • Material thickness
3. Determine the stretch out dimensions using flange calculations	• Flanged shape
4. Determine the stretch out dimensions using mean calculations	• Cylinder • Rolled segments
5. Develop sketches of flat plate layouts.	• Rolled shape • Flanged shape • Dimensions • Labelling • Plate gauge

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F3 Calculate diagonals, volume, mass and capacity

Objectives

To be competent in this area, the individual must be able to:

- Solve simple problems using ratio and proportion.
- Solve a variety of problem types involving weight, mass and the capacity of vessels.

LEARNING TASKS	CONTENT
1. Describe Pythagoras' Theorem	• Right angle triangles • Hypotenuse • Adjacent sides • Opposite sides • Fundamental formula • Desired derivative • Key terms and concepts • Fundamental formula • Transposing

2. Apply Pythagoras' Theorem	• Simple problems
	  ○ Calculate slope
	  ○ Calculate rise
	  ○ Calculate base
	• Identify right angle triangles within a given shape
	• Third angle projection
	• True lengths of sides
	• Rolling offset applied to pipe or round
	• Pythagoras' Theorem
	  ○ Truss
	  ○ Hopper
	  ○ Conical shape

3. Describe key terms and concepts required for problem solution	• Working bevel (WB) • Ratio • Proportion • Word problems
4. Calculate unknown dimensions on shapes using ratio and proportion	• Similar triangles
5. Apply ratio and proportion to trusses	• Working bevels • Similar triangles

LEARNING TASKS	CONTENT

6. Identify types of plate fit up used on vessels	• Cylindrical
	• Box-shaped
	• End plate/corner to corner
	  ○ Open
	  ○ Closed
	  ○ Half

7. Solve for cylindrical vessel weight/mass	• Selection of correct formula • Determine required dimensions
8. Solve for cylindrical vessel capacity	• Selection of correct formula • Determine required dimensions
9. Identify information required to detail box-shaped vessels	• Dimensions of individual sides • Thickness of material • Type of plate fit
10. Solve for box-shaped vessel weight/mass	• Individual plate dimensions • Correct formulas
11. Solve for box-shaped vessel capacity	• Required dimensions for formula used

Line (GAC): G FORM MATERIALS

Competency: G5 Fabricate plate

Objectives

To be competent in this area, the individual must be able to:

- Fabricate a J-hook.
- Fabricate a ring to ring.
- Fabricate a 3-piece, 90º elbow complete with branch.

LEARNING TASKS	CONTENT
1. Fabricate a J-hook	• Stretch out • Layout and tools • Symbols and marking • Machine selection and setup • Patterns and sweeps • Dimensions • Holes
2. Fabricate a ring to ring	• Calculations • Machine selection, setup and sequencing • Fitting considerations • Tolerances • Seam alignment • Projection • Tack weld
3. Fabricate a 3-piece, 90º elbow complete with branch	• Parallel line development • Nested layout • Seam allowance and locations • Ordinate labelling and orientation • Rolling • Machine selection and setup • Fitting considerations • Tack weld • Cardboard mock-up

Achievement Criteria

Performance The learner will be able to fabricate the following:

- J-hook

- Ring to ring
- A 3-piece, 90º elbow complete with branch

Conditions

Shop projects will be completed in a training provider facility, given:

- Drawings
- 1/8" mild steel/low carbon material
- A prescribed time limit

Criteria

The learner will be evaluated on:

- Completion of all three projects within 18 hours in a shop environment
- Dimension and tolerance
- Alignment
- Form and fit
- Appearance
  - Neat and feathered tack welds
  - Tack spacing
  - Tack location
  - Edge finish

Line (GAC): H FABRICATE COMPONENTS

Competency: H1 Construct templates and jigs

Objectives

To be competent in this area, the individual must be able to:

- Assemble and use jigs.
- Layout and design templates.

LEARNING TASKS	CONTENT
1. Describe basic planning considerations for jigs	• Advantages and disadvantages • Required materials • Tooling • Materials • Reference points • Tolerances • Allowances
2. Describe the different types of jigs used in fabrication	• Advantages and disadvantages • Internal • External • Incremental • Alignment • Bolted • Welded
3. Define standard edge distances	• Sheared or thermal • Connecting bolt • Anchor bolt • CISC/AISC

4. Describe templates	• Advantages and disadvantages
	• Purpose and types
	  ○ Templates
	• Materials
	  ○ Cardboard
	  ○ Sheet metal
	  ○ Wood
	  ○ Steel

LEARNING TASKS	CONTENT
5. Lay out template	• Workpoint • Sequence • Quality Control • Labelling and marking • Edge distance

Line (GAC): H FABRICATE COMPONENTS

Competency: H6 Fabricate structural components

Objectives

To be competent in this area, the individual must be able to:

- Describe fabricated components.
- Fabricate a structural beam assembly.

LEARNING TASKS	CONTENT

1. Identify component classification of fabricated items	• Buildings
	  ○ Embedded iron
	  ○ Structural steel
	  ○ Sub-assembly
	  ○ Miscellaneous
	  ○ Architectural
	• Machine fabrication
	• Conveyors
	• Bridges
	• Heavy equipment

2. Determine timeline/estimate	• Drawing
	• Bill of material
	• Fabrication sequence
	• Welding
	• Finishing
	  ○ Painting
	  ○ Sandblasting
	  ○ Galvanizing
	• Inspection and codes
	• Shipping and site coordination
	• Taxes

LEARNING TASKS	CONTENT
3. Fabricate a structural beam assembly	• Structural drawings • Canadian Institute of Steel Construction (CISC) material classification • Templates • Working bevels • Edge distance • Fasteners • Running dimensions • Gauge and pitch • Structural terminology

Achievement Criteria

Performance — The learner will be able to fabricate the following:

- Structural beam assembly

Conditions — Shop project will be completed in a training provider facility, given:

- Drawings
- Suitable CISC references
- Structural steel components
- Shop tools and equipment
- A prescribed time limit

Criteria — The learner will be evaluated on:

- Project completion within 12 hours
- Dimension
- Alignment
- Tolerance and fit up
- Edge preparation
- Hole locations
- Edge distance
- Appearance
  - Orientation
  - Mark up
  - Edge finish

Line (GAC): I PERFORM WELDING ACTIVITIES

Competency: I1 Apply weld symbols

Objectives

To be competent in this area, the individual must be able to:

- Apply standard symbols.
- Identify welding codes and standards.

LEARNING TASKS	CONTENT
1. Describe standard weld symbols	• Terminology • Types • Design • Dimensions • Five basic joints • Edge preparation
2. Draw weld symbols	• Fillets • Grooves • Profiles
3. Identify welding codes and standards	• CWB W59, 47.1 • AWS 3.1 • Inspection

Line (GAC): I PERFORM WELDING ACTIVITIES

Competency: I2 Use welding processes

Objectives

To be competent in this area, the individual must be able to:

- Use SMAW and GMAW welding processes.
- Perform tack welds.

