PROGRAM OUTLINE

Metal Fabricator (Fitter)
METAL FABRICATOR (FITTER)
PROGRAM OUTLINE

APPROVED BY INDUSTRY
MARCH 2013

BASED ON
NOA 2012

Developed by
Industry Training Authority
Province of British Columbia
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Section 1
INTRODUCTION

Metal Fabricator (Fitter)
Introduction

Foreword

This Program Outline is for use in Metal Fabricating industry apprenticeship training classes sponsored by the Industry Training Authority 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

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 Muzylofski, 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)

The Industry Training Authority 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.
# 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.

<table>
<thead>
<tr>
<th>Section</th>
<th>Training Providers</th>
<th>Employers/ Sponsors</th>
<th>Apprentices</th>
<th>Challengers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Credentialing Model</strong></td>
<td>Communicate program length and structure, and all pathways to completion</td>
<td>Understand the length and structure of the program</td>
<td>Understand the length and structure of the program, and pathway to completion</td>
<td>Understand challenger pathway to Certificate of Qualification</td>
</tr>
<tr>
<td><strong>OAC</strong></td>
<td>Communicate the competencies that industry has defined as representing the scope of the occupation</td>
<td>Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification</td>
<td>View the competencies they will achieve as a result of program completion</td>
<td>Understand the competencies they must demonstrate in order to challenge the program</td>
</tr>
<tr>
<td><strong>Training Topics and Suggested Time Allocation</strong></td>
<td>Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided</td>
<td>Understand the relative weightings of various areas of the occupation on which assessment is based</td>
</tr>
<tr>
<td><strong>Program Content</strong></td>
<td>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</td>
<td>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</td>
<td>Provides detailed information on program content and performance expectations for demonstrating competency</td>
<td>Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels</td>
</tr>
<tr>
<td><strong>Training Provider Standards</strong></td>
<td>Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program</td>
<td>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</td>
<td>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</td>
<td>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</td>
</tr>
</tbody>
</table>
Section 2

PROGRAM OVERVIEW

Metal Fabricator (Fitter)
Program Overview

Program Credentialing Model

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

C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work Based Training

RECOMMENDATION FOR CERTIFICATION

C of Q
Metal Fabricator (Fitter)
C of A
Metal Fabricator (Fitter)

Metal Fabricator (Fitter) Level 4
Technical Training: 150 hours (5 weeks*)
Work-Based Training: 6,400 hours total
Interprovincial Red Seal Exam

Metal Fabricator (Fitter) Level 3
Technical Training: 150 hours (5 weeks*)
Work-Based Training: Accumulate hours

Metal Fabricator (Fitter) Level 2
Technical Training: 150 hours (5 weeks*)
Work-Based Training: Accumulate hours

Metal Fabricator (Fitter) Level 1
Technical Training: 150 hours (5 weeks*)
Work-Based Training: Accumulate hours

Metal Fabricator (Fitter) Foundation
Technical Training: 23 weeks*

APPRENTICESHIP - DIRECT ENTRY

* Suggested duration based on 30-hour week

CROSS-PROGRAM CREDITS
Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program

C of Q
Ironworker
Technical Training: Level 1
Work-Based Training: None

C of Q
Boilermaker
Technical Training: Level 1
Work-Based Training: None

C of Q
Welder B
Technical Training: Level 1
Work-Based Training: None

RED SEAL
C of Q
Welder
Technical Training: Level 1
Work-Based Training: None
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, burning, sawing, shearing, punching, rolling, bending, drilling, shaping, forming, straightening, fitting and assembling, reaming, bolting, riveting, welding, testing, inspecting, preparing, priming, 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.
## Program Overview

### Solve complex problems using trigonometry
- **C13**: Solve problems using segmental functions
- 4

### Use Trade Tools
- **D**: Use basic measuring, layout and hand tools
- **D1**: Use bench and hand grinders
- 1
- **D2**: Use and maintain portable power tools
- 1
- **D3**: Use specialized measuring tools
- 1
- **D4**: Use and maintain portable power tools
- 4

### Use Shop Equipment
- **E**: Use the power plate shears
- **E1**: Use the hydraulic brake press
- 1
- **E2**: Use the power plate rolls
- 2
- **E3**: Use the ironworker
- 1
- **E4**: Use shop saws
- 1
- **E5**: Use drill presses
- 1
- **E6**: Use shop saws

### Use the thread cutting machine
- **E7**: Use the Power Shape Rollers (Power Angle Rolls)
- 2
- **E8**: Use the Power Shape Rollers (Power Angle Rolls)
- 2
- **E9**: Use the CNC shape cutting machine
- 3
- **E10**: Use a CNC brake press
- 4
- **E11**: Describe CNC punching equipment
- 4
- **E12**: Develop and use programs for CNC shape cutting equipment

### Burn and Weld Metals
- **F**: Describe safe burning practices
- **F1**: Use a portable oxy-fuel unit
- 1
- **F2**: Use semi-automatic welding machines
- 2
- **F3**: Use the plasma arc cutter
- 1
- **F4**: Use semi-automatic welding machines
- 2
- **F5**: Use arc-air gouging/cutting methods
- 2
- **F6**: Use semi-automatic welding machines
- 2

### Use the thread cutting machine
- **F7**: Use the thread cutting machine
- 2
- **F8**: Use the thread cutting machine
- 2
- **F9**: Use the thread cutting machine
- 2
### Program Overview

<table>
<thead>
<tr>
<th>Category</th>
<th>Task</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Read Drawings</strong></td>
<td>Read Drawings</td>
<td>1 G</td>
</tr>
<tr>
<td></td>
<td>Sketch objects using isometric projection</td>
<td>1 G1</td>
</tr>
<tr>
<td></td>
<td>Sketch objects using orthographic projection</td>
<td>1 G2</td>
</tr>
<tr>
<td></td>
<td>Identify standard weld symbols</td>
<td>1 G4</td>
</tr>
<tr>
<td></td>
<td>Interpreting standard weld symbols</td>
<td>1 G5</td>
</tr>
<tr>
<td></td>
<td>Interpreting simple multi-view shop drawings</td>
<td>1 G6</td>
</tr>
<tr>
<td></td>
<td>Identify standard symbols and abbreviations</td>
<td>1 G3</td>
</tr>
<tr>
<td></td>
<td>Draw secondary views of simple objects</td>
<td>1 G7</td>
</tr>
<tr>
<td></td>
<td>Interpreting complex multi-view shop drawings</td>
<td>1 G8</td>
</tr>
<tr>
<td></td>
<td>Interpret complex multi-view shop drawings</td>
<td>1 G9</td>
</tr>
<tr>
<td></td>
<td>Interpreting specialized multi-view shop drawings</td>
<td>1 G10</td>
</tr>
<tr>
<td></td>
<td>Interpreting complex structural drawings</td>
<td>1 G11</td>
</tr>
<tr>
<td></td>
<td>Interpreting complex structural, erection and detail drawings</td>
<td>1 G12</td>
</tr>
<tr>
<td></td>
<td>Interpreting computer generated shop drawings</td>
<td>2 G13</td>
</tr>
<tr>
<td></td>
<td>Describe electronic detailing</td>
<td>3 G14</td>
</tr>
<tr>
<td></td>
<td>Layout a set of stair stringers</td>
<td>2 G15</td>
</tr>
<tr>
<td><strong>Use Material Handling Equipment</strong></td>
<td>Use safe rigging practices</td>
<td>1 H</td>
</tr>
<tr>
<td></td>
<td>Use material handling equipment and storage practices</td>
<td>1 H1</td>
</tr>
<tr>
<td></td>
<td>Use ladders and scaffolding</td>
<td>2 H2</td>
</tr>
<tr>
<td></td>
<td>Use synthetic and natural fibre lines</td>
<td>2 H3</td>
</tr>
<tr>
<td></td>
<td>Describe safe work practices related to mobile equipment</td>
<td>1 H4</td>
</tr>
<tr>
<td><strong>Use Structural Layout Techniques</strong></td>
<td>Identify standard structural shapes</td>
<td>1 I</td>
</tr>
<tr>
<td></td>
<td>Layout simple templates from a given structural shop drawing</td>
<td>1 I1</td>
</tr>
<tr>
<td></td>
<td>Layout complex templates from a shop drawing</td>
<td>2 I2</td>
</tr>
<tr>
<td></td>
<td>Describe the process operation for various structural projects</td>
<td>2 I7</td>
</tr>
<tr>
<td></td>
<td>Layout a set of stair stringers</td>
<td>3 I8</td>
</tr>
<tr>
<td></td>
<td>Describe the process operation for various structural projects</td>
<td>3 I9</td>
</tr>
<tr>
<td></td>
<td>Identify component parts</td>
<td>2 I3</td>
</tr>
<tr>
<td></td>
<td>Describe the process operation for various structural projects</td>
<td>2 I4</td>
</tr>
<tr>
<td></td>
<td>Identify component parts</td>
<td>2 I5</td>
</tr>
<tr>
<td></td>
<td>Describe the process operation for various structural projects</td>
<td>2 I6</td>
</tr>
</tbody>
</table>
### Program Overview

#### Develop Plate and Structural Patterns

<table>
<thead>
<tr>
<th>J</th>
<th>Define basic layout terms</th>
<th>J1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Develop various patterns</td>
<td>J2</td>
</tr>
<tr>
<td>W</td>
<td>using parallel line</td>
<td></td>
</tr>
<tr>
<td></td>
<td>development</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>Develop shop layout and</td>
<td>J3</td>
</tr>
<tr>
<td></td>
<td>processing for plate</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>W</td>
<td>Integrate radial and</td>
<td>J4</td>
</tr>
<tr>
<td></td>
<td>parallel line development</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>Develop shop layout and</td>
<td>J5</td>
</tr>
<tr>
<td></td>
<td>processing for plate and</td>
<td></td>
</tr>
<tr>
<td>J6</td>
<td>structural sections</td>
<td></td>
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<tr>
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</tr>
<tr>
<td>W</td>
<td>Develop various patterns</td>
<td>J7</td>
</tr>
<tr>
<td></td>
<td>using the triangulation</td>
<td></td>
</tr>
<tr>
<td>J8</td>
<td>method</td>
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</tbody>
</table>

#### Use Surface Preparation and Finishing Methods

<table>
<thead>
<tr>
<th>K</th>
<th>Describe common methods of metal preparation</th>
<th>K1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Describe the types of paints used in industry</td>
<td>K2</td>
</tr>
<tr>
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<tr>
<td></td>
<td>Identify the common methods of paint application</td>
<td>K3</td>
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</tbody>
</table>

#### Fabricate Plate and Structural Sections

<table>
<thead>
<tr>
<th>L</th>
<th>Describe common fitting considerations and procedures</th>
<th>L1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fabricate a cylinder within a cylinder</td>
<td>L2</td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Layout and fit a structural beam</td>
<td>L3</td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Describe modern alignment methods</td>
<td>L4</td>
</tr>
<tr>
<td>W</td>
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<tr>
<td></td>
<td>Fabricate a simple hopper</td>
<td>L5</td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Fabricate a concentric cone</td>
<td>L6</td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Develop and fit branches on a cone</td>
<td>L7</td>
</tr>
<tr>
<td>W</td>
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<td></td>
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<tr>
<td></td>
<td>Fabricate a reduced set of straight stairs</td>
<td>L8</td>
</tr>
<tr>
<td>W</td>
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<td></td>
<td>Fabricate a reduced section of handrail</td>
<td>L9</td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Layout complex templates from a machine detail drawing</td>
<td>L10</td>
</tr>
<tr>
<td>W</td>
<td></td>
<td></td>
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<tr>
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<td>Fabricate a reduced tank with fittings</td>
<td>L11</td>
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<tr>
<td>W</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Fabricate a square to round transition</td>
<td>L12</td>
</tr>
<tr>
<td>W</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Plan, cost and fabricate a structural frame</td>
<td>L13</td>
</tr>
<tr>
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<tr>
<td></td>
<td>Plan, cost and fabricate an eccentric hopper</td>
<td>L14</td>
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<tr>
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<tr>
<td></td>
<td>Apply work simplification methods</td>
<td>L15</td>
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<tr>
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<tr>
<td></td>
<td>Differentiate types of structural steel fasteners</td>
<td>L16</td>
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<tr>
<td></td>
<td>Fabricate a reduced spiral staircase</td>
<td>L17</td>
</tr>
<tr>
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<tr>
<td></td>
<td>Fabricate a multiple transition piece with branches</td>
<td>L18</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>Describe Basic Metallurgy and Testing Techniques</td>
<td>Metal Fabricator (Fitter) Industry Training Authority 13 04/15</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Describe the types, grades and properties of steels</td>
<td>M1 4</td>
<td></td>
</tr>
<tr>
<td>Describe the effects of heat and stress on metals</td>
<td>M2 4</td>
<td></td>
</tr>
<tr>
<td>Describe stress relieving techniques on metals</td>
<td>M3 4</td>
<td></td>
</tr>
<tr>
<td>Identify and use common metal testing methods</td>
<td>M4 4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use Testing and Inspection Methods</th>
<th>N1 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe relevant provincial, national and international fabrication codes</td>
<td>N2 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>On-site Installation</th>
<th>O1 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish area for installation</td>
<td>W 4</td>
</tr>
<tr>
<td>Establish laydown area</td>
<td>O2 4</td>
</tr>
<tr>
<td>Determine required equipment</td>
<td>W 4</td>
</tr>
<tr>
<td>Determine required consumables</td>
<td>O3 4</td>
</tr>
<tr>
<td>Confirm field dimensions</td>
<td>O4 4</td>
</tr>
<tr>
<td>Describe installation of components</td>
<td>O5 4</td>
</tr>
<tr>
<td></td>
<td>O6 4</td>
</tr>
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</table>
### Training Topics and Suggested Time Allocation

#### Metal Fabricator (Fitter) – Level 1

<table>
<thead>
<tr>
<th>Line</th>
<th>Topic</th>
<th>% of Time Allocated to:</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2%</td>
<td>100%</td>
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<tr>
<td>A1</td>
<td>Introduction to the Trade</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Describe the Metal Fabrication trade</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>B1</td>
<td>Use Safe Work Practices</td>
<td></td>
<td>5%</td>
<td>85%</td>
<td>15%</td>
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<td>Describe safe shop practices</td>
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<td>Identify legislation which regulates safe working environments</td>
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<td>Use basic lifting techniques (body mechanics)</td>
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<td>Describe fire safety</td>
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<td>Use a scientific calculator</td>
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<td>Calculate a flat pattern layout for cylinders and forming</td>
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<td>Calculate area and weights/mass for various plate shapes</td>
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<td>Solve problems using ratio and proportion</td>
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<td>Use bench and hand grinders</td>
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<td>Use and maintain portable power tools</td>
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<td>E1</td>
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<td>Use the ironworker</td>
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<td>Use shop saws</td>
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<td>Use drill presses</td>
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## Program Overview

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<td><strong>H</strong></td>
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<td>Use synthetic and natural fibre lines</td>
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<td><strong>I</strong></td>
<td><strong>Use Structural Layout Techniques</strong></td>
<td>8%</td>
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<td>34%</td>
<td>100%</td>
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<tr>
<td>I1</td>
<td>Identify standard structural shapes</td>
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<tr>
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<td>Layout simple templates from a given structural shop drawing</td>
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<td><strong>J</strong></td>
<td><strong>Develop Plate and Structural Patterns</strong></td>
<td>10%</td>
<td>34%</td>
<td>66%</td>
<td>100%</td>
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<tr>
<td>J1</td>
<td>Define basic layout terms</td>
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<td>Develop various patterns using parallel line development</td>
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<tr>
<td>J3</td>
<td>Describe shop layout and processing for plate</td>
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## Program Overview

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<td>Describe common methods of metal preparation</td>
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<td>Describe the types of paints used in industry</td>
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<td>Identify the common methods of paint application</td>
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<td>L</td>
<td>Fabricate Plate and Structural Sections</td>
<td>20%</td>
<td>34%</td>
<td>66%</td>
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<td>Describe common fitting considerations and procedures</td>
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<td>Fabricate a cylinder within a cylinder</td>
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<td>Layout and fit a structural beam</td>
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**Total Percentage for Metal Fabricator (Fitter) Level 1**

100%
# Training Topics and Suggested Time Allocation

## Metal Fabricator (Fitter) – Level 2

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<td>Solve Trade Math Problems</td>
<td>20%</td>
<td>43%</td>
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<tr>
<td>C8</td>
<td>Solve complex problems using geometric construction</td>
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<td>✓</td>
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<tr>
<td>C9</td>
<td>Solve complex problems using Pythagorean theory</td>
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<tr>
<td>C10</td>
<td>Solve problems involving weight, mass and the capacity of vessels</td>
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<tr>
<td>C11</td>
<td>Calculate costs of materials to complete assemblies</td>
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<tr>
<td>Line E</td>
<td>Use Shop Equipment</td>
<td>10%</td>
<td>50%</td>
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<td>100%</td>
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<tr>
<td>E2</td>
<td>Use the hydraulic brake press</td>
<td></td>
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<tr>
<td>E3</td>
<td>Use the power plate rolls</td>
<td></td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>E7</td>
<td>Use the thread cutting machine</td>
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<td>Use the Power Shape Rollers (Power Angle Rolls)</td>
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<td>F7</td>
<td>Use arc-air gouging/cutting methods</td>
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<tr>
<td>F8</td>
<td>Use the plasma arc cutter</td>
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<tr>
<td>F9</td>
<td>Use semi-automatic welding machines</td>
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<td>Line G</td>
<td>Read Drawings</td>
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<td>20%</td>
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<tr>
<td>G5</td>
<td>Interpret standard weld symbols</td>
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<tr>
<td>G8</td>
<td>Draw secondary views of complex objects</td>
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<tr>
<td>G9</td>
<td>Interpret complex multi-view shop drawings</td>
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<td>G10</td>
<td>Interpret complex structural drawings</td>
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<td>Use ladders and scaffolding</td>
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<td>Use Structural Layout Techniques</td>
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<td>Describe standard allowances, required accuracy and shop tolerances</td>
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<td>Identify component parts</td>
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<td>I6</td>
<td>Describe the process operation</td>
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<td>Develop Plate and Structural Patterns</td>
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<td>Develop shop layout and processing for plate and structural sections</td>
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<td>Develop various patterns using radial line development</td>
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Total Percentage for Metal Fabricator (Fitter) Level 2 100%
## Training Topics and Suggested Time Allocation
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<td>Use Structural Layout Techniques</td>
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<td>Describe the process operation for various structural projects</td>
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<td>Line J</td>
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<tr>
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<td>Fabricate a reduced tank with fittings</td>
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<td>L12</td>
<td>Fabricate a square to round transition</td>
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<td>L13</td>
<td>Plan, cost and fabricate a structural frame</td>
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<td>Plan, cost and fabricate an eccentric hopper</td>
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<td><strong>Total Percentage for Metal Fabricator (Fitter) Level 3</strong></td>
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## Training Topics and Suggested Time Allocation

**Metal Fabricator (Fitter) – Level 4**

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<tr>
<th>Line</th>
<th>Topic</th>
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<td>Solve Trade Math Problems</td>
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<td>Solve complex problems using trigonometry</td>
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<td>C14</td>
<td>Solve problems using segmental functions</td>
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<td>E11</td>
<td>Describe CNC punching equipment</td>
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<td>E12</td>
<td>Develop and use programs for CNC shape cutting equipment</td>
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<td>G14</td>
<td>Interpret computer generated shop drawings</td>
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<td>G15</td>
<td>Interpret specialized structural, erection and detail drawings</td>
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<td><strong>Line J</strong></td>
<td>Develop Plate and Structural Patterns</td>
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<td>J8</td>
<td>Develop specialized patterns using the triangulation method</td>
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<tr>
<td><strong>Line L</strong></td>
<td>Fabricate Plate and Structural Sections</td>
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<td>L15</td>
<td>Apply work simplification methods</td>
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<td>L16</td>
<td>Differentiate types of structural steel fasteners</td>
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<td>L17</td>
<td>Fabricate a reduced spiral staircase</td>
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<td>Describe the types, grades and properties of steels</td>
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<td>M3</td>
<td>Describe stress relieving techniques on metals</td>
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<td>Identify and use common metal testing methods</td>
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<td>Describe relevant provincial, national and international fabrication codes</td>
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<td>Use standard non-destructive testing inspection techniques</td>
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<td>O3</td>
<td>Determine required equipment</td>
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<td>O4</td>
<td>Determine required consumables</td>
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<td>O5</td>
<td>Confirm field dimensions</td>
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<td>O6</td>
<td>Describe installation of components</td>
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Total Percentage for Metal Fabricator (Fitter) Level 4 100%
Section 3
PROGRAM CONTENT

Metal Fabricator (Fitter)
Level 1

Metal Fabricator (Fitter)
INTRODUCTION TO THE TRADE

Competency: A1 Describe the metal fabrication trade

Objectives

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

- Describe the trade, including its background and the requirements for qualifications as a metal fabricator.
- Explain the organizational structure and cost considerations found in a fabrication shop.

