WELDER LEVEL B

PROGRAM OUTLINE

March 2008

Developed By
Industry Training Authority
Province of British Columbia
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FOREWORD

This Program Outline was developed to meet the needs of Employers and other Industry Stakeholders. It will be used primarily as a guide for Instructors in the delivery of Welder Level B apprenticeship technical training classes sponsored by the Industry Training Authority.

Practical demonstration and student participation should 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.

a) This document contains an Occupational Analysis Chart of the competencies required for apprenticeship technical training to complete the practical and written tests for a Welder Level B Certificate of Qualification.

Additional Information for Training Providers:

This Welder Level B Apprenticeship Program is competency based with many options available for the delivery of technical training, for example; this program may be offered as a:

- Full-time day school program (including block release and continuous entry)
  - Program is divided into two levels of training in blocks of 240 hours per level
  - Level B-1 and B-2 may be taken consecutively
- Continuous entry competency based model
  - Training options for Level B are outlined in Welders Log Book
- Some theory may be offered as interactive synchronistic “on-line” delivery
- Time lines expressed on the Occupational Analysis Chart are considered as the maximum time allowed and based on consecutive delivery of the modules

This Program Outline also includes:

- A list of recommended curriculum and reference textbooks
- Requirements for Instructor Qualifications, Facilities (classroom and shop sizes), as well as the necessary Tools and Equipment
- Practical competencies as well as destructive and non-destructive testing
- Pipe fabrication competencies

PLEASE NOTE:
All provincial welder training program curriculum is currently under review and subject to amendments by the BC Welding Articulation Committee
ACKNOWLEDGEMENTS

The Program Outline was prepared with the advice and direction from a Project Review Committee convened by the Resource Training Organization (RTO) of British Columbia, with funding support from the Industry Training Authority (ITA) of British Columbia, including:

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Dan Burroughs – Sheet Metal Workers’ Local 280
Ron McKeown – Kwantlen College Faculty Association

**Facilitators**
Dick Vanier – Training Consultant - Vanier Training Consultants Ltd.

**Resource Training Organization**
Curt Cain – Director Program Standards
SECTION 1

OCCUPATIONAL ANALYSIS CHART
<table>
<thead>
<tr>
<th>Task Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performs Shielded Metal Arc Welding (SMAW)</td>
<td>D</td>
</tr>
<tr>
<td>Use the SMAW process to weld groove welds on low carbon steel plate.</td>
<td>D-14</td>
</tr>
<tr>
<td>Use the SMAW process to weld groove welds on low carbon steel pipe.</td>
<td>D-16</td>
</tr>
<tr>
<td>Use the SMAW process to fillet weld flange 5F (vertical up) on low carbon steel pipe.</td>
<td>D-17</td>
</tr>
<tr>
<td>Performs Semi-Automatic Welding (GMAW) (GMAW-P) (FCAW) (FCAW/MC*)</td>
<td>F</td>
</tr>
<tr>
<td>Describe GMAW, GMAW-P, FCAW and FCAW/MC* equipment and their operation.</td>
<td>F-2</td>
</tr>
<tr>
<td>Describe and select filler metal and shielding gases for GMAW.</td>
<td>F-3</td>
</tr>
<tr>
<td>Use the GMAW-P process to weld groove welds on low carbon steel plate.</td>
<td>F-11</td>
</tr>
<tr>
<td>Use the GMAW-P processes to weld groove welds on low carbon steel pipe.</td>
<td>F-12</td>
</tr>
<tr>
<td>Describe and demonstrate GMAW-P groove welds using stainless steel filler metal on low carbon steel sheet and plate (e.g. 18 gauge and thicker).</td>
<td>F-14</td>
</tr>
<tr>
<td>Describe and demonstrate procedures specific to GMAW and GMAW-P on aluminum plate.</td>
<td>F-16</td>
</tr>
<tr>
<td>Use the GMAW and GMAW-P processes to weld groove welds on aluminum plate.</td>
<td>F-17</td>
</tr>
<tr>
<td>Describe and select filler metals and shielding gases for FCAW and FCAW/MC*.</td>
<td>F-18</td>
</tr>
<tr>
<td>Use the FCAW self-shielded process to weld fillet welds on low carbon steel plate.</td>
<td>F-19</td>
</tr>
<tr>
<td>Use the FCAW self-shielded process to weld groove fillets on low carbon steel plate.</td>
<td>F-21</td>
</tr>
<tr>
<td>Use the FCAW/MC* process to weld groove welds on low carbon steel plate.</td>
<td>F-24</td>
</tr>
<tr>
<td>Use the GMAW, FCAW and FCAW/MC* process to weld groove welds on low carbon steel pipe.</td>
<td>F-25</td>
</tr>
<tr>
<td>Describe and demonstrate FCAW fillet welds using stainless steel filler metal on low carbon steel plate.</td>
<td>F-26</td>
</tr>
<tr>
<td>Hard surface low carbon steel plate.</td>
<td>F-27</td>
</tr>
<tr>
<td>DESCRIBES QUALITY CONTROL AND INSPECTION</td>
<td>Identify types and uses of destructive testing methods.</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>B</td>
<td>L-1</td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>DESCRIBES SCOPE OF WELDING STANDARDS, CODES, SPECIFICATIONS AND WELDER QUALIFICATIONS</td>
<td>Identify applicable standards, codes and specifications.</td>
</tr>
<tr>
<td>M</td>
<td>M-1</td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>O-1</td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>O-7</td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Describe resistance welding process.</td>
</tr>
<tr>
<td></td>
<td>O-13</td>
</tr>
</tbody>
</table>