LEARNING TASKS	CONTENT
1. Describe SMAW and GMAW	• Safety • Applications • Power sources • Components • Current design • Set up • Operation • Maintenance • Consummables • Gases and electrodes
2. Describe acceptable weld preparation and profile	• Groove • Edge fit up • Convex • Concave • Flush

3. Describe considerations for tack welding	• Alignment
	• Offsetting
	• Gap allowance
	• Surface appearance
	• Material
	  ○ Preparation and cleaning
	  ○ Grade
	  ○ Electrode
	  ○ Preheat
	• Position and size of component
	• Tack size

4. Perform tack welding	• SMAW • GMAW

Level 2

Metal Fabricator (Fitter)

Line (GAC): A PERFORM SAFETY-RELATED FUNCTIONS

Competency: A1 Maintain safe work environment

Objectives

To be competent in this area, the individual must be able to:

- Use fall arrest/prevention equipment.
- Design a confined space entry plan.

LEARNING TASKS	CONTENT
1. Select appropriate fall arrest/prevention equipment	• Heights • Obstacles • Access and egress • Mobility • Work activity

2. Use fall arrest/prevention equipment	• Equipment
	  ○ Lanyards
	  ○ Harness
	• Anchors
	• Fit and serviceablity

3. Design a confined space entry plan	• Work activity assessment • Air quality • Access and egress • Equipment • Documentation/administration • Personnel • Rescue

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B3 Use thermal cutting and welding equipment

Objectives

To be competent in this area, the individual must be able to:

- Use plasma-arc cutting process

LEARNING TASKS	CONTENT
1. Use plasma-arc cutting equipment	• Set up • Operator position • Cutting procedure • Maintenance ○ Consummables • Trouble-shooting

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B5 Use computer numerical controlled (CNC) equipment

Objectives

To be competent in this area, the individual must be able to:

- Identify the CNC shape cutting machine.
- Use CNC shape cutting menus.

LEARNING TASKS	CONTENT

1. Identify computer numerical controlled (CNC) cutting equipment	• Applications
	• Advantages and disadvantages
	• Safety considerations
	• Components
	• Software
	• Terminology
	  ○ XY axis
	  ○ Absolute
	• Set up and operation
	  ○ Configuration
	  ○ Plate orientation and origin
	• Cutting
	  ○ Nesting
	  ○ Strip
	  ○ Profile
	• Gas types

2. Use menus to profile cut parts	• Pipe flanges • Project plates

Line (GAC): C INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS

Competency: C1 Interpret blueprints

Objectives

To be competent in this area, the individual must be able to:

- Sketch views of complex objects.
- Apply standard symbols, abbreviations and specifications.
- Interpret complex drawings and specifications.
- Draw complex welding symbols.
- Describe CAD generated drawings.

LEARNING TASKS	CONTENT

1. Develop and detail orthographic drawings	• Various views
	  ○ Detail
	  ○ Section
	  ○ Auxiliary
	• Isometric

2. Apply standard symbols, abbreviations and specifications	• Centre line • Base line • Elevation • Work point • Extension and dimension lines • Welding procedure data sheet (WPDS)
3. Draw complex welding symbols	• Multiple reference lines
4. Describe CAD detailing to generate layout	• Plate • Component

Line (GAC): C INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS

Competency: C2 Interpret structural steel drawings

Objectives

To be competent in this area, the individual must be able to:

- Interpret complex structural steel drawing.
- Draw views of complex objects.
- Construct a bill of material.
- Develop a complex estimate.
- Describe electronic detailing.

LEARNING TASKS	CONTENT

1. Interpret a complex structural drawing	• Title block
	• Revisions
	• General layout
	  ○ Orientation of beam or column on given drawing paper
	• Material list
	  ○ Identification of main structural member(s)
	• Specifications

2. Draw section views	• Complex objects
3. Apply welding symbols and abbreviations	• Detail drawings • Shop projects • Templates • Overlays
4. Develop a bill of material	• Structural drawing • Components • Structural shapes • Special instructions
5. Develop a complex estimate	• Structural drawings and details • Table of specifications • Codes and standards
6. Label and detail drawings	• Hole location • Configuration • Profile shape • Cut details • Plate edge preparation • Dimensions

LEARNING TASKS	CONTENT
7. Describe electronic detailing	• AutoCAD Inventor • SigmaNEST • Solidworks • SDS

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D2 Verify structural measurements, welds and layout

Objectives

To be competent in this area, the individual must be able to:

- Describe structural layout systems.
- Identify structural shapes and nomenclature.
- Apply quality control.

LEARNING TASKS	CONTENT
1. Identify structural shapes and their symbols and abbreviations	• Shape characteristics • Component parts • Dimensioning • Symbol or abbreviation
2. Use a CISC manual to determine mass of structural shapes	• Beams • Channels • Angles

3. Interpret and describe manufacturing variances	• Allowances
	  ○ Leg size
	  ○ Angular offset
	  ○ Depth
	  ○ Flange size
	  ○ Web thickness
	• Milling of columns
	• Machining of plates
	• Rolling of shapes
	• Hubs to shafts
	• Bearing to machine surfaces
	• Heat shrink fitting
	• Keyways
	• Trial assembly using dowels

4. Identify structural terms	• Orientation
	  ○ Camber
	  ○ Sweep
	  ○ Twist

5. Identify workmanship tolerances	• Layout tolerances • Cutting to length • Finishing • Thermal cutting

LEARNING TASKS	CONTENT

6. Confirm markings	• Pieces
	  ○ Detail
	  ○ Main
	• Fasteners
	• Components

7. Confirm torque and dimensions	• Size and location • Layout
8. Inspect weldments	• Components • Assemblies • Marquee
9. Confirm diagonals	

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D3 Track structural materials, consumables and parts for traceability

Objectives

To be competent in this area, the individual must be able to:

- Describe the purpose and method of labelling structural components.
- Describe methods and equipment used in metal identification.
- Develop a bill of material.

LEARNING TASKS	CONTENT
1. Describe the purpose of identifying parts required on a shop or field blueprint	• Detail pieces • Completed units

2. Describe the importance of applying field identification marks in their proper location and specification	• Piece mark
	• Direction mark
	• Field assembly marks
	• Match marks after trial assembly
	• Marking devices
	• Manual tracking systems
	  ○ Tagging
	  ○ Number stamping
	  ○ Engraving

3. Describe record keeping and other requirements in the process operation	• Identify sources and availability of materials
	• Quality control information
	  ○ Mill certification
	  ○ Heat number
	  – Information transfer to crop material
	  ○ Weld maps
	  ○ Welder's identification
	  ○ Welder qualification
	  ○ Company policy quality assurance (QA)
	• Document MTR and HIN for project
	  ○ Material test report (MTR)
	  ○ Heat identification number (HIN)
	• Coordinate receipt of materials
	• Document a bill of lading
	• Coordinate receipt of fabricated components
	• Inspect components for defects

LEARNING TASKS	CONTENT
4. Develop a bill of material	• Parts • Material • Weights

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D4 Apply principles of metallurgy

Objectives

To be competent in this area, the individual must be able to:

- Identify methods of relieving stress on metals.
- Describe standard types and methods of testing common metals.
- Describe the tools and equipment used to measure preheat temperatures.