LEARNING TASKS

1. Describe the history of the trade and identify requirements for qualification as a metal fabricator

   - Early techniques used to sever, form and join metals
   - History of metallurgy
     - Metals technology development
     - Development of alloys
     - History of metal work
   - Significance of the discovery of oxy-acetylene welding, heating and cutting techniques
   - Significance of the electric arc welding process in the advancement of the metal fabrication industry
   - Advantages of steel fabricated structures with respect to strength, durability and maintenance
   - Identify requirements for qualification as a metal fabricator

2. Explain the scope of the trade

   - Available plate and structural shapes used in metal fabrication
   - Major steps involved in the layout and preparation of material
   - Major processes involved in shop forming of plates and structural shapes
   - Procedures and aids employed in shop fitting steel fabricated structures
   - Quality control procedures

3. Explain the standard shop administration in a fabrication shop

   - Superintendent
   - Supervisor
   - Qualified Fabricator
   - Fabricator Apprentice
   - Shop Steward
   - Health and Safety Committee
LEARNING TASKS
4. Describe relevant cost considerations in a fabrication shop

CONTENT
- Material
- Person hours/labour costs
- Maintenance
- Quality of work
- Identify requirements for qualification as a metal fabricator

Achievement Criteria
Given information on the metal fab trade, the learner must identify and answer a series of multiple-choice tests with 70% accuracy.
Line (GAC): B USE SAFE WORK PRACTICES
Competency: B1 Describe safe shop practices

Objectives
To be competent in this area, the individual must be able to:
• Describe safe work rules and procedures.
• Explain how accidents commonly occur in a fabrication shop.

LEARNING TASKS CONTENT
1. Describe safe work procedures
   • Initial first aid procedures
     o First aid stations
     o Muster stations
     o Eye wash stations
   • Limits of untrained persons
   • Location of first aid attendant and their responsibilities
   • Recognition of emergency circumstances
     o Unconsciousness
     o Cardio pulmonary emergency
     o Severe bleeding
     o Burns

2. Describe common causes of accidents in a fabrication shop
   • Inattention to work
   • Disregard of fellow workers
   • Dirty and disorderly work
   • Ignorance of good work practices
   • Improper use of tools and machines
   • Improper clothing and equipment
   • Disregard of material and electrical hazards
   • Lack of safe working attitudes

3. Explain the importance of good housekeeping in a shop environment
   • Cleanliness
   • Waste and crop removal - steel, rod stubs, shavings and dust
   • Liquid spillage
   • Projecting objects
   • Effective guarding
   • Compressed air cleaning

4. Explain the general rules for safe operation of power operated machinery
   • Safe operating capacity
   • Starting and stopping
   • Emergency shut off
   • Machine adjustments
   • Securing material
   • General maintenance
LEARNING TASKS
5. Describe work in adverse weather conditions

CONTENT
- Working in elevated temperatures
- Working in freezing temperatures
- Working in other adverse weather conditions

Achievement Criteria
Given information on safety practices for shop areas, the learner must answer a series of multiple-choice tests with 70% accuracy.
Line (GAC): B USE SAFE WORK PRACTICES
Competency: B2 Identify legislation which regulates safe working environments

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

- Identify the applicable safety and environmental regulations from appropriate provincial and federal agencies.

LEARNING TASKS

1. Define key terms used in the Worker's Compensation Act
   - Applicable terms

2. Describe accident reporting procedures
   - Applicable regulatory authority having jurisdiction

3. Describe applications of the Occupational Health and Safety Regulations of WorkSafeBC
   - Applicable regulation

4. Describe applications of the federal Occupational Safety and Health Regulations
   - Applicable regulation

5. Describe requirements for hazardous or toxic materials protection
   - Applicable regulation

6. Describe requirements of waste disposal and environmental protection
   - Applicable regulation

7. Describe requirements of Transport of Dangerous Goods (TDG)
   - Applicable regulation

8. Describe requirements of Workplace Hazardous Material Information Systems (WHMIS)
   - Materials Safety Data Sheets

Achievement Criteria
Given information on the legislation that regulates safe working environments, the learner must be able to answer a series of multiple-choice tests with 70% accuracy.
Program Content
Level 1

Line (GAC): B USE SAFE WORK PRACTICES
Competency: B3 Describe protective clothing and equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe the functions of various pieces of personal protective equipment.
• Identify regulations pertaining to protective equipment and procedures.

LEARNING TASKS
1. Describe personal protective clothing and equipment
   • Hard hats
   • Safety boots
   • Gloves
   • Burning goggles and welding helmet
   • Sight, hearing and respiratory protection
   • Coveralls, leather aprons and jackets

2. Describe fall protection: restraint and arrest
   • Applicable regulation

3. Identify safety precautions for hand and power tools
   • Applicable regulation

4. Describe energy hazards and required lockout procedures
   • Applicable regulation

Achievement Criteria
Given information on PPE and protective procedures, the learner must be able to answer a series of multiple-choice tests with 70% accuracy.
Line (GAC): B USE SAFE WORK PRACTICES
Competency: B4 Use basic lifting techniques (body mechanics)

Objectives
To be competent in this area, the individual must be able to:
• Describe and apply basic lifting techniques.

LEARNING TASKS
1. Describe the techniques for safely moving and lifting objects
   • Straight back
   • Move your feet
   • Bent knees
   • Lift with leg muscles

2. Apply safe lifting principles
   • Straight back
   • Move your feet
   • Bent knees
   • Lift with leg muscles

Achievement Criteria
Given information on basic lifting techniques, the learner must be able to answer a series of multiple-choice tests with 70% accuracy.
In addition, the learner must perform practical lab tests to apply basic lifting techniques. Test must be performed with 70% accuracy.

Workplace Achievement Criteria
Using basic lifting techniques associated with common lifting tasks in routine workplace operations, the learner must lift various commonly-encountered objects while applying safe lifting principles. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): B      USE SAFE WORK PRACTICES
Competency: B5  Describe Fire Safety

Objectives
To be competent in this area, the individual must be able to:
• Describe fire prevention methods and precautions.

LEARNING TASKS

1. List the three components that must be present before a fire can occur
   • Fuel
   • Oxygen
   • Heat

2. Describe the standard classifications of fires and fire extinguishers
   • Classes of fires
   • Types of extinguishers

3. Identify fire hazards and methods of prevention
   • Applicable regulation

4. Describe fire safety precautions while working near combustible materials
   • Flammable liquids and gases
   • Oily rags
   • Paper or wood products
   • Electrical apparatus
   • Manganese
   • Titanium

Achievement Criteria
Given information on fire safety, the learner must be able to answer a series of multiple-choice tests with 70% accuracy.
Line (GAC): B USE SAFE WORK PRACTICES
Competency: B6 Describe safe work practices for confined work spaces

Objectives
To be competent in this area, the individual must be able to:
• Describe requirements for working in confined spaces.

LEARNING TASKS
1. Describe precautions to be followed when working in enclosed/confined areas

CONTENT
• Clear exit
• Testing and ventilation
• Written work procedures
• Standby person
• Respiratory equipment

Achievement Criteria
Given information on safe work practices for confined work spaces, the learner must be able to answer a series of multiple-choice tests with 70% accuracy.
SOLVE TRADE MATH PROBLEMS

Competency: C1 Solve problems involving fractions

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

- Solve problems involving fractions.

LEARNING TASKS
1. Solve problems involving fractions

CONTENT
- Reduce fractions
- Express fractions in higher terms
- Improper fractions and mixed numbers
- Add, subtract, multiply and divide fractions
- Add and subtract fractions and mixed numbers
- Multiply and divide fractions
- Multiply and divide fractions and mixed numbers

Achievement Criteria
Given information on how to solve problems involving fractions, the learner must be able to correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to solve problems involving fractions for each of the types of fraction-based problems listed. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given problems involving fractions in routine workplace operations, the learner must perform calculations for each of the types of fraction-based problems listed. Employer assessed accuracy is required for each task.
Program Content
Level 1

Line (GAC): C SOLVE TRADE MATH PROBLEMS
Competency: C2 Use a scientific calculator

Objectives
To be competent in this area, the individual must be able to:
• Use a scientific calculator.

LEARNING TASKS
1. Describe important calculator functions and their applications
   • Add, subtract, multiply, divide
   • Squares and square root
   • Memory and recall “pi” and secondary function button
   • Use basic functions, methods, conversions, square root

2. Convert imperial dimensions to decimal values and vice versa
   • Fraction of an inch to decimal of an inch; foot
   • Inch and fraction to decimal of a foot
   • Convert between Imperial and Metric
   • Convert feet and inches to decimals
   • Rounding numbers

Achievement Criteria
Given information on how to solve problems involving formulas with a scientific calculator, the learner must be able to correctly answer a series of multiple choice tests with 70% accuracy. In addition, the learner must perform practical lab tasks to use a scientific calculator to perform calculations for each of the items listed above. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given a scientific calculator in routine workplace operations, the learner must perform calculations for each of the items listed. Employer assessed accuracy is required for each task.
Line (GAC): C SOLVE TRADE MATH PROBLEMS
Competency: C3 Calculate a flat pattern layout for cylinders and forming

Objectives
To be competent in this area, the individual must be able to:
- Calculate stretch-out dimensions of flanged plate and partially rolled plate shapes.
- Make sketches to structural dimensions.

LEARNING TASKS

1. Describe key terms and concepts necessary for correct calculation of plate size
   - Inside dimensions
   - Bend allowances
   - Mean arc length
   - Material thickness

2. Calculate the stretch-out dimensions of flanged plate shapes
   - Single 90 degree bends
   - Multiple 90 degree bends
   - Acute and obtuse s-bends

3. Calculate the stretch-out dimensions of cylinders and partially rolled plate shapes
   - Arc length considerations
   - Allowances for material thickness

4. Make sketches of required plates to stretch-out dimensions
   - Arc length considerations
   - Allowances for material thickness
   - Location of required s-bend lines
   - Bending and forming directions
   - Bend allowance considerations

Achievement Criteria
Given information on how to calculate a flat pattern layout for cylinders and forming, the learner must be able to correctly answer a series of multiple choice tests with 70% accuracy.
In addition, the learner must perform practical lab tasks to calculate a flat pattern layout for cylinders and forming. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given the need to calculate a flat pattern layout for cylinders and forming in routine workplace operations, the learner must perform calculations as required. Employer assessed accuracy is required for each task.
Line (GAC): C SOLVE TRADE MATH PROBLEMS
Competency: C4 Calculate area and weights/mass for various plate shapes

Objectives
To be competent in this area, the individual must be able to:
• Calculate area and weights/mass of various plate shapes.

LEARNING TASKS

1. Describe key terms and concepts necessary for correct calculation of plate weight
   • Plate shape (square, rectangular, triangular, circular)
   • Plate weight constants
   • Dimensions required for calculation
   • Required formulas

2. Calculate imperial areas of plate shapes
   • Plate shape
   • Appropriate formula
   • Required variables

3. Calculate imperial weights of plate shapes
   • Plate shape
   • Appropriate formula
   • Required variables

4. Calculate metric areas of plate shapes
   • Plate shape
   • Appropriate formula
   • Required variables

5. Calculate metric mass of plate shapes
   • Plate shape
   • Appropriate formula
   • Required variables

6. Calculate area and weight of plates using imperial dimensions
   • Plate shape
   • Appropriate formula
   • Required variables

7. Calculate area and mass of plates using metric dimensions
   • Plate shape
   • Appropriate formula
   • Required variables
Achievement Criteria
Given information on problems involving area and weights / mass of various plate shapes, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy. In addition, the learner must perform practical lab tasks to make area and weights / mass calculations for each of the types listed. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given problems based on the list above, in routine workplace operations the learner must be able to calculate area and weights / mass. Employer assessed accuracy is required for each task.
Objectives
To be competent in this area, the individual must be able to:
• Calculate ratios and proportion.

LEARNING TASKS
1. State key terms and concepts required for problem solving
   - Ratio
   - Proportion
   - Problems where ratio and proportion can be used

2. Solve word problems using ratio and proportion
   - Equivalent ratios
   - Unknown quantities

3. Calculate unknown dimensions on shapes using ratio and proportion
   - Similar triangles
   - Circles, arcs, sectors

4. Apply ratio and proportion to trusses working bevels, locations of nozzles
   - Similar triangles
   - Circles, arcs, sectors

Achievement Criteria
Given information on how to calculate ratios and proportion, the learner must be able to correctly answer a series of multiple choice tests with 70% accuracy.
In addition, the learner must perform practical lab tasks to calculate ratios and proportion. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given problems involving ratios and proportion in routine workplace operations, the learner must calculate the answers as required for each of the problems, with 70% accuracy. Employer assessed accuracy is required for each task.
Line (GAC): C SOLVE TRADE MATH PROBLEMS
Competency: C6 Solve simple problems using geometric construction

Objectives
To be competent in this area, the individual must be able to:
- Identify types of geometric construction.
- Perform geometric construction and layout procedures.

LEARNING TASKS

1. Describe terms and names used in geometric construction

   CONTENT
   - Angles
   - Bisect
   - Perpendicular
   - Tangent
   - Ellipse
   - Arc
   - Chord

2. Solve simple problems using geometric construction based on parallel lines

   CONTENT
   - Bisect a line or arc
   - Erect perpendicular to a point on a line
   - Bisect an angle
   - Draw arcs tangent to intersecting lines
   - Locate centre of a circle
   - Construct an ellipse
   - Layout specified plate figure using soapstone, tape, chalk line, dividers or trammels

Achievement Criteria
Given information on problems involving geometry, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
In addition, the learner must perform practical lab tasks to make geometric calculations for each of the situations listed. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given geometric problems as listed, in routine workplace operations the learner must identify the types of geometric construction and perform geometric construction and layout procedures. Employer assessed accuracy is required for each task.
Program Content  
Level 1

Line (GAC): C SOLVE TRADE MATH PROBLEMS  
Competency: C7 Solve simple problems using Pythagorean theory

Objectives
To be competent in this area, the individual must be able to:
• Solve simple problems using the Pythagorean formula.

LEARNING TASKS
1. Describe Pythagoras’ Theorem
   - Fundamental formula
   - Desired derivative
   - Right angled triangle situations

2. Describe key terms and concepts required for problem solution
   - Solve for working bevels
   - Identify sides of a 90º triangle (ABC)

3. Calculate base, rise and slope dimensions of right angled triangles
   - Right angle triangles (introduction)
   - Hypotenuse
   - Adjacent sides
   - Opposite sides
   - Simple problems
     - Calculate slope
     - Calculate rise
   - Identify right angle triangles within given shapes

Achievement Criteria
Given information on problems involving Pythagorean geometry, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
In addition, the learner must perform practical lab tasks to calculate base, rise and slope dimensions of right-angled triangles. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given right-angled triangle problems, in routine workplace operations the learner must apply Pythagoras’ formula. Employer assessed accuracy is required for each task.
## Program Content
### Level 1

**Line (GAC):** D  USE TRADE TOOLS

**Competency:** D1 Use basic measuring, layout and hand tools

### Objectives

To be competent in this area, the individual must be able to:
- Select, use and maintain measuring, layout and hand tools.

### LEARNING TASKS

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<tr>
<th>CONTENT</th>
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<tbody>
<tr>
<td>1. Describe the safe use, care and maintenance of everyday hand tools</td>
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<td>Hammers - chipping, ballpeen, sledge and rubber</td>
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<tr>
<td>Punches, chisels, drift pins and reamers</td>
</tr>
<tr>
<td>Wrenches - adjustable, spanner, socket and pipe wrench</td>
</tr>
<tr>
<td>Vice-grips and &quot;C&quot; clamps</td>
</tr>
<tr>
<td>Twist drills, tapping and ease-out</td>
</tr>
<tr>
<td>Files</td>
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<tr>
<td>2. Identify the types and uses of layout tools and describe their safe use, care and maintenance</td>
</tr>
<tr>
<td>Soapstone and scriber</td>
</tr>
<tr>
<td>Tapes (12' and 50')</td>
</tr>
<tr>
<td>Chalk line and straight edge</td>
</tr>
<tr>
<td>Centre punch</td>
</tr>
<tr>
<td>Dividers and trammels</td>
</tr>
<tr>
<td>2' square</td>
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<tr>
<td>2' level</td>
</tr>
<tr>
<td>Combination set - square, protractor and centering heads</td>
</tr>
<tr>
<td>Plumb bob</td>
</tr>
<tr>
<td>Dial indicator</td>
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<tr>
<td>Contour marker</td>
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<tr>
<td>Feeler gauges</td>
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<tr>
<td>Vernier caliper</td>
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<tr>
<td>Micrometer</td>
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<tr>
<td>Laser measuring devices</td>
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<tr>
<td>Laser levelling and alignment devices</td>
</tr>
<tr>
<td>Check and calibrate measuring devices</td>
</tr>
<tr>
<td>Proper storage and handling of specialized measuring tools</td>
</tr>
</tbody>
</table>
LEARNING TASKS
3. Describe and demonstrate the safe use and care of layout tools used in the metal fabrication industry

CONTENT
- Soapstone and scriber
- Tapes
- Centre punches
- Steel square
- Combination square
- Tri square
- Bevel square
- Beam board
- Flange hole locator
- Web hole locator
- Magnet
- Spring clamp
- Chalk line
- Straight edge
- Trammel points
- Dividers - compass
- Utility knife
- Hand bender

Achievement Criteria
Given information on the use and maintenance of measuring, layout and hand tools, the learner must be able to correctly answer a series of multiple choice tests with 70% accuracy.
In addition, the learner must perform practical lab tasks to use and maintain measuring, layout and hand tools as described. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Using protective equipment associated with the use of tools and shop equipment, in routine workplace operations the learner must select, use and maintain measuring, layout and hand tools as described. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 1

Line (GAC): D USE TRADE TOOLS
Competency: D2 Use bench and hand grinders

Objectives
To be competent in this area, the individual must be able to:
• Explain bench and hand grinder safety considerations.
• Select, use, and maintain bench and hand grinders.