*NOTE: FCAW/MC is metal cored filler metals under the CSA. GMAW/MC is metal cored filler metals under the AWS: A5.18 specification.*

*Source: American Welding Society and Canadian Standards Association (03/2007)*
SECTION 2

PROGRAM OUTLINE
## SUGGESTED SCHEDULE OF TIME ALLOTMENT FOR LEVEL B

<table>
<thead>
<tr>
<th>LEVEL B</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line D</strong></td>
<td>Performs Shielded Metal Arc Welding (SMAW)</td>
<td>5%</td>
</tr>
<tr>
<td>D-14</td>
<td>Use the SMAW Process to Weld Groove Welds on Low Carbon Steel Plate</td>
<td>✓</td>
</tr>
<tr>
<td>D-16</td>
<td>Use the SMAW Process to Weld Groove Welds on Low Carbon Steel Pipe</td>
<td>✓</td>
</tr>
<tr>
<td>D-17</td>
<td>Use the SMAW Process to Fillet Weld Flange 5F (Vertical Up) on Low Carbon Steel Pipe</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Line F</strong></td>
<td>Performs Semi-Automatic Welding (GMAW) (GMAW-P) (FCAW) (FCAW/MC)</td>
<td>10%</td>
</tr>
<tr>
<td>F-2</td>
<td>Describe GMAW, GMAW-P, FCAW and FCAW/MC Equipment and Their Operation</td>
<td>✓</td>
</tr>
<tr>
<td>F-3</td>
<td>Describe and Select Filler Metal and Shielding Gases for GMAW</td>
<td>✓</td>
</tr>
<tr>
<td>F-11</td>
<td>Use the GMAW-P Process to Weld Groove Welds on Low Carbon Steel Plate</td>
<td>✓</td>
</tr>
<tr>
<td>F-12</td>
<td>Use the GMAW and GMAW-P Processes to Weld Groove Welds on Low Carbon Steel Pipe</td>
<td>✓</td>
</tr>
<tr>
<td>F-14</td>
<td>Describe and Demonstrate GMAW-P Groove Welds Using Stainless Steel Filler Metal on Low Carbon Steel Sheet and Plate (e.g. 18 Gauge and Thicker)</td>
<td>✓</td>
</tr>
<tr>
<td>F-15</td>
<td>Describe and Demonstrate GMAW-P Groove Welds Using Stainless Steel Filler Metal on Low Carbon Steel Pipe</td>
<td>✓</td>
</tr>
<tr>
<td>F-16</td>
<td>Describe and Demonstrate Procedures Specific to GMAW and GMAW-P on Aluminum Plate</td>
<td>✓</td>
</tr>
<tr>
<td>F-17</td>
<td>Use the GMAW and GMAW-P Processes to Weld Groove Welds on Aluminum Plate</td>
<td>✓</td>
</tr>
<tr>
<td>F-18</td>
<td>Describe and Select Filler Metals and Shielding Gases for FCAW and FCAW/MC</td>
<td>✓</td>
</tr>
<tr>
<td>F-19</td>
<td>Use the FCAW Self-Shielded Process to Weld Fillet Welds on Low Carbon Steel Plate</td>
<td>✓</td>
</tr>
<tr>
<td>F-21</td>
<td>Use the FCAW Self-Shielded Process to Weld Groove Fillets on Low Carbon Steel Plate</td>
<td>✓</td>
</tr>
<tr>
<td>F-22</td>
<td>Use the FCAW Process to Weld Groove Welds on Low Carbon Steel Plate</td>
<td>✓</td>
</tr>
<tr>
<td>F-24</td>
<td>Use the FCAW/MC Process to Weld Groove Welds on Low Carbon Steel Plate</td>
<td>✓</td>
</tr>
<tr>
<td>F-25</td>
<td>Use the GMAW, FCAW and FCAW/MC Process to Weld Groove Welds on Low Carbon Steel Pipe</td>
<td>✓</td>
</tr>
<tr>
<td>F-26</td>
<td>Describe and Demonstrate FCAW Fillet Welds Using Stainless Steel Filler Metal on Low Carbon Steel Plate</td>
<td>✓</td>
</tr>
<tr>
<td>F-27</td>
<td>Hardsurface Low Carbon Steel Plate</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Line G</strong></td>
<td>Describes Basic Metallurgy Relating to Production, Properties and Weldability</td>
<td>100%</td>
</tr>
</tbody>
</table>