LEARNING TASKS	CONTENT
1. Identify methods of stress relieving on metals	• Peening • Vibration • Heat treating • Flame straightening • Ultrasonic stress relieving • Heat pads
2. Describe standard material tests	• Spark spray pattern • Tensile strength • Surface indentation • Notch toughness

3. Determine heat temperatures and tools required	• Preheat/interpass/post
	• Worksite welding procedures
	• Blueprint
	• Crack prevention
	• Temperature measuring tools
	  ○ Temperature stick
	  ○ Digital heat sensor
	  ○ Rosebud
	  ○ Tiger torch
	• Induction heater

4. Interpret technical specifications	• Physical characteristics • Spark spray pattern • Tensile testing and graph interpretation • Surface hardness • Brittleness/toughness

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D5 Control distortion

Objectives

To be competent in this area, the individual must be able to:

- Describe distortion allowances.
- Describe processes to control distortion.
- Describe procedures to minimize distortion.

LEARNING TASKS	CONTENT
1. Estimate possible distortion allowances	• CISC allowance tables • Customer specifications

2. Describe how to help control and minimize the effects of heat distortion	• Sub-assemblies
	• Jigs and fixtures
	  ○ Strong back
	  ○ Clamps
	  ○ Braces
	• Welding sequences
	• Proper fit-up
	• Counterbalance/shrinkage forces

3. Identify methods of distortion control	• Mechanical • Induction • Flame
4. Select and use tools and equipment	• Come-alongs • Hydraulic rams • Peening • Torches • Temperature control devices • Induction heaters and ovens ○ Stress relief
5. Define the steps to correct distortion	• Evaluate • Correct • Measure

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F1 Perform line development

Objectives

To be competent in this area, the individual must be able to:

- Develop various patterns using radial line development.

LEARNING TASKS	CONTENT
1. Develop a true length diagram (TLD)	• Elevation • Offset • Mean dimension
2. Develop patterns and scaled models involving radial line methods	• Concentric cone • Frustum of a concentric cone • Truncated cone • 90° cone to T • Cone transition to a cylinder • Round or square branch intersecting a cone • Inclined cone intersecting a cylinder
3. Calculate and layout complex formed pattern	• Plate gauge and size • Nesting • Quality control • Labelling • Required patterns

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F2 Calculate bending allowances and stretch outs

Objectives

To be competent in this area, the individual must be able to:

- Determine stretch out lengths.
- Interpret complex sketches to develop flat plate layout.
- Calculate mass and diagonals.

LEARNING TASKS	CONTENT
1. Interpret complex sketches to develop flat plate layout.	• Cylinder • Rolled segments • Flanged shape
2. Determine mass of flat plate stretch outs	• Cylinder • Rolled segments • Flanged shape • Plate gauge
3. Calculate stretch out diagonal	• Pythagoras' theorem

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F3 Calculate diagonals, volume, mass and capacity

Objectives

To be competent in this area, the individual must be able to:

- Perform arc length calculations.
- Develop cone patterns.
- Develop hopper layouts.

LEARNING TASKS	CONTENT

1. Develop pattern for cone shape	• Bend line spacing
	• True length diagram
	• Offset
	• Dimensions
	  ○ Apex to base
	  ○ Cone slope
	  ○ Top to apex
	  ○ Base arc
	  ○ Top arc
	• Pattern checks and adjustments
	  ○ Pattern angle calculation

2. Determine true length of hopper	• Calculate
	  ○ Slope
	  ○ Rise
	  ○ Base
	  ○ Offset
	• Labelling
	  ○ Bend directions
	  ○ Plate gauge
	  ○ True length
	  ○ Orientation
	  ○ Inside dimension (ID)

3. Determine arc lengths for nozzle placement on cylindrical planes	• Inside dimension (ID), outside dimesion (OD), mean dimension (MD) • Quarter marks • Ordinates

Line (GAC): G FORM MATERIALS

Competency: G1 Form material using plate rolls

Objectives

To be competent in this area, the individual must be able to:

- Describe power plate rolls.

LEARNING TASKS

1. Review elements of plate roll operation

CONTENT

- Applications
- Safety considerations
- Components
- Machine operation
- Procedure
  - Control console
  - Drive mechanisms
  - Roll adjustment mechanism
  - Pre-form material/pinching
  - Brake press, if required
  - Adjust plate roller
  - Sweep/template
  - Monitor material
- Measurement verification
- Removal of completed material
- Capacity
  - Formability of material
  - Grade
  - Quality
  - Thickness
  - Cut considerations
- Commercial and single pass rolling

Line (GAC): G FORM MATERIALS

Competency: G2 Form material using shape rolls

Objectives

To be competent in this area, the individual must be able to:

- Form material using shape rolls.

LEARNING TASKS	CONTENT

1. Describe the components and procedures of the shape rolls	• Applications
	• Safety considerations
	• Components
	• Machine operation
	• Capacity
	  ○ Formability of material
	  ○ Grade
	  ○ Quality
	• Operation procedure
	  ○ Control console
	  ○ Drive mechanism
	  ○ Roll adjustment mechanism
	  ○ Roll spacer
	  ○ Structure shape and associated dies
	  ○ Sweep/template
	  ○ Monitor material
	• Measurement verification
	• Removal of completed material

2. Use shape rolls to form structural sections	• Hard way/easy way • Machine adjustment • Sweeps • Removal of completed material

Line (GAC): G FORM MATERIALS

Competency: G3 Form material using a brake press

Objectives

To be competent in this area, the individual must be able to:

- Use the hydraulic brake press.
- Perform complex forming operations.

LEARNING TASKS	CONTENT
1. Describe hydraulic brake press operation and capabilities	• Operational theory • Types of forming operations • Component parts • Calibration
2. Use the hydraulic brake press to form metal	• Set up • Complex forming operations involving radial line development • Soft radius bending
3. Apply quality control and assurance	• Sweeps and patterns • Check dimensions • True length dimensions

Line (GAC): G FORM MATERIALS

Competency: G4 Form material using computer numerical controlled (CNC) brake press

Objectives

To be competent in this area, the individual must be able to:

- Describe the various software program functions.
- Form materials using computer numerical controlled (CNC) brake press

LEARNING TASKS	CONTENT
1. Describe forming material using the CNC brake press	• Applications • Terminology • Advantages and disadvantages • Safety considerations • Software • Set up and operation ○ Back gauging • Maintenance • Troubleshooting

2. Form material using CNC brake press	• Back gauge
	• Programming
	  ○ Flanged shapes
	  ○ Cylinders
	  ○ Conical sections
	  ○ Transitions
	• Troubleshooting
	• Project plates
	• Radial line development
	  ○ Cone
	• Hopper plates

Line (GAC): G FORM MATERIALS

Competency: G5 Fabricate plate

Objectives

To be competent in this area, the individual must be able to:

- Fabricate a hopper.
- Fabricate a cone.
- Use a thread cutting machine.
- Fabricate a four-nozzle tank assembly.