LEARNING TASKS
1. Identify the types of grinders and components
   • Bench grinder
   • Pedestal grinder
   • Belt sander
   • Straight and angle grinders
   • Pencil grinders

2. Describe the procedure to install grinding wheels and disks
   • Mounting the wheel
   • Dressing and truing the wheel
   • Proper washers and tightening

3. Describe safety considerations when using grinders
   • Proper safety wear
   • Ventilation requirements
   • Check equipment before starting
   • Considerations while grinding
   • Specific protection of adjacent equipment, materials - i.e. Protection of glass from sparks

4. Use and maintain bench and hand grinders
   • Debur edges
   • Bevel plate edge
   • Remove plate corner radius square corners
   • Routine maintenance according to manufacturer’s specifications

Achievement Criteria
Given information on using bench and hand grinders safely, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
In addition, the learner must perform practical lab tasks to use bench and hand grinders. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given information on the safe use of bench and hand grinders, the learner in routine workplace operations must be able to use grinders as described.
These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): D USE TRADE TOOLS
Competency: D3 Use and maintain portable power tools

Objectives
To be competent in this area, the individual must be able to:
- Describe handheld power tool safety.
- Select, use and maintain handheld power tools.

LEARNING TASKS
1. Use the magnetic base core drill and drill press
   - Safety considerations
   - Applications
   - Operational range
   - Maintenance of unit

2. Use the abrasive cut-off saw
   - Types and features
   - Applications
   - Safety considerations
   - Operational procedures, maintenance

3. Use electric and pneumatic hand drill motors and reamers
   - Types and features
   - Applications
   - Safety considerations
   - Operational procedures, maintenance

4. Use pneumatic chipping guns
   - Types and features
   - Applications
   - Safety considerations
   - Operational procedures, maintenance

5. Describe electric and pneumatic concrete hammer drills
   - Types and features
   - Applications
   - Safety considerations
   - Operational procedures, maintenance

6. Describe electric and pneumatic impact wrenches
   - Types and features
   - Applications
   - Safety considerations
   - Operational procedures, maintenance

7. Describe concrete anchors
   - Types and features
   - Applications
   - Safety considerations
Achievement Criteria

Given information on using and maintaining handheld power tools safely, the learner must be able to answer a series of multiple choice tests with 70% accuracy. In addition, the learner must perform practical lab tasks to select, use and maintain handheld power tools. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

Given information on the safe use and maintenance of handheld power tools, the learner in routine workplace operations must be able to select and maintain power tools as described. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC):   E  USE SHOP EQUIPMENT
Competency:   E1  Use the power plate shears

Objectives
To be competent in this area, the individual must be able to:
- Explain power plate shear safety considerations.
- Use power plate shears using standard operating procedures.

LEARNING TASKS
1. Identify the parts of a power shear and their function
   - Applications
   - Shearing component parts
   - Controls for machine adjustments
   - Accessories for improved operation

2. Describe safety precautions used when operating the plate shears
   - Width and thickness of cut considerations
   - Types of material
   - Positioning of operator and material
   - Routine maintenance awareness

3. Use the power plate
   - Single plate sheared to a line
   - Multiple plates sheared to same dimensions
   - Use standard operating procedures as specified by WorkSafeBC and by site requirements

Achievement Criteria
Given information on power plate shears, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use power plate shears in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use power shears in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): E USE SHOP EQUIPMENT
Competency: E2 Use the hydraulic brake press

Objectives
To be competent in this area, the individual must be able to:
- Explain hydraulic brake press safety considerations.
- Use the hydraulic brake press to form metal.

LEARNING TASKS
1. Describe the hydraulic press brake’s operation and capabilities
   - Operational theory
   - Types of forming operations

2. Identify the component parts of the brake press and their functions
   - Electric controls and settings
   - Manual adjustments
   - Hydraulic components

3. State safety considerations when operating the hydraulic brake press
   - Formability of materials
   - Capacity of machine
   - Operator safety
   - Machine adjustments
   - Routine maintenance awareness

4. Use the hydraulic brake press to form metal
   - Vee-block width
   - Knife selection
   - Ram adjustment
   - Setting plate for bending
   - Press shutdown considerations
   - Flanged bends and formed arcs

Achievement Criteria
Given information on the hydraulic brake press, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use the hydraulic brake press in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use the hydraulic brake press in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): E USE SHOP EQUIPMENT
Competency: E3 Use the power plate rolls

Objectives
To be competent in this area, the individual must be able to:
- Explain power plate roll safety considerations.
- Use the power plate rolls to roll cylindrical shapes.

LEARNING TASKS

<table>
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<tr>
<th>TASK</th>
<th>CONTENT</th>
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<tbody>
<tr>
<td>1. Identify the component parts of the power plate rolls and their function</td>
<td>Applications</td>
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<td>Control console</td>
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<td></td>
<td>Forming rolls</td>
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<td>Drive mechanisms</td>
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<td>Roll adjustment mechanisms</td>
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<td>2. Describe safety considerations when operating power plate rolls</td>
<td>Machine capacity</td>
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<td></td>
<td>Formability of materials</td>
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<td></td>
<td>o Grade</td>
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<td></td>
<td>o Quality</td>
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<td></td>
<td>o Thickness</td>
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<td></td>
<td>Emergency shut-off</td>
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<td>Routine maintenance awareness</td>
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<tr>
<td>3. Describe the procedure for rolling a cylindrical shape</td>
<td>Dimension of required plate</td>
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<td></td>
<td>Machine adjustment</td>
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<td>Preforming plate</td>
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<td>Sweeps</td>
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<td>Removal of completed cylinder</td>
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<tr>
<td>4. Use the power plate rolls</td>
<td>Prepare materials</td>
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<td></td>
<td>Safety considerations</td>
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<tr>
<td></td>
<td>Adjust machine to requirements</td>
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<tr>
<td></td>
<td>Shut down equipment</td>
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</tbody>
</table>

Achievement Criteria
Given information on the power plate rolls, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use the power plate rolls in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use the power plate rolls in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Objectives
To be competent in this area, the individual must be able to:
• Explain ironworker safety considerations.
• Use the ironworker to prepare material.

LEARNING TASKS
1. Identify the component parts of the ironworker and describe their function
   • Applications
   • Hole punch
   • Plate shears
   • Barstock shears
   • Section shears
   • Operating levers

2. Describe safety precautions to follow when operating the ironworker
   • Punching
   • Shearing
   • Notching
   • Plate selection and quality
   • Routine maintenance awareness

3. Use the ironworker to prepare material
   • Shear plate
   • Shear round stock
   • Notch angle iron
   • Punch holes

Achievement Criteria
Given information on the ironworker, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use the ironworker in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use the ironworker in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 1

Line (GAC): E USE SHOP EQUIPMENT
Competency: E5 Use shop saws

Objectives
To be competent in this area, the individual must be able to:
• Explain shop saw safety considerations.
• Use shop saws to make required cuts.

LEARNING TASKS
1. Identify the types and component parts of shop saws and their function
   • Types of saws and saw blades
     o Horizontal saws
     o Vertical saws
   • Automatic feed

2. Describe the procedure for operating shop saws
   • Safety considerations
   • Feed rates and speeds
   • Installation of blade
   • Clamping material in vice
   • Routine maintenance according to manufacturer’s specifications

3. Use shop saws to perform required cuts
   • Square cut on plate and structural shapes to shop tolerances
   • Mitre cut on structural shapes to shop tolerances

4. Positioning shapes to prevent or minimize damage or breakage of blades
   • Seam placement to prevent or minimize damage or breakage
   • Cost of blades

Achievement Criteria
Given information on shop saws, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use shop saws in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use shop saws in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): E USE SHOP EQUIPMENT
Competency: E6 Use drill presses

Objectives
To be competent in this area, the individual must be able to:
- Explain drill press safety considerations.
- Use a variety of drill presses to perform given tasks.
- Perform general maintenance according to manufacturer’s specifications.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Identify the types of drill presses, their component parts, and function | - Types  
  - Bench top  
  - Floor  
  - Radial arm  
  - Sensitive  
  - Magnetic based  
- Components  
  - Base  
  - Chuck  
  - Drive unit  
  - Feed unit  
  - Work-holding unit |
| 2. Identify the parts and tools used with a drill press | - Twist drills (straight and taper)  
- Reamers  
- Sleeves and sockets  
- Machine taps (spiral)  
- Drifts and wedges  
- Drill gauges  
- Using taps and dies |
| 3. Describe the procedure for operating drill presses | - Safety considerations  
- Drill selection  
- Speed/feed rates  
- Clamping/locating work piece  
- Types of material  
- Sharpening drill bits |
| 4. Use a drill press to perform given drilling tasks | - Pilot drilling  
- Final drilling to required diameter  
- Drill and tap to required size |
LEARNING TASKS
5. Describe safety considerations in operating drill presses

CONTENT
- Hazards
  - Not shutting down
  - Not leaving keys at press
- Safe operation procedures
- Routine maintenance according to manufacturer’s specifications

Achievement Criteria
Given information on drill presses, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use drill presses in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use drill presses in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): F  BURN AND WELD METALS
Competency: F1 Describe safe burning practices

Objectives
To be competent in this area, the individual must be able to:
• Explain the safe practices for burning and welding metals.

LEARNING TASKS
1. Describe precautions to be considered when using burning equipment

CONTENT
• Storing and handling cylinders
• Routine maintenance
• Securing and positioning burning outfit
• Fire hazards and extinguishers
• Safe working pressures
• Proper clothing
• Eye protection – goggles, lenses and screens
• Ventilation requirements
• Respiratory protection
• Explosive substances
• Occupational Health and Safety Regulation (WorkSafeBC)
• WHMIS and MSDS

Achievement Criteria
Given information on safe burning practices for welding, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must apply safe burning practices in lab practical tasks. Tasks must be performed with 70% accuracy.
Program Content
Level 1

Line (GAC): F BURN AND WELD METALS
Competency: F2 Use a portable oxy-fuel unit

Objectives
To be competent in this area, the individual must be able to:
• Explain portable oxy-fuel unit safety considerations, including set up and shut down.
• Use the portable oxy-fuel unit to perform given tasks.

LEARNING TASKS
1. Describe the components and features of the oxy-acetylene burning outfit
   • Oxygen and acetylene cylinders - construction, safety features and pressures
   • Oxygen and acetylene regulators - one and two stages
   • Hoses - construction, colour and maintenance
   • Flash backs and burn backs
   • Reverse flow control valves
   • Torch and tip - types and tip size
   • Tip cleaners
   • Striker
   • Goggles

2. Describe safety procedures in setting up and shutting down burning equipment
   • Secure cylinders and crack valves - acetylene upright
   • Attach regulators, hoses, torch and tip
   • Set working pressures
   • Check for leaks
   • Shut down equipment safely - bleed hoses
   • Routine maintenance awareness

3. Demonstrate the correct operation of oxy-acetylene burning equipment
   • Select appropriate tip size
   • Clean the tip
   • Open valves and adjust regulators for working pressure
   • Light torch and adjust for preheat length and neutral flame
   • Travel at appropriate speed and tip inclination
   • Guided cutting
   • Perform a square and bevel cut on mild steel plate
Achievement Criteria
Given information on portable oxy-fuel units, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use a portable oxy-fuel unit in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use a portable oxy-fuel unit in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): F  BURN AND WELD METALS
Competency: F3 Describe safe arc welding practices

Objectives
To be competent in this area, the individual must be able to:
• Describe safe arc welding practices.

LEARNING TASKS
1. Describe safety precautions to be considered when using arc welding equipment

CONTENT
• Location of machine
• Good machine and cable connections
• Electric shock - damp ground
• Fire hazards and extinguishers
• Proper clothing - arc burn
• Eye protections, proper helmet, lenses and screens
• Ventilation
• Explosive substances
• Occupational Health and Safety Regulation

Achievement Criteria
Given information on arc welding equipment, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
Program Content
Level 1

Line (GAC): F BURN AND WELD METALS
Competency: F4 Identify various arc welding practices

Objectives
To be competent in this area, the individual must be able to:
• Describe different arc welding practices.

LEARNING TASKS
1. Describe the basic principles of operation of different types of arc welding machines
   • DC motor driven generator
   • DC engine driven generator
   • AC transformers
   • AC and DC rectifier

2. Describe and demonstrate machine setting of different types of arc welding machines
   • Polarity
   • Amperage
   • Voltage
   • Dual controls
   • Arc length significance

Achievement Criteria
Given information on different arc welding practices, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must demonstrate the machine settings of different type of arc welding machines in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC):   F   BURN AND WELD METALS
Competency:   F5  Identify electrode characteristics and classifications

Objectives
To be competent in this area, the individual must be able to:
•  Describe electrode characteristics and classifications.

LEARNING TASKS
1. Describe the function and classification of welding electrodes

CONTENT
• Coating
  o Types
  o Effects
• Wire or rod size
• Arc stream, gas shield and slag
• Fusion, penetration and reinforcement
• Electrode classification
  o Tensile strength
  o Position used
  o Rod characteristics
• Storage and handling

Achievement Criteria
Given information on the function and classification of welding electrodes, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
Line (GAC): F  BURN AND WELD METALS
Competency: F6  Weld plate using manual arc welding equipment

Objectives
To be competent in this area, the individual must be able to:
• Weld plate using manual arc welding equipment.
• Perform routine maintenance according to manufacturer’s specifications.

LEARNING TASKS  
1. Select and set-up arc welding machine
   - Type of machine
   - Good cable connections
   - Electrode selection
   - Initial machine settings
   - Safety considerations
   - Routine maintenance according to manufacturer’s specifications

2. Weld mild steel plate in the flat and horizontal positions
   - Comfortable position
   - Striking and maintaining arc
   - Arc length and rod angle
   - Manipulation of welding rod
   - Defects and corrections

Achievement Criteria
Given information on welding plate using manual arc welding equipment, the learner must be able to
answer a series of multiple choice tests with 70% accuracy.
The learner must weld plate using manual arc welding equipment in lab practical tasks. Tasks must be
performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use manual arc welding equipment in routine workplace operations. These
competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each
task.
Program Content
Level 1

Line (GAC):   G READ DRAWINGS
Competency:   G1 Sketch objects using isometric projection

Objectives
To be competent in this area, the individual must be able to:
• Sketch different types of objects using isometric projection.

LEARNING TASKS
1. Identify isometric drawings
   • Major axes
   • Measuring/dimensioning
   • Orientation to viewer

2. Make isometric sketches of simple rectangular objects
   • Axes and relationship to dimensions of given object
   • Construction methods
   • Sketching isometric surfaces
   • Non-isometric surfaces and lines

3. Make an isometric drawing of a given object
   • Orientation of object on drawing
   • Development of construction lines
   • Drawing to scale
   • Non-isometric features
   • Dimensioning isometrically

Achievement Criteria
Given information on sketching objects using isometric projection, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must make isometric drawings of simple rectangular objects and of more complex given objects in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use isometric projection to make sketches in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 1

Line (GAC): G READ DRAWINGS

Competency: G2 Sketch objects using orthographic projection

Objectives
To be competent in this area, the individual must be able to:
• Create multi-view drawings of objects using isometric projection.
• Dimension orthographic sketches.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Identify the alphabet of lines used on shop drawings | • Object lines  
• Hidden lines  
• Centre lines  
• Extension line  
• Dimension line  
• Cutting plane lines  
• Break lines  
• Section lines |
| 2. Describe the principles of orthographic projection | • Object in glass box  
• Views and their relationship  
• Projection method to develop views  
• Selection of views to fully describe object |
| 3. Make multi-view drawings of simple objects | • Views required  
• Orientation of views on paper  
• Scale of drawing  
• Project to develop views  
• Types of line required to describe object |
| 4. Dimension orthographic sketches of simple objects | • Principles of dimensioning  
• Rules for dimensioning  
• Dimensioning systems  
• Metric and Imperial units  
• Types of dimensions  
  ○ Intermediate  
  ○ Overall  
  ○ Running  
  ○ Datum  
  ○ Reference  
  ○ Symmetrical  
  ○ Circular  
  ○ Angular tolerance |
Achievement Criteria

Given information on drawing objects using orthographic projection, the learner must be able to answer a series of multiple choice tests with 70% accuracy. The learner must draw objects using orthographic projection, including multi-view drawings of simple objects and dimensioning orthographic sketches of simple objects, in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must use orthographic projection to make sketches in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): G  READ DRAWINGS
Competency: G3  Draw secondary views of simple objects

Objectives
To be competent in this area, the individual must be able to:
- Draw secondary views of simple objects.

LEARNING TASKS
1. Describe the types of secondary views commonly used

   CONTENT
   - Auxiliary views
   - Section views (full, half, revolved)
   - Orientation of views to given orthographic views
   - Reasons for views to be drawn

2. Draw auxiliary views of features on simple objects

   CONTENT
   - Surface(s) requiring additional detailing
   - Development of true view using given views
   - Use of project methods to develop auxiliary view
   - Orientation of auxiliary view to given orthographic views
   - Dimensioning

3. Draw section views of simple objects

   CONTENT
   - Cutting plane
   - Orientation of section view to given views
   - Scale of section view
   - Types of lines used
   - Dimensioning
   - Square box

4. Draw auxiliary and section views at a given point of a simple object

   CONTENT
   - Apply cutting plane line and orientation
   - Apply appropriate scale and proportion
   - Apply section lines to demonstrate relief and shading

Achievement Criteria
Given information on drawing objects using projection techniques, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must draw secondary views (auxiliary and section views) of simple objects using projection techniques, in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use projection techniques to draw secondary views in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): G READ DRAWINGS
Competency: G4 Identify standard symbols and abbreviations

Objectives
To be competent in this area, the individual must be able to:
• Identify standard symbols and abbreviations on multi-view and structural shop drawings.

LEARNING TASKS
1. Identify standard symbols and abbreviations used on multi-view shop drawings
   • Structural steel sections
   • Dimensioning symbols
   • Directional abbreviations
   • Secondary views notation
   • Hole/drilling references
   • Interpretation of individual symbols and abbreviations

2. Identify standard symbols and abbreviations used on structural shop drawings
   • Dimensioning
   • Machining
   • Burning
   • Layout on structural shapes
   • Fasteners
   • Structural shapes

CONTENT

Achievement Criteria
Given information on standard symbols and abbreviations used on multi-view and structural shop drawings, the learner must be able to answer a series of multiple choice tests with 70% accuracy. The learner must identify standard symbols and abbreviations used on multi-view and structural shop drawings, in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must identify standard symbols and abbreviations used on multi-view and structural shop drawings in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): G READ DRAWINGS
Competency: G5 Interpret standard weld symbols

Objectives:
To be competent in this area, the individual must be able to:
- Identify and interpret standard weld symbols.
- Draw standard weld symbols.