Welder Level B Program Outline • Industry Training Authority
01-12
## LEVEL B

<table>
<thead>
<tr>
<th>Skill</th>
<th>Description</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-4</td>
<td>Describe the Grain Structure of Metals</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>G-5</td>
<td>Describe the Alloy Content and Heat Treatments on the Weldability of Steel</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>G-6</td>
<td>Describe Aluminum, Aluminum Alloys and Describe Their Weldability</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

### Line H: Performs Gas Tungsten Arc Welding (GTAW)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Description</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>Describe the GTAW Process and its Application</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>H-2</td>
<td>Describe GTAW Equipment</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>H-3</td>
<td>Use the GTAW Process to Fillet Weld Using Low Carbon Steel Filler Metal</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>on Low Carbon Steel Sheet</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>H-4</td>
<td>Use the GTAW Process to Groove Weld Using Low Carbon Steel Filler Metal</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>on Low Carbon Steel Plate</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>H-5</td>
<td>Use the GTAW Process to Groove Weld Using Low Carbon Steel Filler Metal</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>on Low Carbon Steel Pipe</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>H-6</td>
<td>Use the GTAW Process to Fillet Weld Using Stainless Steel Filler Metal</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>on Low Carbon Steel Sheet and/or Stainless Steel Sheet</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>H-8</td>
<td>Use the GTAW Process to Groove Weld Using Stainless Steel Filler Metal</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>on Thin Wall Stainless Steel Pipe</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>H-10</td>
<td>Use the GTAW Process to Fillet Weld Using Aluminum Filler Metal</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>on Low Carbon Steel Sheet</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>and/or Stainless Steel Sheet</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Line J: Reads and Utilizes Industry Drawings

<table>
<thead>
<tr>
<th>Skill</th>
<th>Description</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>J-7</td>
<td>Read and Interpret Piping Drawings</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>J-8</td>
<td>Perform Basic Pipe Layout</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Line K: Layout and Fabricate Components

<table>
<thead>
<tr>
<th>Skill</th>
<th>Description</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-1</td>
<td>Interpret and Apply Mechanical Drawings</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>K-4</td>
<td>Layout Materials</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>K-5</td>
<td>Prepare Materials</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>K-6</td>
<td>Fabricate Project(s)</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Line L: Describes Quality Control and Inspection

<table>
<thead>
<tr>
<th>Skill</th>
<th>Description</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-1</td>
<td>Identify Types and Uses of Destructive Testing Methods</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L-2</td>
<td>Identify Types and Uses of Non-Destructive Testing Methods</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>L-3</td>
<td>Comply with Weld Procedure Specifications (WPS) and Data Sheets</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>L-4</td>
<td>Describe the Scope of the Welding Supervisor and Inspector Responsibilities</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
## LEVEL B