LEARNING TASKS	CONTENT
1. Fabricate a hopper	• Offsets • Calculations • Working bevel • True length diagram • Nesting • Machine selection, setup and sequencing • Forming • Fitting considerations • Labelling • Cardboard mock-up
2. Fabricate a cone	• Stretch out • Radial line development • Calculations • Dimensions • Layout and tools • Symbols and marking • Machine selection and setup • Patterns and sweeps • Cardboard mock-up
3. Use a thread cutting machine	• Set up • Internal/external • Pipe nipple
4. Fabricate a four-nozzle tank assembly	• As built dimensions • Nozzle placement calculations • Layout and tools • Patterns and wrap arounds • Machine selection and setup

Achievement Criteria

Performance — The learner will be able to fabricate the following:

- Hopper
- Cone
- Four-nozzle tank assembly

Conditions — Shop projects will be completed in a training provider facility, given:

- Drawings
- Tools and equipment
- Manual plasma cutting equipment
- 1/8" mild steel/low carbon material
- A prescribed time limit

Criteria — The learner will be evaluated on:

- Completion of three projects within 24 hours
- Dimension and tolerance
- Alignment
- Form and fit
- Appearance
  - Neat and feathered tack welds
  - Tack spacing
  - Tack location
  - Edge finish

Line (GAC): H FABRICATE COMPONENTS

Competency: H1 Construct templates and jigs

Objectives

To be competent in this area, the individual must be able to:

- Construct a jig.
- Construct a template.

LEARNING TASKS	CONTENT
1. Describe considerations for jig construction	• Distortion • Interference • Clearance • Wear • Welding sequence and distortion

2. Construct a simple jig	• Design
	• Cost
	• Computer-based design
	• Tolerances
	  ○ Axis
	  ○ Plane
	  ○ Work point
	• Internal and external constraints
	• Hold downs
	  ○ Dogging
	  ○ Clamping
	  ○ Manipulation

3. Construct a template	• Interpret drawing • Reference datum • Hole set • Edge distance • Plate size • Codes and standards • Marking and identification

Line (GAC): H FABRICATE COMPONENTS

Competency: H2 Construct sub-components

Objectives

To be competent in this area, the individual must be able to:

- Interpret structural drawings.
- Apply codes and specifications.
- Apply quality control.
- Transfer dimensions to material.

LEARNING TASKS	CONTENT

1. Describe structural layout	• Work points
	• Centre lines
	• Slope
	• Run and rise
	• Working bevel
	• Datum
	• Running dimensions
	• Layout tools and equipment
	  ○ Centre punch
	  ○ Scribe
	  ○ Templates

2. Orient components according to drawings	• Near side/far side • Mirror faces • Left/right • Alignment • Fit up • Dimensional accuracy • Appearance
3. Apply codes and standards	• CISC • Building code ○ Stairs and handrail • Architectural • Quality control

Line (GAC): H FABRICATE COMPONENTS

Competency: H3 Determine proper sequence for assembly and welding

Objectives

To be competent in this area, the individual must be able to:

- Plan for the installation and assembly of all components on site.

LEARNING TASKS	CONTENT
1. Describe the operation process for planning the installation and assembly of all components on-site	• Codes and standards • Contractual requirements • Site dimensions • Elevations • Revisions • Staffing
2. Apply quality control	• Dimensions • Alignment • Holes • Fit up • Marking • Geometry

3. Describe welding sequences	• Distortion control
	• Weld
	  ○ Spacing
	  ○ Distribution
	  ○ Sequence

Line (GAC): H FABRICATE COMPONENTS

Competency: H4 Assemble sub-components and components

Objectives

To be competent in this area, the individual must be able to:

- Describe fasteners used in fabrication.
- Describe fitting considerations.

LEARNING TASKS	CONTENT
1. Describe fasteners used in structural steel	• Terminology • Types • Metric/Imperial • Plated • Anchor bolts • Connecting bolts
2. Describe the installation of hi-tensile bolts	• Procedures • Torquing ○ Turn-of-nut method • Machine fitting • Clearance • Alignment • Bolting sequence • Marking • Quality control/inspection • Quality assurance
3. Describe methods for fitting machine components	• Establishment of datum • Locating centerlines/reference lines • Maintaining position of sub-components • Alignment methods

Line (GAC): H FABRICATE COMPONENTS

Competency: H5 Set fabricated component in place

Objectives

To be competent in this area, the individual must be able to:

- Describe levelling fabricated components using the builder's level.

LEARNING TASKS	CONTENT
1. Read drawings	• Location • Access • Grade • Timing
2. Describe installation considerations	• Shimming • Shot elevations • Sight reduction • Sight maps • Alignment • Securing component
3. Describe the builder's level	• Purpose • Types • Characteristics • Components • Set up • Use • Correction • Maintenance • Calculations • Terminology

Line (GAC): H FABRICATE COMPONENTS

Competency: H6 Fabricate structural components

Objectives

To be competent in this area, the individual must be able to:

- Fabricate a stair assembly complete with handrail.

LEARNING TASKS

1. Fabricate a stair assembly complete with handrail

CONTENT

- Codes and standards
- Layout
- Run and rise
- Structural stair terminology

Achievement Criteria

Performance — The learner will be able to fabricate the following:

- Stair with handrail assembly

Conditions — Shop project will be completed in a training provider facility, given:

- Drawings
- Structural steel components
- Shop tools and equipment
- Manual plasma cutting equipment
- A prescribed time limit

Criteria — The learner will be evaluated on:

- Project completion within 12 hours
- Dimension
- Alignment
- Fit up
- Hole locations
- Appearance
  - Mark up
  - Edge finish

Line (GAC): I PERFORM WELDING ACTIVITIES

Competency: I1 Apply weld symbols

Objectives

To be competent in this area, the individual must be able to:

- Apply complex weld symbols.
- Interpret welding codes and standards.
- Interpret welding procedure data sheet (WPDS)
- Describe standard weld inspection symbols.

LEARNING TASKS	CONTENT
1. Apply complex weld symbols	• Multiple reference line • Terminology • Types • Design • Dimensions • Five basic joints • Edge preparation
2. Interpret welding codes and standards	• CWB W59, 47.1
3. Interpret welding procedure data sheet (WPDS)	• Design • Interpret • Apply
4. Describe standard weld inspection symbols	• Radiography • Dye penetrant • Magnetic particle • Acoustic • Ultrasonic • Visual

Line (GAC): I PERFORM WELDING ACTIVITIES

Competency: I2 Use welding processes

Objectives

To be competent in this area, the individual must be able to:

- Describe FCAW and GTAW welding processes.

LEARNING TASKS	CONTENT
1. Describe FCAW and GTAW	• Safety • Applications • Power sources • Components • Current design • Set up • Operation • Maintenance • Consummables • Gases and electrodes

Level 3

Metal Fabricator (Fitter)

Line (GAC): A PERFORM SAFETY-RELATED FUNCTIONS

Competency: A1 Maintain safe work environment

Objectives

To be competent in this area, the individual must be able to:

- Apply the Field Level Risk Assessment (FLRA)
- Apply the Job Hazard Assessment (JHA)
- Conduct an eccentric lift.

LEARNING TASKS	CONTENT
1. Apply the Field Level Risk Assessment (FLRA)	• Plans • Equipment • Safety parameters • PPE • Actions on
2. Apply the Job Hazard Assessment (JHA)	• Task • Equipment • Duration • PPE
3. Conduct an eccentric lift	• Rigging components • Sling configurations • Centre of balance • Working load limits

Achievement Criteria

Performance: The learner will work in pairs to rotate an eccentric load in a controlled fashion.

Conditions: The learner will be given:

- Rigging components
- Hoist
- Eccentric structural shape
- Saw horses
- Dunnage
- A prescribed time limit

Criteria: The learner will be evaluated on:

- Project completion within 1 hour
- Safety
- Control
- Sling configuration

Line (GAC): B USE TOOLS AND EQUIPMENT

Competency: B5 Use computer numerical controlled (CNC) equipment

Objectives

To be competent in this area, the individual must be able to:

- Describe the CNC shape cutting machine.
- Use the CNC shape cutting features.