LEARNING TASKS

1. Identify the terminology used with welding symbols
   - Backing
   - Types of welds
   - Edge preparation terms
   - Groove weld component names

2. Describe the common joint designs and supplementary edge preparation
   - Five basic joints
   - Modifications of the joints

3. Identify the standard elements of a basic weld symbol and their location
   - Reference line
   - Basic groove and fillet symbols
   - Supplementary weld symbols
   - Arrow side/other side
   - Groove angle
   - Contour
   - Root opening
   - Size of groove/weld
   - Reference tail
   - Length and pitch
   - Leader line/arrowhead

4. Interpret weld symbols
   - Orientation of reference line to joint
   - Arrow side/other side considerations
   - Required edge preparation
   - Size and location of required weld
   - Contour and means of achieving contour
   - Interpret supplementary symbol

5. Draw weld symbols
   - Given a detailed drawing of a welded joint, draw the complete weld symbol to represent the joint
Achievement Criteria
Given information on standard weld symbols, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must identify, interpret and draw standard weld symbols in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must identify, interpret and draw standard weld symbols in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): G READ DRAWINGS
Competency: G6 Interpret simple multi-view shop drawings

Objectives
To be competent in this area, the individual must be able to:
• Follow a standard procedure to read simple shop drawings.
• Determine materials required and components to be fabricated, and then formulate a bill of material.
• Sketch detailed drawings of specific features.

LEARNING TASKS
1. Identify the general format of a shop drawing
   • Title block
   • Materials list
   • Revision block

2. Apply a standard procedure for reading simple shop drawings
   • Type of shop drawing
   • Title block
   • General notes
   • Revision block
   • Materials list
   • Orientation of given views and identification
   • Calculations required to locate detail

3. Formulate a bill of material from a basic multi-view shop drawing
   • Quantity
   • Piece marks
   • Overall dimensions
   • Weight/mass
   • Special remarks
   • Drawings:
     o Plate
     o Structural
     o Orthographic concept
     o Shipbuilding

4. Sketch detailed drawings of specific features found on basic shop drawings
   • Cut details
   • Hole location on plate and structural shapes
   • Location of detail on main structural members
   • Section views
   • Plate edge preparation

5. Using supplied drawings, identify materials required and components to be fabricated
   • Projections
   • Identify needed materials and components
Achievement Criteria

Given information on interpreting simple multi-view drawings, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must read simple multi-view drawings, sketch detailed drawings of specific features and formulate a bill of material in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must read simple multi-view drawings, sketch detailed drawings of specific features and formulate a bill of material in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 1

Line (GAC): G READ DRAWINGS
Competency: G7 Interpret simple structural drawings

Objectives
To be competent in this area, the individual must be able to:
- Follow a standard procedure to read simple structural drawings.
- Formulate a bill of material.
- Sketch detailed drawings of specific information from simple structural shop drawings.

LEARNING TASKS

1. Identify the format of a structural shop drawing
   - Type of shop drawing
   - Material list
   - Revision block
   - Title block
   - Dimensioning
   - Orientation of beam or column on given drawing paper
   - Apply cardinal reference to erection placement
   - Structural drawing terminology

2. Apply a standard procedure for interpreting simple structural shop drawings
   - Information contained in title block
     - General notes and abbreviations
     - Hole size, location and number required
     - Use of material list to interpret drawing
   - Detailed dimensions of cuts/burning required
   - Revision block
   - Orientation of section views to main view(s)
   - Interpret weld symbols
   - Identification of main structural member(s)

3. Formulate a bill of material from simple structural shop drawings
   - Establish standard edge distance
   - Determine main structural members
   - Quantities
   - Piece marks
   - Overall dimensions
   - Weight/mass
   - Special remarks and directions

4. Sketch detailed drawings of specific information found on simple structural shop drawings
   - Hole location on plate and structural shapes
   - Cut details
   - Plate edge preparation
   - Location of detail on main structural member(s)
Achievement Criteria

Given information on interpreting simple structural drawings, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must read structural drawings, sketch detailed drawings of specific features and formulate a bill of material in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must read structural drawings, sketch detailed drawings of specific features and formulate a bill of material in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC):   H      USE MATERIAL HANDLING EQUIPMENT
Competency:   H1  Use safe rigging practices

Objectives
To be competent in this area, the individual must be able to:
- State applicable WorkSafeBC regulations.
- Describe safe rigging procedures.
- Apply shop rigging methods to move loads.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe WorkSafeBC regulations | • Responsibilities of  
  o WorkSafeBC  
  o Employer  
  o Employee  
• Inspection requirements  
  o Annual  
  o Pre-use  
  o Worksite specific requirements  
  o Risk assessment |
| 2. Calculate the weight of steel plates and structural shapes | • Type of metal and its weight/mass constant  
• Formula for weight/mass calculations  
• Dimensions |
| 3. Describe the types, uses and maintenance of rigging equipment | • Rope - natural and synthetic  
• Plate clamps  
• Tirfor jacks  
• Hydraulic and screw jacks  
• Hooks  
• Shackles  
• Spreader bars  
• Cables  
• Chains  
• Come-a-longs  
• Magnets  
• Vacuum lifts |
| 4. Calculate safe weight lifts (WLL) for cable, chains, shackles, eye bolts and ropes | • Breaking strength  
• Safety factor  
• Rigger's rule of thumb |
LEARNING TASKS

5. Use material handling equipment
   - Types of cranes
     - Overhead
     - Hoist
     - Jib
     - Come-a-longs
   - Centre of gravity
   - Lift points
   - Potential damage to object being lifted
   - Capacity of cranes

6. Describe the correct rigging hand signals
   - Boom signals
   - Line signals

7. Describe safe procedures for disconnecting and removing rigging
   - Dangers of load collapse or rollover
   - Tensioned chokers or Tirfors

8. Describe and demonstrate shop rigging methods when moving loads
   - Hoisting
   - Rotating (turning)
   - Rolling
   - Guiding
   - Aligning
   - Safety Considerations

Achievement Criteria

Given information on safe rigging practices, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must move loads by applying shop rigging methods in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must move loads by applying shop rigging methods in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content  
Level 1

**Line (GAC):** H  **USE MATERIAL HANDLING EQUIPMENT**

**Competency:** H2 Use material handling equipment and storage practices

**Objectives**

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

- Select appropriate lifting aids and equipment for lifting jobs.
- Demonstrate correct storage procedures for different metals and structural shapes.

**LEARNING TASKS** | **CONTENT**
---|---
1. Select appropriate lifting aids | • Lugs  
 |  | • Lifting points and attachments  
 |  | • Weld wrap around the lug  
 2. Select correct equipment for lifting job | • Approximate weight/mass  
 |  | • Appropriate rope/chain  
 |  | • Rigging attachments  
 3. Describe and demonstrate correct storage procedures for steel plate and structural shapes | • Wide flange  
 |  | • Angle iron  
 |  | • Channel  
 4. Note special handling considerations for specific metals | • Hard plate  
 |  | • Chrome carbides  
 |  | • Stainless steel  
 |  | • Aluminum  
 |  | • Environmental conditions  
 5. Use safe and appropriate materials storage practices | • Stacking of materials  
 |  | • Nesting techniques  
 |  | • Selection and location of dunnage  
 |  | • Safe heights  
 |  | • Racking techniques for plate  
 |  | • Materials labelling and identification  
 6. Describe laydown area requirements for receiving materials | • Space availability  
 |  | • Workflow coordination  
 |  | • Materials handling areas
Achievement Criteria
Given information on using material handling equipment, the learner must be able to answer a series of multiple choice tests with 70% accuracy. The learner must follow correct procedures for handling various metals and structural shapes in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must follow correct procedures for handling various metals and structural shapes in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): H USE MATERIAL HANDLING EQUIPMENT
Competency: H4 Use synthetic and natural fibre lines

Objectives
To be competent in this area, the individual must be able to:
- Describe the care and maintenance of synthetic and natural fibre lines.
- Demonstrate the use of knots, bends and hitches.

LEARNING TASKS

1. Identify natural and synthetic fibre ropes
   - Terminology
   - Appearance
   - Relative strengths
   - Reaction to moisture/chemicals
   - Safe working load

2. Describe the care and maintenance of ropes
   - Coiling and uncoiling
   - Whipping
   - Storage
   - Maintenance
   - Considerations when in use

3. 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
Given information on using synthetic and natural fibre lines, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use knots, bends and hitches in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner use knots, bends and hitches in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): H

USE MATERIAL HANDLING EQUIPMENT

Competency: H5 Describe safe work practices related to mobile equipment

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

- Describe hazards and regulations related to mobile equipment.

LEARNING TASKS

1. Describe hazards associated with mobile equipment and relevant WorkSafeBC regulations
   - WorksafeBC regulations
   - Hazards in working with
     - Manlifts
     - Forklifts
     - Mobile cranes
   - Working around overhead wires
   - Responsibilities of
     - WorkSafeBC
     - Employer
     - Employee
   - Inspection requirements
     - Annual
     - Pre-use
     - Worksite specific requirements
     - Risk assessment

2. Describe hazards associated with material handling equipment
   - Routine maintenance according to manufacturer’s specifications
   - Load chart calculations
   - Safe lift practices
   - Cordon off areas
   - Fueling and refueling
   - Securing and storing

Achievement Criteria
Given information on safe work practices related to mobile equipment, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must apply safe work practices when using mobile equipment in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must apply safe work practices when using mobile equipment in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 1

Line (GAC): I USE STRUCTURAL LAYOUT TECHNIQUES
Competency: I1 Identify standard structural shapes

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

- Describe all aspects of standard structural shapes.

LEARNING TASKS

1. Describe standard structural shapes and their symbols and abbreviations

- Distinctive shape characteristics
- Names of component parts
- Symbol or abbreviation for each

2. Describe the standard dimensioning of plates, HSS shapes, pipe and angle iron

- Standard order of dimensions
- Location of shape symbols and abbreviation
- Specific distances the dimensions represent
- Pipe description - old and new methods

3. Describe dimensioning of wide flange, beams and channel shapes

- Nominal sizes
- Exact sizes
- Table listings for exact and nominal sizes
- Table listings for exact and nominal sizes

4. Demonstrate correct use of the steel handbook for dimensions for the following steel shapes

- Beams - WWF, W, W, M
- Channels - standard, miscellaneous
- Angles

Achievement Criteria
Given information on standard structural shapes, the learner must be able to answer a series of multiple choice tests with 70% accuracy. The learner must incorporate knowledge of standard structural shapes in lab practical tasks. Tasks must be performed with 70% accuracy.
**Program Content**  
**Level 1**

**Line (GAC):** I  
**Competency:** I2  
**USE STRUCTURAL LAYOUT TECHNIQUES**  
**Layout simple templates from a given structural shop drawing**

**Objectives**

To be competent in this area, the individual must be able to:
- Describe applications of various types of simple templates.
- Lay out a simple template.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe the function and meaning of key</td>
<td>• Pitch</td>
</tr>
<tr>
<td>structural layout terminology</td>
<td>• Work point</td>
</tr>
<tr>
<td></td>
<td>• Centre line</td>
</tr>
<tr>
<td></td>
<td>• Gauges</td>
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<tr>
<td></td>
<td>• Running dimension</td>
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<td></td>
<td>• Centre to centre</td>
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<tr>
<td></td>
<td>• Working bevel</td>
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<tr>
<td></td>
<td>• Right and left hand</td>
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<td></td>
<td>• Opposite hand</td>
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<tr>
<td></td>
<td>• Template</td>
</tr>
<tr>
<td>2. Describe the function and reasons for making</td>
<td>• Number required</td>
</tr>
<tr>
<td>a template</td>
<td>• Repetitive order</td>
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<td></td>
<td>• Usefulness of bridge work</td>
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<td></td>
<td>• Requirement in large shop</td>
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<td>3. Describe the reasons for using different</td>
<td>• Cardboard</td>
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<tr>
<td>materials for templates for varying job situations</td>
<td>• Sheet metal</td>
</tr>
<tr>
<td></td>
<td>• Wood</td>
</tr>
<tr>
<td></td>
<td>• Steel</td>
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<tr>
<td>4. Describe the importance and reasons for</td>
<td>• Type of material</td>
</tr>
<tr>
<td>inspecting and using the correct material called</td>
<td>• Grade of material - colour code</td>
</tr>
<tr>
<td>for on a drawing</td>
<td>• Size of material</td>
</tr>
<tr>
<td></td>
<td>• Defective material</td>
</tr>
<tr>
<td>5. Demonstrate a proficiency in the making of a</td>
<td>• Layout principles in regard to material</td>
</tr>
<tr>
<td>simple template in an accurate, economical and</td>
<td>utilization</td>
</tr>
<tr>
<td>productive manner</td>
<td>• Hole location using working bevel</td>
</tr>
<tr>
<td></td>
<td>• Edge distances</td>
</tr>
<tr>
<td></td>
<td>• Mark-up of template</td>
</tr>
</tbody>
</table>
Achievement Criteria

Given information on laying out simple templates from a structural shop drawing, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must apply lay out simple templates from a structural shop drawing in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must lay out simple templates from a structural shop drawing in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): J DEVELOP PLATE AND STRUCTURAL PATTERNS
Competency: J1 Define basic layout terms

Objectives
To be competent in this area, the individual must be able to:
• Define basic layout terms.

LEARNING TASKS

1. Define basic layout terms

CONTENT
• Flange
• Roll
• Form
• Bend set
• Sweep
• Template
• Pattern
• Opposite hand (R/L hand)
• Preform
• Dish
• Stretch-out
• Bend allowance
• Tolerance
• Template angle
• Nesting

Achievement Criteria
Given information on basic layout terms, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
Line (GAC): J DEVELOP PLATE AND STRUCTURAL PATTERNS
Competency: J2 Develop various patterns using parallel line development

Objectives
To be competent in this area, the individual must be able to:
• Use parallel line development to create patterns and scaled models for common applications.

LEARNING TASKS
1. Describe the procedure for developing patterns using the parallel line method
   • Views required to develop patterns
   • Dimensions for required views
   • Establish element lines
   • True lengths for required patterns
   • Layout and mock-up of patterns

2. Develop patterns and scaled models using the parallel line method
   • Truncated rectangular pipe
   • Truncated round pipe
   • Pipe tee-joint
   • Offset-pipe tee-joint
   • Inclined (lateral) pipe joint

3. Develop patterns and scaled models using the parallel line method
   • Multi-piece pipe elbow

Workplace Achievement Criteria
The learner must use parallel line development to create patterns and scaled models for common applications in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): J DEVELOP PLATE AND STRUCTURAL PATTERNS
Competency: J3 Develop Shop Layout and Processing for Plate

Objectives
To be competent in this area, the individual must be able to:
• Calculate and lay out various formed plate shapes.

LEARNING TASKS
1. Calculate and layout various formed plate shapes

CONTENT
• Make required stretch-out calculations
• Check material list
• Inspect plate for type and size
• Demonstrate efficient utilization of material
• Employ geometric and dimensional accuracy in layout of reference lines, element lines and perimeter dimension
• Make diagonal checks where possible
• Mark plates for cutting edge preparation and forming
• Develop required bend sets, templates or sweeps

Workplace Achievement Criteria
The learner must calculate and lay out various formed plate shapes in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): K USE SURFACE PREPARATION AND FINISHING METHODS
Competency: K1 Describe common methods of metal preparation

Objectives
To be competent in this area, the individual must be able to:
• Describe methods and equipment used in metal preparation.

LEARNING TASKS
1. Describe "hand-held" methods of surface preparation
   • Brushes
   • Chippers
   • Sealer
   • Scrapers
   • Grinders
   • Sanders
   • Safety and environmental considerations (WHMIS and MSDS)

2. Describe blasting-type equipment used for surface preparation
   • Wheelabrator
   • Sandblaster
   • Portable vacuum blaster
   • Types and grades of abrasives
   • Dry ice blasting
   • Sponge blast
   • Safety and environmental considerations (WHMIS and MSDS)

3. Describe chemical methods used for surface preparation
   • Petroleum solvents
   • Chlorinated solvents
   • Acid cleaners (pickling and passivating stainless steel)
   • Safety and environmental considerations (WHMIS and MSDS)

4. Describe the different grades of finish required on metal
   • Brush-off cleaning
   • Near white
   • Commercial white metal
   • Safety and environmental considerations (WHMIS and MSDS)
   • Standard finishing codes (SB, SSPC, NACE)
LEARNING TASKS

5. Describe other methods of surface coating and finishing

- Galvanizing
  - Air bleeds
  - Drain holes
- Thermal spray
- Anodizing
- Electroplating
- Powder coating
- Painting
  - Filling
  - Blending
- Safety and environmental considerations (WHMIS and MSDS)
- Property damage considerations

6. Describe manual tracking systems for traceability

- Tagging
- Number stamping
- Engraving

Achievement Criteria

Given information on methods and equipment used in metal preparation, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must apply the methods and equipment used in metal preparation in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): K USE SURFACE PREPARATION AND FINISHING METHODS
Competency: K2 Describe the types of paints used in industry

Objectives
To be competent in this area, the individual must be able to:
• Describe types and characteristics of paint used in the metal fabrication industry.

LEARNING TASKS
1. Identify the various types of paint used in the metal fabrication industry
   • Alkyd paint
   • Zinc paint
   • Epoxy paint
   • Coal tar paint
   • Vinyl paint
   • Water base paint

2. Describe the characteristics and suitability of a paint
   • Ease of application
   • Method of application
   • Suitability to anticipated on-site conditions
   • Cost overall
   • Drying time
   • Surface conditions
   • Safety and environmental considerations (WHMIS and MSDS)

Achievement Criteria
Given information on the types and characteristics of paint used in the metal fabrication industry, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must apply knowledge of the types and characteristics of paint used in the metal fabrication industry in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): K

USE SURFACE PREPARATION AND FINISHING METHODS

Competency: K3 Identify the common methods of paint application

Objectives
To be competent in this area, the individual must be able to:
• Describe the common methods of paint application used in the metal fabrication industry.

LEARNING TASKS
1. List the advantages/disadvantages of common paint application methods

CONTENT
• Equipment required
• Speed of application
• Quality of finish
• Cleanup
• Shop space
• Protection considerations re: finishes and coatings

2. Describe the common methods of paint application

CONTENT
• Hand application (brush, roller)
• Dip tank
• Electrostatic spraying
• Spray outfit (air, airless)
• Safety and environmental and property damage (overspray) considerations (WHMIS and MSDS)
• Ventilation requirements

Achievement Criteria
Given information on the common methods of paint application used in the metal fabrication industry, the learner must be able to answer a series of multiple choice tests with 70% accuracy. The learner must apply knowledge of the common methods of paint application used in the metal fabrication industry in lab practical tasks. Tasks must be performed with 70% accuracy.
Program Content
Level 1

Line (GAC): L

FABRICATE PLATE AND STRUCTURAL SECTIONS

Competency: L1 Describe common fitting considerations and procedures

Objectives
To be competent in this area, the individual must be able to:
• Describe common fitting considerations, including methods, procedures and types of jigs used.