<table>
<thead>
<tr>
<th>Line M</th>
<th>Describes Scope of Welding Standards, Codes, Specifications and Welder Qualifications</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-1</td>
<td>Identify Applicable Standards, Codes and Specifications</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>M-2</td>
<td>Describe Materials and Filler Metal Classification Systems</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>M-3</td>
<td>Describe Welding Procedure and Performance Qualification Tests</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>M-4</td>
<td>Describe BCSA Jurisdiction</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line O</th>
<th>Describes Specialized Welding and Other Welding Processes (AWS)</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-1</td>
<td>Describe Orbital Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-2</td>
<td>Describe Plastic Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-3</td>
<td>Describe Thermal Spray Process</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-4</td>
<td>Describe Thermit Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-5</td>
<td>Describe Electro-Gas Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-6</td>
<td>Describe Electro-Slag Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-7</td>
<td>Describe Laser Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-8</td>
<td>Describe Plasma Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-9</td>
<td>Describe Flash Butt Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-10</td>
<td>Describe Electron Beam Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-11</td>
<td>Describe Friction and Friction Stir Welding</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-12</td>
<td>Describe Stud Arc Welding Process</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>O-13</td>
<td>Describe Resistance Welding Process</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

**Total Percentage for Level “B”**: 100%
PROGRAM OUTLINE
FOR
LEVEL B
LINE D: PERFORMS SHIELDED METAL ARC WELDING (SMAW)

Competency: D-14 Use the SMAW Process to Weld Groove Welds on Low Carbon Steel Plate

Learning Objectives:
The learner will be able to identify safe work practices and PPE for SMAW, as well as being able to identify the main factors. The learner will also be required to weld groove welds on low carbon steel plate in all positions.

LEARNING TASKS

1. Review safety requirements and main factors of SMAW.

   - WHMIS and WorkSafeBC safety requirements:
     - Electric shock
     - Slag
     - Arc flash
     - Protective clothing and equipment (PPE)
     - Arc burn
     - Ventilation
     - Electrode stubs
     - Fire prevention

   - Main factors:
     - Machine setting
     - Electrode angle
     - Correct position
     - Speed of travel
     - Arc length

2. Weld groove welds in the flat (1G) position, horizontal (2G), vertical (3G), overhead (4G) position on low carbon steel plate.

   - Multi-pass groove weld on single vee butt joint in the 1G position - refer to practical competency for Weld Procedure Specification (WPS)
   - Multi-pass groove weld on single vee butt joint in the 2G position - refer to practical competency for Weld Procedure Specification (WPS)
   - Multi-pass groove weld on single vee butt joint in the 3G position (uphill) - refer to practical competency for Weld Procedure Specification (WPS)
   - Multi-pass groove weld on single vee butt joint in the 3G position (downhill) - refer to practical competency for Weld Procedure Specification (WPS)
   - Multi-pass groove weld on single vee butt joint in the 4G position - refer to practical competency for Weld Procedure Specification (WPS)
NOTE: Refer to Current Welder Training Program Curriculum Module/Line P7-1, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to perform groove welds on low carbon steel plate in all positions. This is part of a practical shop project as per the acceptance criteria in the current curriculum module/line P7-1 procedure B face and root bend tests. This evaluation must meet section IX ASME code.
LINE D: PERFORMS SHIELDED METAL ARC WELDING (SMAW)

Competency: D-16 Use the SMAW Process to Weld Groove Welds on Low Carbon Steel Pipe

Learning Objectives:
The learner will be able to fit up and tack weld pipe, and feather tack welds. The learner will also be able to identify pipe welding positions and weld groove welds in the 1G, 2G, 5G and 6G positions on steel pipe.

LEARNING TASKS

1. Weld groove welds in the flat rolled (1G) position on low carbon steel pipe.

2. Weld groove welds in the vertical fixed (2G) position on low carbon steel pipe.

3. Weld groove welds in the horizontal fixed (5G) position (uphill) on low carbon steel pipe.

4. Weld groove welds in the inclined fixed 45° (6G) position (uphill) on low carbon steel pipe.

5. Weld groove welds in the horizontal fixed (5G) position (downhill) on low carbon steel pipe.


NOTE: Refer to Current Welder Training Program Curriculum Module/Line P7-2, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to perform groove welds in the 1G, 2G, 5G, and 6G positions on steel pipe, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P7-2 procedure B face and root bend tests. This evaluation must meet section IX ASME code.
LINE D: PERFORMS SHIELDED METAL ARC WELDING (SMAW)

Competency: D-17 Use the SMAW Process to Fillet Weld Flange 5F (Vertical Up) on Low Carbon Steel Pipe

Learning Objectives:
The learner will be able to fit up, tack and weld slip-on flange to pipe in the 5F position.