LEARNING TASKS	CONTENT

1. Describe computer numerical controlled (CNC) cutting equipment	• Applications
	• Advantages and disadvantages
	• Safety considerations
	• Components
	• Software
	• Terminology
	  ○ XY axis
	  ○ Absolute
	• Set up and operation
	  ○ Configuration
	  ○ Plate orientation and origin
	• Cutting
	  ○ Nesting
	  ○ Strip
	  ○ Profile
	• Gas types

2. Use CNC to generate shape cut parts	• Pipe flanges • Project plates • Nests • Detail plates

Line (GAC): C INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS

Competency: C1 Interpret blueprints

Objectives

To be competent in this area, the individual must be able to:

- Interpret advanced multi-drawing sets.
- Apply specifications.
- Apply welding symbols.
- Develop simple CAD details.
- Develop a detailed estimate.

LEARNING TASKS	CONTENT

1. Interpret multi-drawing sets	• Drawing sets
	  ○ Equipment
	  ○ Machinery
	  ○ Mechanical
	  ○ Tanks
	  ○ Vessels
	  ○ Conveyance
	  ○ Transportation

2. Apply specifications	• Codes and standards
	  ○ BC Building Code
	  ○ S16
	  ○ CSA

3. Apply welding symbols	• Inspection
4. Use weld procedure data sheet (WPDS)	• Design • Layout • Content • Application
5. Use CAD software to produce details	• Plate • Component • Part configuration • Identification • Nests

LEARNING TASKS	CONTENT
6. Create a detailed estimate	• Material list • Quantity • Mass • Description • Time • Process requirements • Shipping • Cost

Line (GAC): C INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS

Competency: C2 Interpret structural steel drawings

Objectives

To be competent in this area, the individual must be able to:

- Interpret an advanced structural steel drawing.
- Use computer software to conduct a simple take-off.
- Develop an advanced estimate.

LEARNING TASKS	CONTENT
1. Interpret an advanced structural drawing	• Title block • Material list • Specifications
2. Apply welding symbols and abbreviations	• Detail drawings • Shop projects • Templates • Overlays

3. Develop an advanced estimate	• Computer software
	• Bill of material
	• Structural drawings and details
	• Table of specifications
	• Codes and standards
	• Cranes
	• Shipping
	• Special considerations
	  ○ Traffic control
	  ○ Pilot car
	  ○ Overtime

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D2 Verify structural measurements, welds and layout

Objectives

To be competent in this area, the individual must be able to:

- Apply quality control to structural components.

LEARNING TASKS	CONTENT
1. Identify processes which contribute to measureable change of components	• Machining • Rolling • Shaft clearances • Faying surface alignment • Thermal fitting (shrink fitting) • Interference fit • Alignment fit
2. Apply structural allowances	• Deflection • Twist • Alignment • Distortion
3. Apply appropriate codes to determine permitted tolerances	• CSA, CISC, ASME, AISC, API, CWB, ANSI • Camber tolerances • Sweep tolerances • Mill tolerances • Layout tolerances • Cutting to length • Finishing of ends • Cutting of bevel ends
4. Verify measurements	• Work points (WP) • Datum • Elevations • Offsets

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D3 Track structural materials, consumables and parts for traceability

Objectives

To be competent in this area, the individual must be able to:

- Develop a complex bill of material.
- Create an estimate.

LEARNING TASKS	CONTENT
1. Develop a complex bill of material based on a sub-assembly	• Beam • Column • Structural shape
2. Develop a complex bill of material based on a structural detail	• Plasma • Burned components • Machined items • Fasteners
3. Develop a complex bill of material based on a handrail	• Cost per lineal foot • Jigs
4. Create an estimate	• Bill of material

Line (GAC): D PERFORM QUALITY CONTROL

Competency: D5 Control distortion

Objectives

To be competent in this area, the individual must be able to:

- Apply control methods to prevent distortion.

LEARNING TASKS	CONTENT
1. Identify material classifications	• Compatability • Pre-heatability
2. Apply welding sequences	• Offset • Balance • Deposition
3. Apply pre-forming considerations	• Angular • Offset • Linear
4. Apply pre and post heat	• Material grade • Plate gauge

Line (GAC): E HANDLE MATERIALS

Competency: E1 Organize specialty materials and products.

Objectives

To be competent in this area, the individual must be able to:

- Identify specific handling and storage requirements for specialty materials and products.

LEARNING TASKS	CONTENT

1. Identify and select material and profile	• Alloy
	  ○ Steel
	  ○ Stainless
	  ○ Aluminum
	  ○ Copper
	• Pre-cast
	• High grade finishes
	• Painted products
	• Plated components
	• Surface polished components

2. Locate and verify components	• Sub-assemblies • Cut-to-size pieces • Pre-cut parts • Flanges • Elbows • Pre-fabricated and welded
3. Determine suitable storage for dissimilar products	• Under cover • Temperature • Cross contamination • Softeners • Plate grabs • Rigging

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F1 Perform line development

Objectives

To be competent in this area, the individual must be able to:

- Develop patterns using the triangulation method.

LEARNING TASKS	CONTENT
1. Describe the procedure for developing patterns using triangulation	• Views • Dimensions • Ordinates • True lengths
2. Develop patterns and scaled models using the triangulation method	• Chutes • Square to round transitions • Round to round transitions
3. Calculate and layout intersecting branches	• Round to square • Shape/profile • Angle • Geometric construction requirements • Ordinate plane • Cardboard mock-up (metering valve)

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F2 Calculate bending allowances and stretch outs

Objectives

To be competent in this area, the individual must be able to:

- Determine stretch out lengths.
- Interpret advanced sketches to develop flat plate layout.
- Calculate mass and diagonals.

LEARNING TASKS	CONTENT
1. Interpret advanced sketches to develop flat plate layout	• Cylinder • Rolled segments • Flanged shape
2. Determine mass of flat plate stretch outs	• Cylinder • Rolled segments • Flanged shape • Plate gauge
3. Calculate stretch out diagonal	• Pythagoras' theorem

Line (GAC): F PERFORM TRADE MATH AND LAYOUT

Competency: F3 Calculate diagonals, volume, mass and capacity

Objectives

To be competent in this area, the individual must be able to:

- Solve problems using trigonometric functions.
- Use triangulation to develop patterns.
- Solve advanced problems involving mass and the capacity of vessels.

LEARNING TASKS	CONTENT
1. Describe terms and names used in geometric construction	• Tangent • Arc • Chord
2. Solve problems using trigonometry	• Tangent • Sine • Cosine • Trusses • Cones • Hoppers ○ Bend sets • Arc lengths
3. Develop flat patterns for transition shapes	• Square to round • Offset

4. Calculate dimensions using trigonometry and triangulation	• Advanced problems
	  ○ Slope
	  ○ Rise
	  ○ Base
	• Pattern angle
	• Identify right angle triangles within given shapes
	• True lengths of sides
	• Trigonometry
	  ○ Trusses
	  ○ Hoppers
	  ○ Conical shapes

Line (GAC): G FORM MATERIALS

Competency: G2 Form material using shape rolls

Objectives

To be competent in this area, the individual must be able to:

- Form material using shape rolls.