LEARNING TASKS
CONTENT
1. Describe a typical method of fitting used in the steel fabrication industry
   • Basic planning procedures
   • Required materials
   • Special tooling
   • Starting point for fabrication
   • Required tolerances
2. Describe the proper procedures to follow when preparing materials for fitting
   • Detail pieces
   • Main pieces
3. Describe the criteria used to decide if a jig is required to aid a fabrication
   • Size of assembly
   • Number required
   • Complexity of assembly
   • Dimensional tolerances
4. Describe the different types of jigs used in fabrication
   • Built-up on plate
   • Built-up off frame specifically made
   • First unit fabricated made into jig
   • Portable jigs - set holes and distances
5. Describe the reasons for making sub-assemblies for certain components
   • Size of job
   • Delivery date
   • Estimate person hours/labour costs
6. Describe how to help control and minimize the effects of heat distortion
   • Sub-assemblies
   • Jigs and fixtures
   • Welding sequences
   • Proper fit-up
7. Select and use tools and equipment for assembly
   • Type and space
   • Torque requirements

Achievement Criteria
Given information on the common fitting considerations, including methods, procedures and types of jigs used, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must apply knowledge of the common fitting considerations, including methods, procedures and types of jigs used in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): L  FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L2  Fabricate a cylinder within a cylinder

Objectives
To be competent in this area, the individual must be able to:
• Create patterns and use shop equipment to fabricate a cylinder within a cylinder.

LEARNING TASKS
<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Develop required patterns for various pipe connections</td>
</tr>
<tr>
<td>• Pipe diameter considerations</td>
</tr>
<tr>
<td>• Layout of patterns and sweeps</td>
</tr>
<tr>
<td>2. Use selected shop layout and material preparation equipment</td>
</tr>
<tr>
<td>• Quarter line layout</td>
</tr>
<tr>
<td>• Torch angle when burning profiles</td>
</tr>
<tr>
<td>• Clean-up of burned edges</td>
</tr>
<tr>
<td>• Tolerances</td>
</tr>
<tr>
<td>• Layout drilling and tapping</td>
</tr>
<tr>
<td>3. Describe an accepted method for fitting detail pieces</td>
</tr>
<tr>
<td>• Establishment of datum</td>
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<tr>
<td>• Locating centerlines/reference lines</td>
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<tr>
<td>• Establish drilling and tapping</td>
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<tr>
<td>• Alignment methods</td>
</tr>
<tr>
<td>• Fitting tools and aids</td>
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<tr>
<td>• Trial assembly considerations</td>
</tr>
<tr>
<td>4. Describe relevant fitting considerations and review job planning to identify efficiencies</td>
</tr>
<tr>
<td>• Establish drilling and tapping locations</td>
</tr>
<tr>
<td>• Alignment</td>
</tr>
<tr>
<td>• Dimensional accuracy</td>
</tr>
<tr>
<td>• Fitting/fairing considerations</td>
</tr>
<tr>
<td>• Appearance</td>
</tr>
<tr>
<td>• Estimation of time/material accuracy</td>
</tr>
</tbody>
</table>

Workplace Achievement Criteria
The learner must create patterns and use shop equipment to fabricate a cylinder within a cylinder in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 1

Line (GAC): L FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L3 Layout and fit a structural beam

Objectives
To be competent in this area, the individual must be able to:
• Lay out templates and prepare materials to fit a structural beam.

LEARNING TASKS  

1. Layout the templates required from a simple drawing
   • Nesting considerations
   • Baseline/reference line
   • Working bevels
   • Standard edge distances
   • Template mark-up

2. Use shop equipment to prepare materials
   • Layout equipment to prepare materials
   • Locating/punching holes
   • Preparing plate edges and holes
   • Plate fitting angle iron
   • Beam board for squaring lines
   • Flange/web gauge tools

3. Describe relevant fitting considerations
   • Framing square to locate detail
   • Location of detail on structural shape
   • Location of tack welds

4. Use structural fitting tools and methods
   • Alignment
   • Dimensional accuracy
   • Fitting/fairing
   • Appearance

5. Review of job planning to identify efficiency
   • Estimation of time/material accuracy

Workplace Achievement Criteria
The learner must lay out templates and prepare materials to fit a structural beam in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Level 2

Metal Fabricator (Fitter)
Program Content  
Level 2

Line (GAC):   C   SOLVE TRADE MATH PROBLEMS
Competency: C8 Solve complex problems using geometric construction

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

• Use geometric construction applied to a radial pattern to solve complex problems.

LEARNING TASKS  
1. Solve complex problems using geometric construction applied to a radial pattern

CONTENT
• Bisect a line or arc
• Erect perpendicular to a point on a line
• Bisect an angle
• Draw arcs tangent to intersecting lines
• Locate centre of a circle
• Construct an ellipse on a cone
• Layout specified plate figure using soapstone, tape, chalk line, dividers or trammels
• Solve for chord length
• Connect points with an arc
• Perpendicular line through an arc

Achievement Criteria
Given information on using geometric construction applied to a radial pattern to solve complex problems, the learner must be able to answer a series of multiple choice tests with 70% accuracy. In addition, the learner must perform practical lab tasks using geometric construction applied to a radial pattern to solve complex problems. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
In routine workplace operations the learner must use geometric construction applied to a radial pattern to solve complex problems. Employer assessed accuracy is required for each task.
Program Content
Level 2

Line (GAC): C SOLVE TRADE MATH PROBLEMS
Competency: C9 Solve complex problems using Pythagorean theory

Objectives
To be competent in this area, the individual must be able to:
• Solve complex problems using the Pythagorean formula.

LEARNING TASKS
1. Review Pythagoras' theorem
   • Key terms and concepts
   • Fundamental formula
   • Transposing
   • Right angled triangles

2. Calculate base, rise and slope dimensions of right angle triangles
   • Third angle projections
   • True lengths of sides
   • Rolling offsets applied to pipes or rounds

3. Apply Pythagorean Theory
   • Trusses
   • Hoppers
   • Conical shapes

Achievement Criteria
Given information on complex problems involving Pythagorean geometry, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
In addition, the learner must perform practical lab tasks to calculate base, rise and slope dimensions of right-angled triangles. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given complex right-angled triangle problems, in routine workplace operations the learner must apply Pythagoras' formula. Employer assessed accuracy is required for each task.
Line (GAC): C  SOLVE TRADE MATH PROBLEMS
Competency: C10  Solve problems involving weight, mass and the capacity of vessels

Objectives
To be competent in this area, the individual must be able to:
• Solve a variety of problem types involving weight, mass and the capacity of vessels.

LEARNING TASKS
1. Types of plate fit used on vessels
   • Cylindrical vessels
   • Box-shaped vessels
2. Identify information required to detail cylindrically shaped tank vessels
   • Given and required diameters
   • Type of plate fit
   • Material thickness
3. Solve for shell plate stretch-out dimensions
   • Given and required dimensions
   • Selection of required formula
4. Solve for cylindrical vessel weight / mass
   • Selection of correct formula
   • Determine required dimensions
5. Solve for cylindrical vessel capacity
   • Selection of correct formula
   • Determine required dimensions
6. Identify information required to detail box-shaped vessels
   • Dimensions of individual sides
   • Thickness of material
   • Type of plate fit
7. Solve for box-shaped vessel weight/mass
   • Individual plate dimensions
   • Correct formulas
8. Solve for box-shaped vessel capacity
   • Required dimensions for formula used

Achievement Criteria
Given information on a variety of problem types involving weight, mass and the capacity of vessels, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy. In addition, the learner must perform practical lab tasks to solve a variety of problem types involving weight, mass and the capacity of vessels. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
Given problems based on the list above, in routine workplace operations the learner must be able to solve a variety of problem types involving weight, mass and the capacity of vessels. Employer assessed accuracy is required for each task.
Program Content  
Level 2

Line (GAC):   C      SOLVE TRADE MATH PROBLEMS
Competency:   C11  Calculate costs of materials to complete assemblies

Objectives
To be competent in this area, the individual must be able to:
• Calculate materials and labour costs needed to complete assemblies.

LEARNING TASKS
1. Calculate costs of geometric plate shapes
   • Individual plate dimensions
   • Correct formulas
   • Material price lists

2. Calculate costs of detailed components excluding fabrication (assembly) costs
   • Individual plate/stock dimensions
   • Correct formulas
   • Material price lists

3. Calculate labour requirements and costs for an assembly
   • Man-hour requirements
   • Based on weight

Achievement Criteria
Given information on the materials and labour costs needed to complete assemblies, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy. In addition, the learner must perform practical lab tasks to calculate materials and labour costs needed to complete assemblies. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
In routine workplace operations the learner must be able to calculate materials and labour costs needed to complete assemblies. Employer assessed accuracy is required for each task.
Line (GAC): E USE SHOP EQUIPMENT
Competency: E2 Use the hydraulic brake press

Objectives
To be competent in this area, the individual must be able to:
• Explain hydraulic brake press safety considerations.
• Use the hydraulic brake press to perform complex forming operations.

LEARNING TASKS
1. Review the operation of the hydraulic brake press
   • Operational theory
   • Components and functions
     o Electric controls and settings
     o Manual adjustments
     o Hydraulic components
   • Safety considerations
     o Operator safety
     o Machine adjustments

2. Use the hydraulic brake press
   • Complex forming operations involving radial line development
   • Pre-bends
   • Soft radius bending
   • Offset dies
   • Goose-neck dies

Achievement Criteria
Given information on the hydraulic brake press, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use the hydraulic brake press in complex lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use the hydraulic brake press to perform complex forming operations in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): E USE SHOP EQUIPMENT
Competency: E3 Use the power plate rolls

Objectives
To be competent in this area, the individual must be able to:
• Explain power plate roll safety considerations.
• Operate the power plate rolls.

LEARNING TASKS
1. Review the operation of the power plate rolls
   • Operational theory
   • Components and functions
     o Forming rolls
     o Drive mechanisms
     o Roll adjustment mechanisms
   • Safety considerations
     o Operator safety
     o Formability of materials
     o Machine capacity
     o Emergency shut-off

2. Use the power plate rolls
   • Prepare materials
   • Machine adjustments
   • Pre-forming plate
   • Sweeps
   • Shut down equipment

CONTENT

Achievement Criteria
Given information on the power plate rolls, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use the power plate rolls in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use the power plate rolls in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 2

Line (GAC): E USE SHOP EQUIPMENT
Competency: E7 Use the thread cutting machine

Objectives
To be competent in this area, the individual must be able to:
• Explain thread cutting machine safety and maintenance considerations.
• Thread round stock and pipe using the thread cutting machine.

LEARNING TASKS
1. Identify the component parts of the thread cutting machine and their function
   • Carriage
   • Chucks
   • Lubrication
   • Cutting tools

2. Identify safety procedures and maintenance of machine
   • Machine operation
   • Operator safety
   • Routine cleaning

3. Thread round stock using thread cutting machine
   • Installing dies in die-head
   • Mounting material in chuck
   • Starting/stoping cutting operation

4. Thread pipe using thread cutting machine
   • Installing dies in die-head
   • Starting/stoping cutting operation
   • Reaming/cutting pipe

Achievement Criteria
Given information on thread cutting machines, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use the thread cutting machine in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use the thread cutting machine in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
**Program Content**  
**Level 2**

**Line (GAC):** E  USE SHOP EQUIPMENT  
**Competency:** E8 Use the Power Shape Rollers (Power Angle Rolls)

**Objectives**

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

- Explain power angle rolls safety considerations.
- Use power shape rollers (power angle rolls).

**LEARNING TASKS**

1. Identify the component parts of the power shape rollers and their function
   - Control console
   - Forming rolls
   - Structural shape and associated dies
   - Drive mechanisms
   - Roll adjustment mechanisms
   - Roll spacers

2. Describe safety considerations when operating power shape rollers
   - Machine capacity
   - Formability of materials
   - Emergency shut-off

3. Describe the procedure for rolling an angle leg in or leg out
   - Machine adjustment
   - Sweeps
   - Removal of completed angle

4. Use the power shape rollers
   - Materials properly prepared
   - Safety considerations
   - Adjust machine to requirements
   - Shut down equipment

**Achievement Criteria**

Given information on power shape rollers (angle rolls), the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must use the power shape rollers (angle rolls), in lab practical tasks. Tasks must be performed with 70% accuracy.

**Workplace Achievement Criteria**

The learner must use the power shape rollers (angle rolls), in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Objectives
To be competent in this area, the individual must be able to:
- Explain the safety considerations involved with arc-air gouging and cutting methods.
- Use arc-air gouging/cutting methods to remove material.

LEARNING TASKS

1. Describe the arc-air process of removing material
   - Gouging
   - Cutting
   - Advantages/disadvantages

2. Identify the component parts of an arc-air gouging unit and their function
   - Power source
   - Electrode holder
   - Air supply
   - Electrodes

3. Describe the procedure for operating an arc-air gouging unit
   - Initial settings
   - Gouging
   - Cutting techniques

4. Identify operational problems and suggested remedies
   - Slag adherence
   - Depth of gouging varies
   - Difficulty maintaining arc

5. Describe safety considerations when using the arc-air equipment
   - Safety wear for operator
   - Fire hazard
   - Noise
   - Heat
   - Light/radiation
   - Ventilation requirements

6. Use arc-air gouging/cutting methods
   - Gouge out welds
   - Prepare joint for welding
   - Bevel plate edge
   - Cut welded joint to separate pieces
**Achievement Criteria**

Given information on arc-air gouging / cutting methods used to remove material, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must use arc-air gouging / cutting methods in lab practical tasks. Tasks must be performed with 70% accuracy.

**Workplace Achievement Criteria**

The learner must use arc-air gouging / cutting methods to remove material in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC):   F   BURN AND WELD METALS  
Competency:   F8   Use the plasma arc cutter

Objectives
To be competent in this area, the individual must be able to:
- Explain plasma-arc safety considerations.
- Use manual plasma-arc cutters on various metals according to manufacturer specifications.
- Perform routine maintenance according to manufacturer’s specifications.

LEARNING TASKS

1. Identify the component parts of the plasma arc cutter and their function
- Power supply and cables
- Types of gases used
- Control console
- Cutting torch

2. Describe safety precautions related to operating the plasma-arc cutter
- Electrical hazards
- Dangerous gases
- Noise
- Eye protection
- Ventilation requirements

3. Use the plasma-arc cutter on various metals
- Initial machine adjustments
- Operator position
- Cutting procedure
- Shutdown procedure

4. Perform routine maintenance
- Plasma torch head
- Consumables

Achievement Criteria
Given information on plasma-arc cutters, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must use plasma-arc cutters in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use plasma-arc cutters in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): F BURN AND WELD METALS
Competency: F9 Use semi-automatic welding machines

Objectives
To be competent in this area, the individual must be able to:
- Describe the principles of semi-automatic welding machines, including operation, settings and filler wire classifications.
- Use semi-automatic welding machines to weld plate in the flat and horizontal positions.
- Perform routine maintenance according to manufacturer’s specifications.

LEARNING TASKS
1. Describe the principles of operation of various semi-automatic welding machines
   - GMAW
   - GTAW
   - FCAW

2. Describe machine settings of various semi-automatic welding machines
   - Polarity
   - Amperage
   - Voltage

3. Describe filler wire classifications and characteristics
   - Wire size
   - Shielding gases
   - Penetration and reinforcement
   - Filler wire
     - Tensile strength
     - Position used

4. Use semi-automatic welding machines to weld plate in the flat and horizontal positions
   - Initial machine settings
   - Operator position
   - Direction of travel
   - Torch positioning
   - Initiating and maintaining arc
   - Defects and corrections
   - Tack welding
   - Safety considerations

5. Perform routine maintenance
   - Wire feeders
   - Ground clamps
Achievement Criteria

Given information on the principles of semi-automatic welding machines, including operation, settings and filler wire classifications, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must use semi-automatic welding machines to weld plate in the flat and horizontal positions in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must use semi-automatic welding machines to weld plate in the flat and horizontal positions in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): G READ DRAWINGS
Competency: G5 Interpret standard weld symbols

Objectives
To be competent in this area, the individual must be able to:
- Identify and interpret weld symbols on a detailed drawing of a complex welded joint.
- Draw standard weld symbols and interpret welding data sheets.

LEARNING TASKS

1. Review weld symbols
   - Orientation of reference line to joint
   - Arrow side/other side considerations
   - Required edge preparation
   - Size and location of required weld
   - Contour and means of achieving contour
   - Supplementary symbols

2. Draw weld symbols
   - Given a detailed drawing of a complex welded joint, draw the complete weld symbols to represent the joint
   - Staged
   - Complex
   - Multiple weldments in a small area
   - Welding procedures
   - Welding notes

3. Interpret welding data sheets
   - Contents of welding data sheets
   - Reading
   - Interpreting
   - Applications

Achievement Criteria
Given information on weld symbols on a detailed drawing of a complex welded joint, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must interpret weld symbols on a detailed drawing of a complex welded joint in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must interpret weld symbols on a detailed drawing of a complex welded joint in routine workplace operations, and also draw standard weld symbols and interpret welding data sheets. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
**Line (GAC):** G \hspace{1cm} **READ DRAWINGS**  
**Competency:** G8 Draw secondary views of complex objects

**Objectives**  
To be competent in this area, the individual must be able to:  
- Identify common types of secondary views.  
- Draw auxiliary and section views of complex objects.

**LEARNING TASKS**  
1. Identify the types of secondary views commonly used  
   - Auxiliary views  
   - Section views (full, half, revolved)  
   - Orientation to views to given orthographic views  
   - Reasons for views to be drawn

2. Draw auxiliary views of features on complex objects  
   - Surface(s) requiring additional detailing  
   - Development of true view using given views

3. Draw section views of complex objects  
   - Cutting plane  
   - Orientation of section view to given views  
   - Types of lines used  
   - Surface(s) requiring additional detailing

4. Draw auxiliary and section views at a given point of complex objects  
   - Development of true view using given views  
   - Cutting plane  
   - Orientation of section view to given views  
   - Types of lines used

**CONTENT**

**Achievement Criteria**  
Given information on common types of secondary views, the learner must be able to answer a series of multiple choice tests with 70% accuracy.  
The learner must draw auxiliary and section views of complex objects in lab practical tasks. Tasks must be performed with 70% accuracy.

**Workplace Achievement Criteria**  
The learner must draw auxiliary and section views of complex objects in routine workplace operations, and also draw standard weld symbols and interpret welding data sheets. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
## Program Content
### Level 2

**Line (GAC):** G READ DRAWINGS  
**Competency:** G9 Interpret complex multi-view shop drawings

### Objectives
To be competent in this area, the individual must be able to:
- Follow a standard procedure to read complex multi-view shop drawings.
- Determine materials required and components to be fabricated, and then formulate a bill of material.
- Sketch detailed drawings of specific features found on complex drawings.