LEARNING TASKS	CONTENT
1. Review the components and procedures for the use of shape rolls	• Capacity • Direction • Set up and maintenance
2. Use shape rolls to form structural sections	• Hard way/easy way • Machine adjustment • Sweeps • Removal of completed material

Line (GAC): G FORM MATERIALS

Competency: G3 Form material using a brake press

Objectives

To be competent in this area, the individual must be able to:

- Perform complex forming operations.

LEARNING TASKS	CONTENT
1. Use the hydraulic brake press to form metal	• Radial line development • Triangulation • Programming
2. Apply quality control and assurance	• Sweeps and patterns • Check dimensions • True length dimensions

Line (GAC): G FORM MATERIALS

Competency: G4 Form material using computer numerical controlled (CNC) brake press

Objectives

To be competent in this area, the individual must be able to:

- Use machine operations software.
- Form materials using computer numerical controlled (CNC) brake press.

LEARNING TASKS	CONTENT
1. Describe forming material using the CNC brake press	• Applications • Terminology • Advantages and disadvantages • Safety considerations • Software • Set up and operation ○ Back gauging • Maintenance • Troubleshooting

2. Form material using CNC brake press	• Back gauge
	• Programming
	  ○ Flanged shapes
	  ○ Cylinders
	  ○ Conic sections
	  ○ Transitions
	• Troubleshooting
	• Project plates
	• Triangulation
	  ○ Square to round transition
	  ○ Structural frame

3. Use machine operations software to generate formed shapes	• Flanged shapes • Cylindrical • Conic sections • Transition

Line (GAC): G FORM MATERIALS

Competency: G5 Fabricate plate

Objectives

To be competent in this area, the individual must be able to:

- Fabricate a square to round transition.

LEARNING TASKS

1. Fabricate a square to round transition

CONTENT

- Offsets
- Calculations
- Triangulated layout
- CNC machine operation
- CAD drawing
- Nesting software
- Forming
- Fitting considerations
  - Seam orientation
- Cardboard mock-up

Achievement Criteria

Performance — The learner will be able to fabricate the following:

- Square to round transition
- OPTIONAL – spiral staircase complete with handrail (CNC) – *technical training time permitting*

Conditions — Shop projects will be completed in a training provider facility, given:

- Drawings
- Tools and equipment
- 1/8" mild steel/low carbon material
- A prescribed time limit

Criteria — The learner will be evaluated on:

- Completion of the square to round transition project within 12 hours
- OPTIONAL – spiral staircase project complete with handrail completed within 18 hours
- Fitting accuracy
- Alignment
  - Appearance
  - Tack spacing
  - Tack location
  - Edge finish

Line (GAC): H FABRICATE COMPONENTS

Competency: H1 Construct templates and jigs

Objectives

To be competent in this area, the individual must be able to:

- Construct a complex jig.
- Layout a complex template.

LEARNING TASKS	CONTENT
1. Construct a complex jig	• Efficiencies • Construction materials • Time
2. Layout a complex template	• Interpret complex drawing • Material list • Orientation • Marks and labelling

Line (GAC): H FABRICATE COMPONENTS

Competency: H2 Construct sub-components

Objectives

To be competent in this area, the individual must be able to:

- Interpret complex structural drawings.
- Apply codes and specifications.
- Apply quality control.
- Construct a material list.

LEARNING TASKS	CONTENT
1. Construct a material list	• Structural drawings • Templates • Patterns • Material thickness • Part quantity • Marks and numbers • Codes and standards
2. Apply quality control	• Tolerance • Dimensions • Angular offset

Line (GAC): H FABRICATE COMPONENTS

Competency: H3 Determine proper sequence for assembly and welding

Objectives

To be competent in this area, the individual must be able to:

- Plan for fabrication.

LEARNING TASKS	CONTENT
1. Coordinate fabrication	• Site • Shop • Delivery • Sequencing • Space • Staging • Identification • Orientation
2. Apply quality control	• Codes and standards • Inspection • Calibration of equipment • Staffing • Special needs • Cranes and rigging • Shipping

Line (GAC): H FABRICATE COMPONENTS

Competency: H4 Assemble sub-components and components

Objectives

To be competent in this area, the individual must be able to:

- Plan for the installation and assembly of all components.

LEARNING TASKS	CONTENT
1. Verify component is correctly placed.	• Manufacturers' specifications • Blueprints • Tolerances • Inspections • Codes
2. Describe fabrication marks and shipping considerations.	• Orientation • Cardinal • Item marks • Location reference • Coordination • Size and complexity • Handling

Line (GAC): H FABRICATE COMPONENTS

Competency: H5 Set fabricated component in place

Objectives

To be competent in this area, the individual must be able to:

- Use builder's level to establish elevations.

LEARNING TASKS	CONTENT
1. Set up and use a builder's level	• Peg test • Sight plan • Record of sights • Corrected elevations ○ Shim requirement • Maintenance and storage • Transportation • Components
2. Demonstrate effective communication for recording sights	• Environmental considerations • Obstacles • Spatial considerations • Hand signals • Verbal • Radios

Achievement Criteria

Performance: The learner will work in pairs to level two 20' beams 8' apart from each other to within 1/16".

Conditions: As part of a practical shop project completed in a training provider facility, given:

- Sketch
- Shops tools and equipment
- Suitable foundation to measure (sight, grade and condition)
- Suitable assembly to level/evaluate
- Selection of shims
- Within prescribed time

Criteria: The learner will be evaluated on:

- Project completion within 4 hours
- Accuracy
  - +/- 1/16"

Line (GAC): H FABRICATE COMPONENTS

Competency: H6 Fabricate structural components

Objectives

To be competent in this area, the individual must be able to:

- Fabricate a structural frame assembly.

LEARNING TASKS	CONTENT
1. Fabricate a structural frame assembly	• Electronic nesting software • Layout • Machine operation
2. Manage project requirements	• Coordinate • Conflict resolution • Roles and responsibilities • Troubleshooting • Quality control • Time management

Achievement Criteria

Performance

The learner will work in pairs and will be able to fabricate the following:

- Structural frame assembly

Conditions

As part of a practical shop project completed in a training provider facility, given:

- Structural detail drawing
- Computer lab
  - Electronic drawing and detailing software
  - Nesting software
- Structural steel components
- Shop tools and equipment
- Code and standards
- A prescribed time limit

Criteria

The learner will be evaluated on:

- Project completion within 12 hours
- CNC/machinery selection and operation
- Quality control
  - Conforms to specifications
- Accuracy
  - Time
  - Estimate
- Troubleshooting

Line (GAC): I PERFORM WELDING ACTIVITIES

Competency: I1 Apply weld symbols

Objectives

To be competent in this area, the individual must be able to:

- Apply advanced weld symbols.
- Interpret welding codes and standards.

LEARNING TASKS	CONTENT
1. Apply advanced weld symbols	• Component to drawing (and vice versa) • Field marking
2. Interpret welding codes and standards	• CWB W59, 47.1
3. Apply weld inspection symbols	• Radiography • Dye penetrant • Magnetic particle • Acoustic • Ultrasonic • Visual

Line (GAC): J COMPLETE PROJECT

Competency: J1 Determine finishing process

Objectives

To be competent in this area, the individual must be able to:

- Describe finishing processes.
- Describe safety and environmental considerations
- Describe methods and equipment used.