### LEARNING TASKS

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<td>2. Apply a standard procedure for reading complex shop drawings</td>
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<td>- General notes</td>
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<td>- Materials list</td>
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<td>- Orientation of given views and identification</td>
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<td>- Weight/mass</td>
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<td>- Special remarks</td>
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<td>- Cut details</td>
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<td>4. Sketch detailed drawings of specific features found on complex shop drawings</td>
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<td>- Plate edge preparation</td>
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<td>- Location of major components given on multi-view assembly drawings</td>
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<td>- Locate sub-assemblies within a component</td>
</tr>
</tbody>
</table>
Achievement Criteria

Given information on interpreting complex multi-view drawings, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must read complex multi-view drawings, sketch detailed drawings of specific features and formulate a bill of material in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must read complex multi-view drawings, sketch detailed drawings of specific features and formulate a bill of material in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC):  G  READ DRAWINGS  
Competency:  G10  Interpret complex structural drawings

Objectives
To be competent in this area, the individual must be able to:
- Follow a standard procedure to read simple structural drawings.
- Formulate a bill of material.
- Sketch detailed drawings of specific information from simple structural shop drawings.

LEARNING TASKS  CONTENT
1. Review the format of a structural shop drawing  
   - Title block
   - Materials list
   - Revision block
   - Type of shop drawing
   - Dimensioning
   - Orientation of beam or column on given drawing paper
   - Structural drawing terminology

2. Apply a standard procedure for interpreting complex structural shop drawings  
   - Information contained in title block
   - General notes and abbreviations
   - Hole size, location and number required
   - Use of material list of interpret drawing
   - Detailed dimensions of cuts/burning required
   - Revision block
   - Orientation of section views to main view(s)
   - Interpret weld symbols
   - Identification of main structural member(s)

3. Formulate a bill of material from complex structural shop drawings  
   - Establish standard edge distance
   - Determine main structural members
   - Quantities
   - Piece marks
   - Overall dimensions
   - Weight/mass
   - Special remarks and directions

4. Sketch detailed drawings of specific information found on complex structural shop drawings  
   - Hole location on plate and structural shapes
   - Cut details
   - Plate edge preparation
   - Location of detail on main structural member(s)
LEARNING TASKS

5. Sketch detailed drawings of specific information found on erection and detail drawings of complex project

CONTENT

- Hole location on plate and structural shapes
- Cut details
- Plate edge preparation
- Location of detail on main structural member(s)

Achievement Criteria

Given information on interpreting complex structural drawings, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must read structural drawings, sketch detailed drawings of specific features and formulate a bill of material in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must read structural drawings, sketch detailed drawings of specific features and formulate a bill of material in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 2

Line (GAC): H USE MATERIAL HANDLING EQUIPMENT
Competency: H3 Use ladders and scaffolding

Objectives
To be competent in this area, the individual must be able to:
- State safety considerations for types and use of ladders and scaffolds.
- Use ladders and scaffolds safely.

LEARNING TASKS

1. Identify the various types of ladders and scaffolds
   - Step, extension, single straight
   - Rolling towers, fixed tower
   - Field constructed

2. Use ladders and scaffolds
   - Correct ladder/scaffold for job
   - Safety considerations
   - Erecting ladders and scaffolds on varying terrain
   - Overhead wire hazards

3. Describe safety equipment requirements for fall restraint when using ladders and scaffolds
   - Fall restraint equipment

CONTENT

ACHIEVEMENT CRITERIA
Given information on safety considerations for types and use of ladders and scaffolds, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must re-use ladders and scaffolds safely in lab practical tasks. Tasks must be performed with 70% accuracy.

WORKPLACE ACHIEVEMENT CRITERIA
The learner must use ladders and scaffolds safely in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): I USE STRUCTURAL LAYOUT TECHNIQUES
Competency: I3 Layout complex templates from a shop drawing

Objectives
To be competent in this area, the individual must be able to:
• Lay out a complex template.

LEARNING TASKS
1. Create a complex template in an accurate, economical and productive manner

CONTENT
• Layout principles in regard to material utilization
• Hole location using working bevel
• Edge distances
• Mark-up of template

Achievement Criteria
The learner must apply lay out complex templates from a structural shop drawing in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must lay out complex templates from a structural shop drawing in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 2

**Line (GAC):** I USE STRUCTURAL LAYOUT TECHNIQUES

**Competency:** I4 Describe standard allowances, required accuracy and shop tolerances

**Objectives**
To be competent in this area, the individual must be able to:
- Describe structural layout metrics.

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<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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</table>
| 1. Interpret and describe the reasons for the allowances required for the following | • Milling of columns  
• Machining of plates  
• Rolling of shapes  
• Hubs to shafts  
• Bearing to machine surfaces  
• Heat shrink fitting  
• Keyways  
• Trial assembly using dowels |
| 2. List hole clearances required for different types of fasteners | • Connecting bolts  
• Anchor bolts  
• Pins  
• Studs |
| 3. List standard edge distances for different sizes of holes | • Sheared edge  
• Mill or burnt edge |
| 4. Create a sketch illustrating the amount of clearance to be allowed | • Block  
• Cope  
• Back cut  
• Snipe  
• Clip  
• Notch |
| 5. Identify the meanings of the following terms | • Re-entrant cuts  
• Camber  
• Sweep |
| 6. Identify permitted tolerances by using the appropriate code | • 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 |
Achievement Criteria

Given information on structural layout metrics, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must apply structural layout metrics in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): I USE STRUCTURAL LAYOUT TECHNIQUES
Competency: I5 Identify component parts

Objectives
To be competent in this area, the individual must be able to:
• Describe component parts fabricated for complete units and transfer equipment.

LEARNING TASKS
1. Identify and describe component pieces fabricated for the following complete units and transfer equipment

CONTENT
• Buildings
• Machinery bases
• Conveyors/transfer equipment
• Bridges
• Cranes
• Heavy equipment

Achievement Criteria
Given information on component parts fabricated for complete units and transfer equipment, the learner must be able to answer a series of multiple choice tests with 70% accuracy. The learner must apply the knowledge of component parts fabricated for complete units and transfer equipment in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): I

Competency: I6 Describe the process operation

Objectives

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

- Describe the structural layout process.

LEARNING TASKS

1. Make a bill of material and layout the material in an accurate and productive manner

2. Describe the purpose of identifying parts required on a workshop or field drawing

3. Describe the importance of applying field identification marks in their proper location

4. Describe record keeping and other requirements in the process operation

CONTENT

- A simple beam
- Column
- A-frame
- An engine base
- Machine components
- Detail pieces
- Completed units
- Piece mark
- Direction mark
- Field assembly marks
- Match marks after trial assembly
- Identify sources and availability of materials
- Record quality control information
- Document MTR and HIN for project
  - Material transit receipt
  - Heat identification number
- Coordinate receipt of materials
- Document a bill of lading
- Coordinate receipt of fabricated components
- Inspect components for defects

Achievement Criteria

Given information on the structural layout process, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must apply the knowledge of the structural layout process in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): I USE STRUCTURAL LAYOUT TECHNIQUES
Competency: I7 Layout a set of stair stringers

Objectives
To be competent in this area, the individual must be able to:
- Describe various types of stair treads.
- Produce a layout for a pair of stair stringers.

LEARNING TASKS
1. Describe the various types of stair treads called for on shop drawings
   - Grating tread
   - Welded
   - Bolted
   - Checker plate
   - Inverted channel
   - Standard C
   - Plate C

2. Produce a layout for a pair of stair stringers
   - Left/right hand considerations
   - Working bevel interpretation
   - Use of framing square to layout cuts and treads
   - Fitting procedure

Achievement Criteria
Given information on the various types of stair treads, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must produce a layout for a pair of stair stringers in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must produce a layout for a pair of stair stringers in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): J  DEVELOP PLATE AND STRUCTURAL PATTERNS
Competency: J4  Integrate radial and parallel line development

Objectives
To be competent in this area, the individual must be able to:
• Integrate radial and parallel line methods to create patterns and scaled models.

LEARNING TASKS
1. Develop patterns and scaled models involving integration of the radial and parallel line methods

CONTENT
• Reducing multi-piece pipe elbow
• Branch to cone

Workplace Achievement Criteria
The learner must integrate radial and parallel line methods to create patterns and scaled models in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): J DEVELOP PLATE AND STRUCTURAL PATTERNS
Competency: J5 Develop shop layout and processing for plate and structural sections

Objectives
To be competent in this area, the individual must be able to:
• Lay out and process various formed plate and structural sections.

LEARNING TASKS

1. Calculate, layout and process various formed plate shapes
   • Make required stretch-out calculations
   • Check material list
   • Inspect material for type and size
   • Demonstrate efficient utilization of material
   • Employ geometric and dimensional accuracy in layout of reference lines, element lines and perimeter dimension
   • Make diagonal checks where possible
   • Mark material for cutting edge preparation and forming
   • Develop required bend sets, templates or sweeps

2. Calculate, layout and process various formed structural sections
   • Make required stretch-out calculations
   • Check material list
   • Inspect material for type and size
   • Demonstrate efficient utilization of material
   • Make diagonal checks where possible
   • Mark material for cutting edge preparation and forming
   • Develop required bend sets, templates or sweeps
   • Hard way and easy way forming
   • Calculate true lengths for
     o Flat bar
     o Round sections
     o Angle
     o Channel
     o Wide flange
     o Formed sections

Workplace Achievement Criteria
The learner must lay out and process various formed plate and structural sections in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): J  DEVELOP PLATE AND STRUCTURAL PATTERNS
Competency: J6  Develop various patterns using radial line development

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

- Describe the procedure for developing patterns using the radial line method.
- Develop various patterns and scaled models using radial line development.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe the procedure for developing patterns</td>
<td>• Views required to develop patterns</td>
</tr>
<tr>
<td>using the radial line method</td>
<td>• Dimensions for required views</td>
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<td>• Establishment of element lines</td>
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<td>• True lengths for required patterns</td>
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<td>• Layout and mark-up of patterns</td>
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<tr>
<td>2. Develop patterns and scaled models involving</td>
<td>• Concentric cone</td>
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<td>radial line methods</td>
<td>• Frustum of a concentric cone</td>
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<td>• Truncated cone</td>
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<td>• 90° cone to T</td>
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<td>• Cone transition to a cylinder</td>
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<td>• Round or square branch intersecting a cone</td>
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<td>• Inclined cone intersecting a cylinder</td>
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<tr>
<td>3. Describe considerations not apparent in scale</td>
<td>• Distortions</td>
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<tr>
<td>model construction</td>
<td>• Effect of cumulative or progressive errors in</td>
</tr>
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<td></td>
<td>measurement or assembly</td>
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</tbody>
</table>

Achievement Criteria
Given information on the procedure for developing patterns using the radial line method, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must develop various patterns and scaled models using radial line development in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must develop various patterns and scaled models using radial line development in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
**Line (GAC):**   L   FABRICATE PLATE AND STRUCTURAL SECTIONS  
**Competency:**   L3   Layout and fit a structural beam

**Objectives**

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

- Lay out a template and prepare materials to fit a structural beam.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Content</th>
</tr>
</thead>
</table>
| 1. Layout the templates required from a complex drawing | Nesting considerations  
Baseline/reference line  
Working bevels  
Standard edge distances  
Template mark-up |
| 2. Use structural fitting tools and methods | Layout equipment to prepare materials  
Locating/punching holes  
Preparing plate edges and holes |
| 3. Use shop equipment to prepare materials | Plate fitting angle iron  
Beam board for squaring lines  
Flange/web gauge tools  
Framing square to locate detail  
Location of detail on structural shape  
Location of tack welds |
| 4. Describe relevant fitting considerations | Alignment  
Dimensional accuracy  
Fitting/fairing  
Appearance |

**Workplace Achievement Criteria**

The learner must lay out a template and prepare materials to fit a structural beam in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 2

Line (GAC): L FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L4 Describe modern alignment methods

Objectives
To be competent in this area, the individual must be able to:
• Describe the concepts of modern alignment methods.

LEARNING TASKS

1. Describe the purposes of alignment

   • Facilitation of fabrication
   • Ease of installation of other parts
   • Jigs
   • Field installation considerations

2. Identify situations where alignment must be considered

   • Engine bases
   • Pipe/flange connections
   • Drive units
   • Bolted connections
   • Spliced connections
   • Trial assemblies
   • Drilling operations
   • Heat straightening
   • Dowel connections during trial assembly

3. Aligned fitted parts

   • Tape
   • Chalk line
   • Dial indicators
   • Wire
   • Feeler gauges
   • Ground straight edges
   • Machinist levels
   • Laser levels

4. Describe the effects of machining, bending and heating on materials

   • Hydraulic presses
   • Screw jacks
   • Jigs for heat forming
   • Cambering

5. Describe various methods to minimize shrinkage forces and distortion

   • Accurate fit-up
   • Minimum edge preparation
   • Weld size
   • Ultrasonics
LEARNING TASKS

6. Describe various methods to counterbalance shrinkage forces and distortion
   - Balance welds
   - Double groove welds
   - Sequence welding
   - Preheating
   - Peening and stress relieving

7. Describe heat forming methods
   - Jigs
   - Torches
   - Temperature control devices
   - Induction heaters and ovens

Achievement Criteria

Given information on the concepts of modern alignment methods, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must apply the concepts of modern alignment methods in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): L  FABRICATE PLATE AND STRUCTURAL SECTIONS

Competency: L5  Fabricate a simple hopper

Objectives

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

- Use a shop drawing of a simple hopper to develop required patterns for individual plates
- Fabricate the hopper.

LEARNING TASKS

1. Interpret a shop drawing of a simple hopper
   - Orientation of views
   - Identification of individual plates
   - Vertical heights and offsets
   - Foreshortened and true surfaces

2. Develop required patterns for individual plates
   - True length diagram
   - Offset triangle and Pythagorean theorem
   - Bend set considerations
   - Width of opening at top and bottom of plates
   - Bending direction
   - Nesting patterns
   - Bend sets

3. Describe the method of fitting hopper plates
   - Profile of large drawing
   - Squareness checks
   - Corner fit edges
   - Tack weld location

4. Describe relevant fitting considerations
   - Alignment
   - Dimensional accuracy
   - Fitting/fairing
   - Appearance

Achievement Criteria

The learner must develop required patterns for individual plates and fabricate the hopper lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must develop required patterns for individual plates and fabricate the hopper in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC):   L   FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency:   L6   Fabricate a concentric cone

Objectives
To be competent in this area, the individual must be able to:
•   Use shop layout and material forming equipment to fabricate a concentric cone.

LEARNING TASKS
1.   Calculate dimensions required to fully detail cone patterns
2.   Use shop layout and material forming equipment
3.   Describe the fitting sequence for a concentric cone
4.   Describe relevant fitting considerations

CONTENT
•   Slopes (Apex/Base, Apex, Top of cone)
•   Arc lengths - top and bottom
•   Bend line spacing
•   Seam length
•   Pattern layout onto plate
•   Shearing/burning operations
•   Press set-up
•   Forming sequence
•   Adjusting formed plates
•   Bench top profiling
•   Twisting distortion
•   Seam location and fit
•   Mismatched sections
•   Tack weld locations
•   Alignment
•   Dimensional accuracy
•   Fitting/fairing
•   Appearance

Workplace Achievement Criteria
The learner must fabricate a concentric cone in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Objectives

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

- Use shop layout and material preparation equipment to develop and fit branches on a cone.

LEARNING TASKS

1. Develop required patterns for rectangular and round branches
   - Cone profile
   - Required views
   - Branch dimensions
   - Layout of true patterns

2. Use shop layout and material preparation equipment
   - Quarter lines
   - Torch angle on profiles
   - Edge preparation
   - Tolerances

3. Describe an accepted method for fitting branches
   - Establishment of datum
   - Locating centerlines/reference lines
   - Maintaining position of branches
   - Alignment methods

4. Describe relevant fitting considerations
   - Alignment
   - Dimensional accuracy
   - Fitting/fairing considerations
   - Appearance

Workplace Achievement Criteria

The learner must develop and fit branches on a cone in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): L FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L8 Fabricate a reduced set of straight stairs

Objectives
To be competent in this area, the individual must be able to:
• Use shop layout and material preparation equipment to fabricate a reduced set of straight stairs.

LEARNING TASKS

1. Complete a detailed bill of material from a given drawing
   - Interpret given drawing
   - Edge distances
   - Formed channel stretch-out sizes

2. Use shop layout and material forming equipment
   - Formed channel on press
   - Cuts and treads, layout with framing square
   - Burning torch considerations
   - Common mitre line layout
   - Left hand/right hand layout

3. Describe an accepted method for fitting stairs
   - Stringer fitting techniques
   - Tread attachment
   - Squareness techniques
   - Base plate/end plate location
   - Tack weld location

4. Describe relevant fitting considerations
   - Alignment
   - Dimensional accuracy
   - Fitting/fairing considerations

5. Describe considerations not apparent in scale model construction
   - Appearance/distortions
   - Effect of cumulative or progressive errors in measurement or assembly

Workplace Achievement Criteria
The learner must fabricate a reduced set of straight stairs in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): L  FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L9  Fabricate a reduced section of handrail

Objectives
To be competent in this area, the individual must be able to:
• Use shop layout and material preparation equipment to fabricate a reduced set of handrail.

LEARNING TASKS
1. Layout full size profile of handrail section of jig use
   • Centrelines
   • Working bevel
   • Establishment of work points
   • Drawing outline and establishing mitre cuts
   • Jig stop considerations

2. Develop required wraparound templates for designated joints
   • Pipe diameter considerations
   • Views required
   • Layout of true pattern

3. Use shop equipment to prepare materials
   • Abrasive cut-off saw
   • Band saws
   • Hand torch use considerations
   • Alignment of torch cut ends
   • Cutting order

4. Describe an accepted method for fitting handrail section
   • Fitting sequence for pieces
   • Checking joint fit
   • Tack weld location

5. Describe relevant fitting considerations
   • Alignment
   • Dimensional accuracy
   • Fitting/fairing considerations
   • Appearance

6. Describe considerations not apparent in scale model construction
   • Distortions
   • Effect of cumulative or progressive errors in measurement or assembly

Workplace Achievement Criteria
The learner must fabricate a reduced set of handrail in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Objectives

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

- Identify standard allowances, required accuracy, codes and shop tolerances for machine assembly.
- Use shop layout and material preparation equipment to lay out complex templates from a machine detail drawing.

LEARNING TASKS

1. Develop required templates for detailed machine component

2. Use shop layout and material preparation equipment

3. Describe an accepted method for fitting machine component

4. Describe relevant fitting considerations

5. Describe standard allowances, required accuracy, codes and shop tolerances for machine assembly

CONTENT

- Machine detail drawing
- Required views
- Branch dimensions
- Layout of true patterns
- Centrelines
- Reference lines
- Establishment of work points
- Edge preparation
- Tolerances
- Special Notes and Directions
- Establishment of datum
- Locating centerlines/reference lines
- Maintaining position of sub-components
- Alignment methods
- Alignment
- Dimensional accuracy
- Fitting/fairing considerations
- Appearance
- CSA
- CISC
- ASME
- AISC
- API
- CWB
- ANSI
Achievement Criteria
Given information on identifying standard allowances, required accuracy, codes and shop tolerances for machine assembly, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must lay out complex templates from a machine detail drawing, in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must lay out complex templates from a machine detail drawing in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task
Level 3

Metal Fabricator (Fitter)
Program Content
Level 3

Line (GAC): C SOLVE TRADE MATH PROBLEMS
Competency: C12 Solve simple problems using trigonometry

Objectives
To be competent in this area, the individual must be able to:
• Solve simple problems using trigonometry.