LEARNING TASKS	CONTENT

1. Describe finishing processes	• Advantages and disadvantages
	  ○ Cost benefit
	• Process lifecycle
	• Tools, equipment and identification
	  ○ Galvanizing
	  – Air bleeds
	  – Drain holes
	  ○ Metalizing
	  ○ Painting
	  – Zinc
	  – Epoxy
	  – Latex
	  – Enamel
	  ○ Plating
	  ○ Powder coat
	  ○ Electro-plating
	• Cleaning and maintenance

2. Describe safety and environmental considerations	• WorkSafe • Workplace Hazardous Materials Identification System (WHMIS) • Environmental • Local regulations
3. Identify special considerations	• Inspection • No paint areas • Marking and tagging

Line (GAC): J COMPLETE PROJECT

Competency: J2 Prepare material for finishing

Objectives

To be competent in this area, the individual must be able to:

- Describe methods used to prepare material for finishing.

LEARNING TASKS	CONTENT
1. Describe the different grades of finish required on metal	• Society for Protective Coatings (SSPC)
2. Describe tools used for surface preparation	• Brushes • Chipper • Scraper • Grinder • Sander • Rotary wire wheel
3. Describe equipment used for surface preparation	• Wheelabrator • Sandblaster • Portable vacuum blaster • Abrasives
4. Describe chemical agents used for surface preparation	• Petroleum • Chlorinated solvents • Acid

5. Inspect material edge and surface preparation	• Burrs
	• Sharp edges
	• Cross-contamination
	• Surface blemishes
	  ○ Plate clamp gouges
	  ○ Arc strikes
	  ○ Welding defects
	  ○ Profile weld
	  ○ Spatter
	  ○ Slag

Section 4

ASSESSMENT GUIDELINES

Metal Fabricator (Fitter)

Assessment Guidelines – Level 1

Level 1 Grading Sheet: Subject Competency and Weightings

PROGRAM:	Metal Fabricator
IN-SCHOOL TRAINING:	LEVEL 1

LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	PERFORM SAFETY RELATED FUNCTIONS	3	0
B	USE TOOLS AND EQUIPMENT	15	20
C	INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS	20	0
D	PERFORM QUALITY CONTROL	5	0
E	HANDLE MATERIALS	3	10
F	PERFORM TRADE MATH AND LAYOUT	20	0
G	FORM MATERIALS	7	40
H	FABRICATE COMPONENTS	20	30
I	PERFORM WELDING ACTIVITIES	7	0
	Total	100%	100%
In-school theory / practical subject competency weighting		60	40
Final in-school percentage score		**IN-SCHOOL %**	

In-school Percentage Score Combined theory and practical subject competency multiplied by	80%
Standard Level Exam Percentage Score The exam score is multiplied by	20%
Final Percentage Score	**FINAL%**

Assessment Guidelines – Level 2

Level 2 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	Metal Fabricator LEVEL 2		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
A	PERFORM SAFETY-RELATED FUNCTIONS	3	0
B	USE TOOLS AND EQUIPMENT	15	0
C	INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS	20	0
D	PERFORM QUALITY CONTROL	5	0
F	PERFORM TRADE MATH AND LAYOUT	20	0
G	FORM MATERIALS	10	55
H	FABRICATE COMPONENTS	20	45
I	PERFORM WELDING ACTIVITIES	7	0
	Total	100%	100%
In-school theory / practical subject competency weighting		60	40
Final in-school percentage score		**IN-SCHOOL %**	

In-school Percentage Score Combined theory and practical subject competency multiplied by	80%
Standard Level Exam Percentage Score The exam score is multiplied by	20%
Final Percentage Score	**FINAL%**

Assessment Guidelines – Level 3

Level 3 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	Metal Fabricator LEVEL 3		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
A	PERFORM SAFETY-RELATED FUNCTIONS	2	10
B	USE TOOLS AND EQUIPMENT	18	0
C	INTERPRET PLANS, DRAWINGS AND SPECIFICATIONS	20	0
D	PERFORM QUALITY CONTROL	5	0
E	HANDLE MATERIALS	3	0
F	PERFORM TRADE MATH AND LAYOUT	25	0
G	FORM MATERIALS	9	50
H	FABRICATE COMPONENTS	10	40
I	PERFORM WELDING ACTIVITIES	6	0
J	COMPLETE PROJECT	2	0
	Total	100%	100%
In-school theory / practical subject competency weighting		60	40

Final in-school percentage score Apprentices must achieve a minimum 70% as the final in-school percentage score to be eligible to write the Interprovincial Red Seal or SkilledTradesBC CofQ exam.	**IN-SCHOOL** %

All apprentices who complete Level 3 of the Metal Fabricator program with a FINAL level percentage score of 70% or greater will write the Interprovincial Red Seal examination as their final assessment.

SkilledTradesBC will enter the apprentices' Metal Fabricator Interprovincial Red Seal examination percentage score in SkilledTradesBC Portal.

A minimum percentage score of 70% on the examination is required for a pass.

Section 5

TRAINING PROVIDER STANDARDS

Metal Fabricator (Fitter)

Facility Requirements

Classroom Area

- 900 sq. ft. for a class size of 12 - 16 students, with moveable tables and chairs
- Instructional media to include multimedia projector, projection screen, DVD player, and whiteboard

Shop Area

- 175 sq. ft. per student
- Well heated and ventilated
- 22 ft. high ceilings
- Lighting appropriate for detailed work
- Student locker and changeroom facilities
- 200 sq. ft. clean-up/waste area

Storage

- 200 sq. ft. raw materials storage (may be outdoors)
- 20 sq. ft. per student for tools storage (indoors)

Instructor's Office Space

- 150 sq. ft. per instructor, with a desk, chairs and materials storage/filing system

Tools and Equipment

CUTTING EQUIPMENT

- Angle shear
- Nibblers
- Band saw
- Oxy-fuel torches
- Bevellers
- Pipe cutters
- Dry cutter saw
- Power hack saw
- Friction saw
- Vertical saw
- Hand shear
- Mechanical, electric and hydraulic shears
- Hand-help plasma cutter
- CNC cutting centre

DRILLING EQUIPMENT

- Blocks
- Micrometers
- Calipers
- Pedestal drill
- Core drills (cutters)
- Portable hand drill
- Drill bits
- Punches and dies
- Drill gauges
- Radial arm drill
- Drill press
- Reamers
- Drill press vise
- Standard upright drill
- Hold down clamps
- Tap and dies
- Magnetic drill

BENDING AND SHAPING EQUIPMENT

- Porta power
- CNC process equipment
- Brake press
- Punches
- Fixed and portable mechanical and hydraulic
- Punch presses
- Ironworker
- Various dies
- Manual shape bender
- Plate rolls

FINISHING TOOLS AND EQUIPMENT

- Angle grinder
- Pencil grinder (die)
- Assorted finishing discs
- Sand blaster
- Belt sander
- Sander
- Buffers
- Wheelabrator
- Chippers
- Wire brush
- Hand brush
- Wire wheels