LEARNING TASKS
1. Solve for angles and sides of single right triangles
2. Calculate pipe elbows

CONTENT
• Calculation of working bevels
• Relate given information to trigonometric solutions
• Consideration of material thickness
• Required derived function

Achievement Criteria
Given information on problems involving trigonometry, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.
In addition, the learner must perform practical lab tasks to make trigonometry calculations for working bevels and pipe elbows. Tasks must be performed with 70% accuracy.
Line (GAC): E USE SHOP EQUIPMENT
Competency: E9 Use the CNC shape cutting machine

Objectives
To be competent in this area, the individual must be able to:
- Describe the CNC shape cutting machine and its safety considerations.
- Operate the CNC shape cutting machine.

LEARNING TASKS

1. Define common technical terms related to the CNC system and equipment
   - Syntax
   - Default
   - Pierce point
   - Lead-in/Lead-out
   - Absolute zero
   - Incremental
   - Absolute
   - Straight line motion
   - Circular motion

2. Identify components of the CNC shape-cutting machine and their functions
   - Upper and lower carriages
   - Torch units
   - Drive unit
   - Oxy-fuel system
   - Control console

3. Describe the procedure to operate the CNC shape-cutter
   - Safety considerations
   - Coordinate system
   - Coding
   - Machine layout
   - General operation procedure
   - Initial settings
   - Template/plate location
   - Burning considerations
   - Nesting patterns
   - Maintenance checks

4. Use the CNC shape-cutting machine
   - Strip burning
   - Profile burning with template
   - Multi-torch set-up
Achievement Criteria

Given information on the CNC shape cutting machine and its safety considerations, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must operate the CNC shape cutting machine in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must operate the CNC shape cutting machine in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): G READ DRAWINGS
Competency: G5 Interpret standard weld symbols

Objectives
To be competent in this area, the individual must be able to:
• Identify and interpret standard weld symbols.

LEARNING TASKS
1. Review weld symbols
   • Orientation of reference line to joint
   • Arrow side/other side considerations
   • Required edge preparation
   • Size and location of required weld
   • Contour and means of achieving contour
   • Interpret supplementary symbols

2. Review drawing weld symbols
   • Given a detailed drawing of a specialized welded joint, draw the complete weld symbols to represent the joint
   • Staged
   • Complex
   • Multiple weldments in a small area
   • Welding procedures
   • Welding notes

3. Review welding data sheets
   • Contents of welding data sheets
   • Reading
   • Interpreting
   • Applications

Achievement Criteria
Given information on standard weld symbols, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must identify, interpret and draw standard weld symbols in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): G READ DRAWINGS
Competency: G11 Interpret specialized multi-view shop drawings

Objectives
To be competent in this area, the individual must be able to:
- Read a specialized multi-view shop drawing and from it formulate a bill of materials.
- Sketch detailed drawings of specific features found on specialized multi-view shop drawings.

LEARNING TASKS
1. Review the general format of a complex shop drawing
   - Title block
   - Materials list
   - Revision block
   - Type of shop drawing

2. Apply a standard procedure for reading specialized shop drawings
   - Title block
   - General notes
   - Revision block
   - Materials list
   - Orientation of given views and identification
   - Calculations required to locate detail

3. Formulate a bill of materials from a specialized shop drawing
   - Quantity
   - Piece marks
   - Overall dimensions
   - Weight/mass
   - Special remarks

4. Sketch detailed drawings of specific features found on specialized shop drawings
   - Cut details
   - Hole location on plate and structural shapes
   - Location of detail on main structural members
   - Section views
   - Plate edge preparation
   - Location of major components given on assembly drawings

5. Sketch detailed drawings of mechanical or hydraulic components found on specialized shop drawings
   - Orthographic projection
   - Scale and proportion
   - Abbreviations and notations
   - Welding symbols
   - Dimensioning techniques
   - Tolerances
   - Bill of materials
Workplace Achievement Criteria

The learner must read a specialized multi-view shop drawing and from it formulate a bill of materials in routine workplace operations. In addition, the learner must sketch detailed drawings of specific features found on the drawing. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
**Line (GAC):**   G     **READ DRAWINGS**

**Competency:**  G12   Interpret complex structural, erection and detail drawings

**Objectives**
To be competent in this area, the individual must be able to:
- Read complex structural, erection and detail drawings and from them formulate bills of materials.
- Sketch detailed drawings of specific features found on complex structural, erection and detail drawings.

**LEARNING TASKS**

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<td>1. Review the format of a structural shop drawing</td>
<td>- Title block</td>
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<td>- Materials list</td>
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<td>- Revision block</td>
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<td>- Type of shop drawing</td>
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<td>- Dimensioning</td>
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<td>- Orientation of beam or column on given drawing paper</td>
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<tr>
<td>2. Apply a standard procedure for interpreting structural, erection and detail drawings</td>
<td>- Information contained in title block</td>
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<td>- General notes and abbreviations</td>
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<td>- Hole size, location and number required</td>
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<tr>
<td></td>
<td>- Use of material list to interpret drawing</td>
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<td>- Detailed dimensions of cutting/burning required</td>
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<td></td>
<td>- Revision block</td>
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<td>- Orientation of section views to main view(s)</td>
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<td></td>
<td>- Interpret weld symbols</td>
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<td>- Identification of main structural member(s) and their orientation</td>
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<tr>
<td>3. Formulate a bill of material from complex structural, erection and detail drawings</td>
<td>- Establish standard edge distance</td>
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<td>- Determine main structural members</td>
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<td>- Quantities</td>
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<td>- Piece marks</td>
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<td>- Special remarks and directions</td>
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<tr>
<td>4. Sketch detailed drawings of specific information found on complex structural, erection and detail drawings</td>
<td>- Hole location on plate and structural shapes</td>
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<td>- Cut details</td>
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<td>- Plate edge preparation</td>
</tr>
<tr>
<td></td>
<td>- Location of detail on main structural member(s) and their orientation</td>
</tr>
</tbody>
</table>
Workplace Achievement Criteria

The learner must read complex structural, erection and detail drawings and from them formulate bills of materials in routine workplace operations. In addition, the learner must sketch detailed drawings of specific features found on the drawings. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): G READ DRAWINGS
Competency: G13 Describe electronic detailing

Objectives
To be competent in this area, the individual must be able to:
• Describe electronic detailing, including the benefits and the process.

LEARNING TASKS
1. Identify the advantages of electronic detailing
   • Speed
   • Accuracy
   • Efficiency of detailing
   • Consistency

2. Describe the process of electronic detailing
   • Inputs required
     o Part compilation
     o Component lists
   • Generation of specifics
     o Mass
     o Surface areas
     o Lift points
     o Dimensions
   • Production steps
   • Quality control
   • Marking and identification
   • Nesting

Achievement Criteria
Given information on electronic detailing, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must apply knowledge of electronic detailing, including the benefits and the process in lab practical tasks. Tasks must be performed with 70% accuracy.
Line (GAC): I  USE STRUCTURAL LAYOUT TECHNIQUES
Competency: I8 Layout complex templates from a complex structural shop drawing

Objectives
To be competent in this area, the individual must be able to:
• Develop a complex structural template from complex structural and erection drawings.

LEARNING TASKS
1. Develop a complex template from complex structural and erection drawings

CONTENT
• Layout principles in regard to material utilization
• Hole location using working bevel
• Edge distances
• Accuracy
• Efficiency in template production
• Mark-up of template

Workplace Achievement Criteria
The learner must develop a complex structural template from complex structural and erection drawings in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): I USE STRUCTURAL LAYOUT TECHNIQUES
Competency: I9 Describe the process operation for various structural projects

Objectives
To be competent in this area, the individual must be able to:
• Interpret complex structural drawings for various applications and determine the process operation for each, including drawing up a bill of materials and laying out the materials.

LEARNING TASKS
1. Interpret complex structural drawings and determine the process operation

CONTENT
• Welded girder
• Truss
• Boxed and beam crane
• Bill of materials
• Layout of materials

Achievement Criteria
Given information on complex structural drawings for various applications and determine the process operation for each, including drawing up a bill of materials and laying out the materials, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must interpret complex structural drawings for various applications and determine the process operation for each, including drawing up a bill of materials and laying out the materials in lab practical tasks. Tasks must be performed with 70% accuracy.
Program Content
Level 3

Line (GAC): J DEVELOP PLATE AND STRUCTURAL PATTERNS
Competency: J7 Develop various patterns using the triangulation method

Objectives
To be competent in this area, the individual must be able to:
• Describe the steps required to develop patterns using the triangulation method.
• Develop patterns and scaled models using the triangulation method.

LEARNING TASKS
1. Describe the procedure for developing patterns using the triangulation method
   • Views required to develop patterns
   • Dimensions for required views
   • Establishment of element and diagonal lines
   • True lengths of lines for required patterns
   • Layout and mark-up of patterns

2. Develop patterns and scaled models using the triangulation method
   • Square and rectangular hoppers
   • Offset hoppers and chutes
   • Inclined and flanged hoppers
   • Square to round transitions
   • Round to round transitions

Achievement Criteria
Given information on the steps required to develop patterns using the triangulation method, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must develop patterns and scaled models using the triangulation methods in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must develop patterns and scaled models using the triangulation methods in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): L  FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L11 Fabricate a reduced tank with fittings

Objectives
To be competent in this area, the individual must be able to:
- Make the calculations required to fabricate a reduced tank with fittings.
- Use the material preparation and forming operations equipment needed to fabricate a reduced tank with fittings.

LEARNING TASKS
1. Make calculations required to detail tank and fittings
   - Stretch-out dimensions of required plates
   - Dimensions to locate fittings

2. Use material preparation and forming operations equipment
   - Layout of required plates
   - Develop templates/sweeps
   - Preforming
   - Forming/rolling to shop standards
   - Use of power angle rolls
   - Estimate

3. Use an accepted method of fitting detail and component parts
   - Fitting sequence
   - Locating centerlines/reference lines
   - Maintaining positioning of pieces
   - Alignment considerations
   - Fitting tools and aids

4. Describe relevant fitting considerations
   - Alignment
   - Dimensional accuracy
   - Fitting/fairing of pieces
   - Appearance

5. Describe considerations not apparent in scale model construction
   - Distortions
   - Effect of cumulative or progressive errors in measurement or assembly

Workplace Achievement Criteria
In routine workplace operations, the learner must make the calculations required to fabricate a reduced tank with fittings, and then use the material preparation and forming operations equipment needed to fabricate the tank. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Objectives

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

- Develop a pattern and then use shop layout and material forming equipment to fabricate a square to round transition.

LEARNING TASKS

1. Develop required 1/2 pattern for transition
   - Views required
   - Dimensions of transition to develop pattern
   - Bend line spacing
   - True length diagram
   - Required pattern checks and adjustments

2. Use shop layout and material forming equipment
   - Pattern layout onto plate
   - Allowances and stress-relieving for forming operations
   - Brake press set-up
   - Forming sequence
   - Adjusting pattern for shape trueness

3. Describe the fitting sequence for a square to round transition
   - Bench top profiling
   - Plate distortion
   - Seam location and fit
   - Mismatched sections
   - Stress-relieving

4. Describe relevant fitting considerations
   - Alignment
   - Dimensional accuracy
   - Fitting/fairing
   - Appearance

Workplace Achievement Criteria

The learner must develop a pattern and then use shop layout and material forming equipment to fabricate a square to round transition in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC):   L      FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency:   L13   Plan, cost and fabricate a structural frame

Objectives
To be competent in this area, the individual must be able to:
- Describe an accepted method of fitting a structural frame.
- Formulate a bill of material from a drawing.
- Lay out templates and use shop equipment to prepare materials.

LEARNING TASKS

1. Complete a detailed bill of material from the given drawing
   - Identification of main structural members
   - Calculations required to detail individual pieces
   - Establish standard edge distances
   - Listing required information on standard bill of material
   - Estimate materials costs

2. Layout the templates required from the given drawing
   - Nesting considerations
   - Baseline/reference line
   - Working bevels
   - Standard edge distances
   - Template mark-up

3. Use shop equipment to prepare materials
   - Layout of required plates
   - Locating/punching holes
   - Preparing plate edges and holes

4. Describe an accepted method of fitting a structural frame
   - Alignment
   - Dimensional accuracy
   - Fitting/fairing considerations
   - Appearance

Achievement Criteria
Given information on accepted methods of fitting a structural frame, the learner must be able to answer a series of multiple choice tests with 70% accuracy.
The learner must formulate a bill of material from a drawing. The learner must also be able to lay out templates and use shop equipment to prepare materials in lab practical tasks. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must formulate a bill of material from a drawing in routine workplace operations. The learner must also lay out templates and use shop equipment to prepare materials. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): L FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L14 Plan, cost and fabricate an eccentric hopper

Objectives
To be competent in this area, the individual must be able to:
- Describe relevant fitting considerations.
- Interpret shop drawings and formulate a bill of material.
- Lay out templates for individual plates and use an accepted method to fit hopper plates.

LEARNING TASKS

1. Interpret given shop drawings
   - Orientation of views
   - Identification of individual plates
   - Foreshortened and true surfaces
   - Vertical heights and offsets
   - Plan and estimate costs

2. Develop required patterns for individual plates
   - Mathematical calculations required for true dimensions
   - Bend set considerations
   - Plate width considerations for layout
   - Bending directions
   - Nesting patterns
   - Bend sets

3. Use an accepted method of fitting hopper plates
   - Set-up/forming of plates
   - Squareness checks
   - Plate edge fit
   - Tack weld location

4. Describe relevant fitting considerations
   - Alignment
   - Dimensional accuracy
   - Fitting/fairing
   - Appearance
Achievement Criteria
Given information on relevant fitting considerations, the learner must be able to answer a series of multiple choice tests with 70% accuracy.

The learner must interpret shop drawings and formulate a bill of material in lab practical tasks. The learner must also lay out templates for individual plates and use an accepted method to fit hopper plates. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must interpret shop drawings and formulate a bill of material in routine workplace operations. The learner must also lay out templates for individual plates and use an accepted method to fit hopper plates. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Level 4

Metal Fabricator (Fitter)
Program Content
Level 4

Line (GAC): C SOLVE TRADE MATH PROBLEMS
Competency: C13 Solve complex problems using trigonometry

Objectives
To be competent in this area, the individual must be able to:
• Solve complex problems using trigonometry.

LEARNING TASKS
1. Develop a solution using trigonometry and given information

CONTENT
• Solve for angles of right triangles
• Solve for sides of right triangles
• Calculate
  o Elbows
  o Working bevels
  o Cones
  o Frustrums
  o Gussets
  o Bracing
  o Trusses
• Consideration of material thickness
• Required derived function

Achievement Criteria
Given information on complex problems involving trigonometry, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to solve for angles and sides of right triangles, calculating for the items in the list above. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must solve for angles and sides of right triangles, calculating the items in the list above in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): C SOLVE TRADE MATH PROBLEMS
Competency: C14 Solve problems using segmental functions

Objectives
To be competent in this area, the individual must be able to:
• Solve problems using segmental functions.

LEARNING TASKS
1. Develop a solution using segmental functions and given information

CONTENT
• Key terms and concepts related to segmental functions
• Express fundamental formulas
• Transpose for desired derivative
• Identify parts of a circular segment
• Calculate
  o Angles
  o Arcs
  o Chords
  o Middle ordinates of circular segments
  o Pipe elbows
  o Pipe flanges
  o Circular chutes

Achievement Criteria
Given information on problems using segmental functions, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to solve problems using segmental functions, calculating the items in the list above. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must solve problems using segmental functions, calculating the items in the list above in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): D USE TRADE TOOLS
Competency: D4 Use specialized measuring tools

Objectives
To be competent in this area, the individual must be able to:
- Describe the procedures for using various specialized measuring tools.
- Use and maintain specified measuring tools and devices.

Learning Tasks

1. Identify the types and uses of builders level
   - Telescopic dumpy
   - Three-pin automatic dumpy

2. Describe the procedures for setting up a builders level
   - Placing tripod on floor and ground
   - Unpacking and setting up instrument
   - Centering instrument
   - Levelling instrument
   - Packing up and transporting

3. Describe the procedure for testing and adjusting the instrument
   - Tubular level
   - Horizontally of the line of sight
   - Tripods
   - Care and maintenance

4. Describe the procedure for reading the elevation rod
   - Metric/Imperial rod
   - Cross hairs/stadia hairs
   - Plumbing rod
   - Long distance shots

5. Define common terms related to a builder's level
   - Focusing
   - Crosshairs
   - Datum
   - Baseplate
   - Benchmark
   - Backsight
   - Foresight
   - Stadia hairs
   - Tripod
   - Turning point
   - Footscrews
LEARNING TASKS

6. Use a builder's level
   - Set up
   - Determine benchmark
   - Reading/recording elevations
   - Vertical distances
   - Interpret results

7. Use other specialized measuring tools and devices
   - Laser levelling
   - Laser measuring
   - Laser alignment
   - Standard and safe operation procedures for laser devices

Achievement Criteria

Given information on procedures for using various specialized measuring tools, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to use specified measuring tools and devices. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must use specified measuring tools and devices in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 4

Line (GAC): E USE SHOP EQUIPMENT
Competency: E10 Use a CNC brake press

Objectives
To be competent in this area, the individual must be able to:
- Describe the various software program functions.
- Describe the safety considerations of the CNC brake press.
- Form various specialty shapes using a CNC brake press.

LEARNING TASKS

1. Identify the component parts of a CNC brake press and their function
   - Mechanical backgauge
   - Controller and display unit
   - Power supply

2. Define common terms used with a CNC brake press
   - Main menu
   - User friendly format
   - Soft keys/hard keys
   - Ram bottom
   - Limit messages
   - Modes

3. Describe the mode functions given on the main menu
   - Set-up
   - Calibrate
   - Single step
   - Run
   - Manual
   - Diagnostics and service
   - Program catalogue

4. Describe the various functions of the set-up mode menu
   - Step changing
   - Clear dimension/old dimension
   - Key-in dimensions
   - Step review
   - Set-up angle mode
   - Angle parameters

5. Describe the various functions of the program catalogue mode
   - Program listings
   - Program review
   - Program parameters
   - Part I.D. number
   - Angle parameters
   - Tool I.D. number
LEARNING TASKS

6. Describe the function of the other mode settings listed on the main menu

7. Select programs to form various shapes from plate using a CNC brake press

8. Form various specialty shapes using a CNC brake press

9. Identify the safety considerations associated with operation of a CNC brake press

CONTENT

- Calibration
- Single step
- Run

- Flanged shapes
- Cylinders
- Conical sections

- Preparation of material
- Set-up of machine
- Forming sequence
- Safety considerations

- Moving backstop
- Auto-indexing backstops
- Variable rest positions
- Secondary stage forming

Achievement Criteria

Given information on the various CNC brake press software program functions and safety considerations, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to form various specialty shapes using a CNC brake press. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must form various specialty shapes using a CNC brake press in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): E USE SHOP EQUIPMENT
Competency: E11 Describe CNC punching equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe CNC punching equipment.