HAND TOOLS

- Assorted wrenches
- Ballpeen hammer
- Bar clamps
- C-clamps
- Dogs and wedges
- Drift pins
- File
- Hand magnets
- Hi/low gauge
- Locking grips
- Measuring tools
- Plumb bob
- Punches
- Sledge hammer
- Squares
- Steel thickness gauge
- Tape measure
- Toggle clamps
- Torque wrench
- Transits
- Various levels
- Vernier calipers

SAFETY EQUIPMENT

- Dust mask
- Face shields
- Fire resistant clothing
- Gloves
- Hard hats
- Hearing protectors
- Reflective gauntlet
- Reflective vest and coveralls
- Respirator
- Safety glasses
- Safety harness
- Self-contained breathing apparatus (SCBA)
- Welding helmets

POWER TOOLS

- Angle grinder
- Air tools
- Bench grinder
- Concrete drills
- Core drill
- Explosive activated tools
- Hammer drill
- Hydraulic power tools
- Magnetic drill
- Pneumatic tools
- Power actuated tools (wrenches, riveters)
- Punches/rams
- Reamer drill

WELDING EQUIPMENT

- Anti spatter paste/gel/spray
- Carbon air arc gouging
- Chipping hammer
- Electrical resistance welding (ERW)
- Equipment for shielded metal arc
- Flux core welding (FCAW)
- Gas metal arc welding (MIG)
- Gas tungsten arc welding (TIG)
- Ground clamps
- Mig pliers
- Oxy-fuel welding
- Thermal electrode device (TED)
- Welding (SMAW)
- Welding cables

- Welding gauge
- Wire brush

RIGGING EQUIPMENT

- Blocks
- Chain cinch
- Chain falls
- Chain slings
- Come-along
- Endless sling assemblies
- Hydraulic and manual jacks
- Manila rope
- Mesh slings
- Personnel basket
- Plate clamps
- Rope and tackle
- Shackles
- Spreader bars
- Synthetic ropes
- Synthetic slings
- Tirfor®
- Tuggers
- Turnbuckles
- Wire rope slings

ELEVATED WORK PLATFORMS

- Ladders
- Personnel basket
- Powered personnel lifts
- Scaffolds

MATERIAL HANDLING EQUIPMENT

- Bridge crane
- Fork lift
- Hydraulic cranes
- Magnetic lifting devices
- Overhead crane
- Mobile cranes and lifts

LAYOUT TOOLS

- Ballpeen hammer
- Beam board
- Beam gauge
- Bevel square
- Centre finder
- Centre punch
- Chalk line
- Combination square
- Divider
- Hand magnet
- Measuring tape
- Paint marker
- Piano wire
- Protractor
- Scribe
- Small clamps
- Soap stone
- Straight edge
- Templates
- Transfer punches
- Transits
- Trammel points
- Various squares
- Laser level

Reference Materials

Required Reference Materials

- Metal Fabrication – a Practical Guide, Third Edition – R.L O'Con and R.H. Carr, 2010
- IPT's Metal Trades & Welding Training Manual – R.G. Garby and B.J. Ashton, 2007
- WorkSafeBC Regulations Online
- Student Materials Package

Recommended

- IPT's Guide to Blueprint Interpretation – G.E. Jacobs, 2004
- AccurPress Accell User Manuals, No. 1 - 3
- American Institute of Steel Construction (AISC) website - Bolting & Welding, ppt.
- Steel Fabrication Modules (BCIT) – 1994, 1995, 2002
- Koike CNC Plus Cutting Machine Operation Modules – No. 1 - 5 (Robotronic Oy, 1997-2004)
- Koike Aronson Instruction Manual MI0549A, 2006 (Kwantlen Polytechnic University)
- EHRT Punching Machine Holecut 40-9 Professional Operation Modules (CNC) - (Kwantlen Polytechnic University)
- Tool Change – Metal Forming Magazine, March 2007
- Canadian Welding Bureau (CWB) Learning Centre Modules, No. 1, 2, 3, 4, 6, 7 and 10 – CWB Group Industry Services, 2006
- Metal Fabrication Apprentice Modules, Level 1, 2 and 3 (Kwantlen Polytechnic University, 2008, 2009)
- Welder Training Program Modules, Level A & B (ITAC 2001)
- Welder Fitting Skills Modules (ITAC 1999)
- Alberta Learning ILM Welder Modules 204a-e, 204h, 2007

NOTE:

This list of Reference Materials is for training providers. Apprentices should contact their preferred training provider for a list of recommended or required texts for this program.

Instructor Requirements

Qualifications and Work Experience

A Metal Fabricator Instructor must have a combination of the following occupational qualifications and work experience:

Metal Fabricator Interprovincial Red Seal certification

A minimum of 5 years' experience working in the industry as a journeyperson after earning Red Seal certification

Demonstrated effectiveness of communication skills, instructional and interpersonal

Experienced user of relevant software for:

- Word processing
- Spreadsheets
- Presentations

Instructional Experience and Education

It is preferred that the instructor also possesses one of the following:

Provincial (BC) Instructor Diploma or completion of a similar Trainer Training/Instructional Methods program, plus

1 year of supervisory or administrative experience

Welding certification level "C" or equivalent

Experienced user of relevant software for CAD

Appendices

Appendix A: Previous Contributors

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Resource Training Organization of British Columbia. Members include:

Industry Subject Matter Experts retained in 2008-2009 to assist in the development of Program Outline content:

- Eric Bohne, Int Assn of Bridge, Ornamental & Reinforcing Iron Workers, Local 712
- Alex Bunt, DC Welding
- Garry Callander, Canadian Forces
- Derek Critchley, Canron
- Lorne Cook, Elk Valley Coal Corp.
- Robert Finlayson, Kwantlen Polytechnic University
- Gary George, Nahanni Manufacturing Ltd
- John Mortimer, Vancouver Shipyards Co. Ltd.
- Mike Pellett, Nahanni Manufacturing Ltd
- Terry Subtelny, BCIT
- Peter Thomas, BCIT
- Allen White, Teck
- Les Wiebe, Thompson Rivers University

Key stakeholders from industry sectors, including employers, associations, training providers, and trades workers, were integral to the guidance of this program development project. Members of the Project Steering Committee who contributed their valuable time and insights to the project were:

- Steve Anderson, Department of National Defence
- Danny Bradford, BC Federation of Labour
- Larry Doskoch, Teck
- Dana Goedbloed, Kwantlen Polytechnic University
- Wayne Muzylowski, West Fraser (Eurocan Pulp and Paper)
- James Piwek, Teck
- Brad Smith, Catalyst Paper
- Cindy Soderstrom, CAODC (Rig Tech Trade)
- Gene Von Matt, Elk Valley Coal
- Wayne Wetmore, Enform Training
- Trevor Williams, BCIT

Industry Subject Matter Experts retained in 2013 to assist in reviewing the Program Outline to address the 2012 NOA updates:

- Robert Finlayson, Kwantlen Polytechnic University
- John Folkers, Weldco Beales
- Nathan Van Seters, Intercontinental Truck Body
- Henry Ostermann, BCIT
- John Sutton, Thompson Rivers University
- Dave Marcinew, Canron
- Al White, Teck (accompanied by Sean Horton)

SkilledTradesBC would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Metal Fabrication occupation.