LEARNING TASKS
1. Identify the component parts of CNC punching equipment
   • Punches
   • Turret
   • End stoop
   • Clamps and locators
   • Plasma arc torch
   • Controller and display unit

2. Define common terms used with CNC punching equipment
   • Absolute
   • Incremental
   • Trailing zeros
   • Coordinate system
   • Coding system
   • Side gage
   • Programming limits
   • Workpiece
   • Home position

Achievement Criteria
Given information on CNC punching equipment, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.
Program Content
Level 4

Line (GAC): E USE SHOP EQUIPMENT
Competency: E12 Develop and use programs for CNC shape cutting equipment

Objectives
To be competent in this area, the individual must be able to:
- Describe the operation of CNC shape cutting equipment and the system, and the associated safety considerations.
- Describe various software program functions of various CNC shape cutting equipment.
- Use CNC shape cutting equipment programs to cut plate.

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<thead>
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<th>LEARNING TASKS</th>
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</table>
| 1. Describe the general operation of CNC shape cutting equipment and the system | - Coordinate system
- Coding
- Machine layout
- General operation procedure
- Keyboard functions
- Loading variables
- Variable display
- Loading data
- Recall speed
- Kerf considerations
- M-codes
- Position values in other modes |
| 2. Review common technical terms related to CNC shape cutting equipment | - Syntax
- Default
- Pierce point
- Lead-in/Lead-out
- Absolute zero
- Incremental
- Absolute
- Straight line motion
- Circular motion |
| 3. Develop programs for cutting complex plate shapes | - Incremental programming
- Standard command codes |
| 4. Develop programs for cutting plates with circular sections using incremental programming | - Incremental straight line motion
- Incremental circular motion
- Relevant command codes
- Cutting inside/outside arc |
LEARNING TASKS

5. Develop programs for cutting plates with curved sections using incremental programming

6. Use programs to cut plate

CONTENT

- Incremental curve fitting motion
- Repetitive motion
- Relevant command codes
- Loops
- Cycling
- Entering data
- Shapes
- Plate positioning
- Equipment check
- Program check
- Safety considerations

Achievement Criteria

Given information on the operation of CNC shape cutting equipment and the system, the associated safety considerations, and the various software program functions, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must perform practical lab tasks to use CNC shape cutting equipment programs to cut plate. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must use CNC shape cutting equipment programs to cut plate in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): G READ DRAWINGS
Competency: G14 Interpret computer generated shop drawings

Objectives
To be competent in this area, the individual must be able to:
- Formulate a bill of material from and sketch detailed drawings of specific features contained on a complex computer-generated shop drawing.
- Create a detailed drawing of specialized components using a computer.

LEARNING TASKS

1. Formulate a bill of material from a complex computer generated shop drawing
   - Quantity
   - Piece marks
   - Overall dimensions
   - Weight/mass
   - Special remarks

2. Sketch detailed drawings of specific features found on complex computer generated shop drawings
   - Cut details
   - Hole location on plate and structural shapes
   - Location of detail on main structural members
   - Section views
   - Plate edge preparation

3. Apply a standard procedure for reading computer generated shop drawings
   - Extension lines
   - Leader lines
   - Line types
     - Widths
     - Intensities

4. Using a computer, create a detailed drawing of specialized components
   - Location of major components given on assembly drawings
   - Location of mechanical or hydraulic components

Workplace Achievement Criteria
From a complex computer-generated shop drawing, the learner must formulate a bill of material and sketch detailed drawings of specific features contained on the shop drawing in routine workplace operations. In addition, using a computer, the learner must create a detailed drawing of specialized components. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
**Line (GAC):** G  **READ DRAWINGS**  
Competency: G15 Interpret specialized structural, erection and detail drawings

### Objectives
To be competent in this area, the individual must be able to:
- Use specialized structural, erection and detail shop drawings to formulate a bill of material
- Sketch detailed drawings of specific information found on the drawings

### LEARNING TASKS

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<td>- Materials list</td>
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<td>- Revision block</td>
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<td>- Type of shop drawing</td>
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<td>- Orientation of beam or column</td>
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<td>- Structural drawing terminology</td>
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<td>- Interpret weld symbols</td>
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<td>- Identification of main structural member(s) and their orientation</td>
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<td><strong>3. Formulate a bill of material from specialized structural, erection and detail shop drawings</strong></td>
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<td>- Establish standard edge distance</td>
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<td>- Determine main structural members</td>
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<td>- Piece marks</td>
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<td>- Overall dimensions</td>
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<td>- Weight/mass</td>
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<td>- Special remarks</td>
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<td>- Specializations include</td>
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<td>- Sweeping spiral staircases</td>
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<td>- Heavy girder and beam applications</td>
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**Workplace Achievement Criteria**

Using specialized structural, erection and detail shop drawings, the learner must formulate a bill of material and sketch detailed drawings of specific information found on the drawings in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): J DEVELOP PLATE AND STRUCTURAL PATTERNS
Competency: J8 Develop specialized patterns using the triangulation method

Objectives
To be competent in this area, the individual must be able to:
• Develop specialized patterns and scaled models involving triangulation methods for square to round elbows and irregularly shaped objects.

LEARNING TASKS
1. Review the procedure for developing specialized patterns using the triangulation method
   • Views required to develop patterns
   • Dimensions for required views
   • Establishment of element and diagonal lines
   • True lengths of lines (required patterns)
   • Layout and mark-up of patterns

2. Develop specialized patterns and scaled models involving the triangulation methods
   • Square to round elbow
   • Irregularly shaped objects

Workplace Achievement Criteria
The learner must develop specialized patterns and scaled models involving triangulation methods for square to round elbows and irregularly shaped objects in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): L  FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L15  Apply work simplification methods

Objectives
To be competent in this area, the individual must be able to:
- Describe work simplification principles and methods.
- Design and construct a simple jig.

LEARNING TASKS

1. Describe the concept of work simplification and its basic principles
   - Eliminate unnecessary work
   - Efficient arrangement of work processes
   - Selection of correct methods

2. Describe the process to analyze a workplace operation
   - Break down the job
   - Question every detail
   - Develop new method

3. Describe the aids which can be used to help analyze work situations
   - Suggestion list
   - Operation activity list
   - Flow process chart

4. Design and construct a simple jig
   - Computer-based design
   - Tolerances
   - Extraction
   - Bracing
   - Weld requirements
   - Internal and external constraints
   - Operational sequencing
   - Robotic welder
   - Hold downs
   - Dogging
   - Clamping
   - Manipulation

Achievement Criteria
Given information on work simplification principles and methods, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must design and construct a simple jig. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must design and construct a simple jig in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): L FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L16 Differentiate types of structural steel fasteners

Objectives
To be competent in this area, the individual must be able to:
- Describe the different types of structural steel fasteners.
- Describe procedures for working with high tensile bolts.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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</thead>
</table>
| 1. Define terms related to structural steel fasteners | - Bolt length  
- Thread length  
- Grip  
- Nominal size  
- Pitch  
- Shoulder  
- Machine bolts  
- High strength bolts  
- Bevel and flat washers |
| 2. Identify fastening devices and anchors common to the metal fabrication industry | - Machine bolts - A307  
- Hi-tensile bolts  
- A325  
- A390  
- Washers  
- Studs  
- Pins  
- Fluted bolts  
- Concrete fasteners |
| 3. Describe the correct procedures to follow when installing hi-tensile bolts | - Preparation of connection plates  
- Alignment methods  
- Snug-tight bolts to draw in plates  
- Bolting sequence |
| 4. Describe correct procedures to follow when torquing hi-tensile bolts using various methods | - Controlled torque  
- Turn of nut  
- Direct tension indicator  
- Procedures when torquing should not be performed |
Achievement Criteria

Given information on the different types of structural steel fasteners, as well as procedures for working with high tensile bolts, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must apply the knowledge of different types of structural steel fasteners, as well as procedures for working with high tensile bolts. Tasks must be performed with 70% accuracy.
Program Content
Level 4

Line (GAC): L FABRICATE PLATE AND STRUCTURAL SECTIONS
Competency: L17 Fabricate a reduced spiral staircase

Objectives
To be competent in this area, the individual must be able to:
• Use a given drawing to fabricate a reduced spiral staircase.

LEARNING TASKS

1. Interpret the given drawing and information
   • Pitch of staircase
   • Turn of staircase
   • Number of treads
   • Tread details
   • Diameters
   • Height of staircase

2. Determine information required for fabrication
   • Riser dimensions
   • Tread fitting dimensions
   • Material sizes require

3. Describe an accepted method for fitting spiral stairs
   • Establishment of datum
   • Locating centerlines/reference lines
   • Tread fitting
   • Handrail considerations
   • Squareness techniques

4. Describe relevant fitting considerations
   • Alignment
   • Dimensional accuracy
   • Fitting/fairing considerations
   • Appearance

Achievement Criteria
Given information on fabricating a reduced spiral staircase, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must use a given drawing to fabricate a reduced spiral staircase. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use a given drawing to fabricate a reduced spiral staircase in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
### Program Content
#### Level 4

**Line (GAC):** L  **FABRICATE PLATE AND STRUCTURAL SECTIONS**

**Competency:** L18  Fabricate a multiple transition piece with branches

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

- Use shop layout and material forming equipment to fabricate multiple transition pieces with branches.

### LEARNING TASKS
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<td>• Dimensions of transition pieces to develop patterns</td>
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<td>• Bend line spacing</td>
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<td>• True length diagram</td>
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<td>2. Develop required patterns for rectangular and round branches</td>
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<td>• Adjusting formed plates</td>
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<tr>
<td>4. Describe the fitting sequence for the transition pieces</td>
<td>• Benchtop profiling</td>
</tr>
<tr>
<td></td>
<td>• Seam location and fit</td>
</tr>
<tr>
<td></td>
<td>• Mismatched sections</td>
</tr>
<tr>
<td></td>
<td>• Tack weld location</td>
</tr>
<tr>
<td>5. Describe an accepted method for fitting branches</td>
<td>• Establishment of datums</td>
</tr>
<tr>
<td></td>
<td>• Locating centerlines/reference lines</td>
</tr>
<tr>
<td></td>
<td>• Maintaining position of branches</td>
</tr>
<tr>
<td></td>
<td>• Alignment methods</td>
</tr>
<tr>
<td>6. Describe relevant fitting considerations</td>
<td>• Alignment</td>
</tr>
<tr>
<td></td>
<td>• Dimensional accuracy</td>
</tr>
<tr>
<td></td>
<td>• Fitting/fairing considerations</td>
</tr>
<tr>
<td></td>
<td>• Appearance</td>
</tr>
</tbody>
</table>

### Workplace Achievement Criteria
After developing patterns for given transition shapes, as well as rectangular and round branches, the learner must use shop layout and material forming equipment to fabricate multiple transition pieces with branches in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): M DESCRIE BASIC METALLURGY AND TESTING TECHNIQUES

Competency: M1 Describe the types, grades and properties of steels

Objectives

To be competent in this area, the individual must be able to:
• Describe the characteristics of various types of steels.

LEARNING TASKS

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

3. Describe important properties of types of metals
   • Density
   • Tensile strength
   • Hardness
   • Ductility
   • Weldability
   • Corrosion resistance
   • Heat resistance

4. State the types and grades of structural metals used in industry
   • CSA standard types
   • ASTM standard types
   • Cross-reference for similarity of types

Achievement Criteria

Given information on the characteristics of various types of steels, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.
Program Content
Level 4

Line (GAC): M DESCRIBE BASIC METALLURGY AND TESTING TECHNIQUES

Competency: M2 Describe the effects of heat and stress on metals

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

- Describe effects of heat and stress on metals.

LEARNING TASKS

1. Describe the effects of heat on metals
   - Hardening
   - Tempering
   - Annealing and normalizing
   - Distortion

2. Describe stress that may develop in fabricated metal structures
   - Residual stress
   - Reaction stresses

Achievement Criteria
Given information on the effects of heat and stress on metals, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.
Line (GAC): M DESCRIBE BASIC METALLURGY AND TESTING TECHNIQUES

Competency: M3 Describe stress relieving techniques on metals

Objectives
To be competent in this area, the individual must be able to:
• Describe methods of relieving stress on metals.

LEARNING TASKS
1. Describe the common methods of stress relieving on metals

CONTENT
• Peening
• Vibration
• Heat treating
• Flame straightening
• Ultra sonic stress relieving
• Heat pads

Achievement Criteria
Given information on methods of relieving stress on metals, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.
Program Content
Level 4

Line (GAC): M DESCRIBE BASIC METALLURGY AND TESTING TECHNIQUES

Competency: M4 Identify and use common metal testing methods

Objectives
To be competent in this area, the individual must be able to:
- Describe standard types and methods of testing common metals.
- Use standard methods to test metal samples.

LEARNING TASKS

1. Describe standard material tests
   - Spark spray pattern
   - Tensile strength
   - Surface indentation
   - Notch toughness

2. Describe standard testing equipment and methods
   - Bench grinder
   - Universal testing machine
   - Brinnel hardness
   - Charpy V-notch
   - Standard specimen sizes

3. Use standard test methods on metal samples
   - Physical characteristics
   - Spark spray pattern
   - Tensile testing and graph interpretation
   - Surface hardness
   - Britteness/toughness

Achievement Criteria
Given information on standard types and methods of testing common metals, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must use standard methods to test metal samples. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria
The learner must use standard methods to test metal samples in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 4

Line (GAC): N USE TESTING AND INSPECTION METHODS
Competency: N1 Describe relevant provincial, national and international fabrication codes

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

- Describe types and applications of fabrication codes.
- Apply given codes.

LEARNING TASKS
1. Identify codes appropriate to application in metal fabrication
   - CSAS16
   - CSA W59
   - CSA G40.20 M
   - AWSD1.1
   - CSA G40.21
   - CSA G40.12
   - CSA W47.1 (steel)
   - CSA W47.2 (aluminum)
   - BC Building Code
   - Lloyds
   - API

2. Describe the application of key parts of codes appropriate to metal fabrication
   - Welding code tolerances
   - Material characteristics

3. Apply given codes
   - Given a practical shop exercise, use given codes

Achievement Criteria
Given information on types and applications of fabrication codes, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must use given codes in lab practical shop tasks. Tasks must be performed with 70% accuracy.
Objectives

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

- Describe non-destructive and visual inspection techniques used in metal fabrication.
- Test various materials for performance characteristics and unacceptable flaws.

Learning Tasks

1. Describe the various non-destructive testing techniques used in metal fabrication
   - Radiography - gamma and X-ray
   - Dye and fluorescent penetrants
   - Ultrasonic
   - Magnetic particle
   - Hydrostatic - air and water

2. Describe visual inspection techniques used in metal fabrication
   - Material
   - Welds
   - Completed unit

3. Test various materials for performance characteristics and unacceptable flaws
   - Weld coupons
   - Vessels
   - Plate and structural shapes
   - Mill imperfections

Achievement Criteria

Given information on non-destructive and visual inspection techniques used in metal fabrication, the learner must be able to identify and correctly answer a series of multiple choice tests with 70% accuracy.

In addition, the learner must test various materials for performance characteristics and unacceptable flaws. Tasks must be performed with 70% accuracy.

Workplace Achievement Criteria

The learner must test various materials for performance characteristics and unacceptable flaws in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 4

Line (GAC): O ON-SITE INSTALLATION
Competency: O1 Establish area for installation

Objectives
To be competent in this area, the individual must be able to:
• Establish the on-site installation area, taking site safety requirements into account.

LEARNING TASKS
1. Plan and apply the operation process for establishing the on-site installation area

CONTENT
• Safety requirements at the job site
  o Gasses
  o Electrical
  o Specific site requirements based on job
  o Weather related considerations
  o Ventilation requirements
• Communication with other key people
• Interpret site drawings
• Environmental protection requirements

Workplace Achievement Criteria
The learner must establish the on-site installation area, taking site safety requirements into account in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): O ON-SITE INSTALLATION
Competency: O2 Establish laydown area

Objectives
To be competent in this area, the individual must be able to:
- Establish the on-site installation laydown area, observing all applicable regulations and dunnage requirements.

LEARNING TASKS
1. Plan and apply the operation process for establishing the laydown area for on-site installation

CONTENT
- Shipping documents for materials and components
- Relevant codes, by-laws and regulations
- Dunnage requirements

Workplace Achievement Criteria
The learner must establish the on-site installation laydown area, observing all applicable regulations and dunnage requirements, in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): O ON-SITE INSTALLATION
Competency: O3 Determine required equipment

Objectives
To be competent in this area, the individual must be able to:
• Determine all equipment required for on-site installation, including rigging and lifting, materials handling, and fabrication and assembly.

LEARNING TASKS
1. Plan and apply the operation process for determining the equipment that will be required for on-site installation

CONTENT
• Rigging and lifting requirements
• Communication with other key people on-site
• Materials handling requirements on-site
  o Hoisting
  o Mobile ground machinery
• Fabrication and assembly equipment requirements on-site
• Welding equipment
• Cutting equipment
• Oxy-fuel equipment
• Layout equipment
• Hand and power tools
• Personal protective equipment

Workplace Achievement Criteria
Based on all requirements for rigging and lifting, materials handling, and fabrication and assembly equipment, the learner must determine all equipment that will be needed for on-site installation in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Objectives
To be competent in this area, the individual must be able to:
• Determine the consumables required for on-site installation.

LEARNING TASKS
1. Plan and apply the operation process for determining the consumables that will be required for on-site installation

CONTENT
• Job specifications
• Welding supplies
• Materials requirements
• Operation process planning

Workplace Achievement Criteria
The learner must determine the consumables required for on-site installation in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Line (GAC): O ON-SITE INSTALLATION
Competency: O5 Confirm field dimensions

Objectives
To be competent in this area, the individual must be able to:
- Confirm field dimensions required for on-site installation.

LEARNING TASKS
1. Plan and apply the operation process for confirming field dimensions required for on-site installation

CONTENT
- Field measuring devices
- Transfer field dimensions to drawings

Workplace Achievement Criteria
The learner must confirm field dimensions required for on-site installation in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task.
Program Content
Level 4

Line (GAC):  O  ON-SITE INSTALLATION
Competency:  O6  Describe installation of components

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
1. Describe the operation process for planning the installation and assembly of all components on site

CONTENT
•   On-site contract requirements
•   Required field modifications
•   Fastening and welding requirements
•   Relevant codes and regulations
•   Personnel requirements

Workplace Achievement Criteria
The learner must plan for the installation and assembly of all components on site in routine workplace operations. These competencies are primarily assessed in the workplace. Employer assessed accuracy is required for each task
Section 4

TRAINING PROVIDER STANDARDS
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 to 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 centr

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 vice
- Standard upright drill
- Hold down clamps
- Tap and dies
- Magnetic drill

BENDING AND SHAPING EQUIPMENT
- Portapower
- CNC process equipment
- Press brake
- 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
- Wheelabrater
- Chippers
- Wire brush
- Hand brush
- Wire wheels
Training Provider Standards

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, Rivetters)
- 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
- Manilla 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

- WorkSafeBC Regulations Online
- Student Materials Package

Recommended

- AccurPress Accell User Manuals, No. 1 - 3
- American Institute of Steel Construction (AISC) website - Bolting & Welding, ppt.
- 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