LEARNING TASKS

7. Weld fillet welds in the (5F) position on slip-on flange to low carbon steel pipe.

CONTENT

- Multi-pass fillet weld in the 5F position (vertical uphill) - refer to practical competency for Weld Procedure Specification (WPS)

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P7-2, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to fit up, tack and weld slip-on flange to pipe in the 5F position, as part of a practical shop project. This evaluation must meet a visual inspection as described in section IX ASME code.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW)
(GMAW-P) (FCAW) (FCAW/MC)

Competency: F-2 Describe GMAW, GMAW-P, FCAW and FCAW/MC
Equipment and Their Operation

Learning Objectives:
The learner will be able to identify all the safety requirements related to the GMAW and GMAW-P processes. The learner will also be able to identify the pre-selected, the primary adjustable, and the secondary adjustable variables in GMAW and GMAW-P.

The learner will be able to identify all the safety requirements related to the FCAW process. The learner will also be able to identify the pre-selected, the primary adjustable, and the secondary adjustable variables in FCAW/MC.

LEARNING TASKS

1. Review safety requirements and welding variables for GMAW, GMAW-P, FCAW and FCAW/MC.
   - WHMIS and WorkSafeBC safety requirements:
     - PPE
     - Electrical hazards and safety precautions
     - Arc flash and arc burn
     - Ventilation
     - Fire prevention
     - Cylinder handling
   - Welding variables:
     - Pre-selected variables
     - Primary adjustable variables
     - Secondary adjustable variables

2. Review GMAW, GMAW-P, FCAW and FCAW/MC.
   - Principles of operation
   - Advantages and disadvantages of GMAW, GMAW-P, FCAW and FCAW/MC

3. Review modes of metal transfer in GMAW, GMAW-P, FCAW and FCAW/MC.
   - Pinch effect
   - Short-circuit transfer
   - Globular transfer
   - Spray transfer
   - Pulsed spray transfer
   - Transition currents
4. Review power sources for semi-automatic processes.
   - **Constant voltage/current power sources:**
     - Arc voltage
     - Slope
     - Inductance
   - **Types of controls on CV power sources:**
     - Voltage controls
     - Slope controls
     - Inductance controls
     - Current controls
     - Voltmeters and ammeters
     - Remote controls and dual schedules
   - **Pulsed power sources**

5. Review the equipment for semi-automatic wire-feed systems.
   - **Push type systems**
   - **Pull-type feed systems**
   - **Push-pull systems**
   - **Feed rolls**
   - **Wire-feed controls**
   - **Constant and variable speed wire-feeders**

   - **Welding gun types:**
     - Amperage rating
     - Water cooled
     - Gas cooled
     - Spool
   - **Welding gun consumables**
   - **Cable assembly:**
     - Size
     - Adapters
   - **Liners**
   - **Preventive maintenance**

   - **Conventional power sources**
   - **Inverter power sources**
   - **Pulse controls**
   - **Welding cables**
   - **Welding guns**
   - **Filler metal**
   - **Shielding gases**

8. Review primary process variables for semi-automatic equipment.
   - **Voltage**
   - **Wire feed speed**
   - **Welding current**
   - **Trim or arc length (GMAW-P)**
   - **Inductance**
   - **Electrode extension (stickout)**
   - **Arc length**
   - **Contact tip to work distance**
   - **Push/pull technique**
   - **Gun to work angles**

10. Review process related weld faults and their causes.

- Nozzle to work distance
- Travel speed
- Dimensional defects:
  - Incorrect weld size
  - Insufficient throat/underfill
- Structural discontinuities in the weld:
  - Under cut
  - Incomplete penetration
  - Lack of fusion
  - Cold lap
  - Porosity
  - Cracking (internal/external)
  - Slag inclusions

11. Review corrective measures (e.g. trouble shooting) for malfunctioning semi-automatic equipment.

- Mechanical:
  - Drive feed mechanism
  - Liner
- Electrical:
  - Cable sizes
  - Grounding
  - Contact tip
  - Contactor (gun trigger)
- Gases:
  - Leaks in system
  - Flow rates
  - Nozzle

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P8-1 (includes reference to review P1 and P6), and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on the safety requirements related to the GMAW and GMAW-P processes and the pre-selected, the primary adjustable, and the secondary adjustable variables in GMAW and GMAW-P, the learner will demonstrate their knowledge by correctly answering 14 questions or more.

Given a 10 question test on the safety requirements related to the FCAW and FCAW/MC processes and the pre-selected, the primary adjustable, and the secondary adjustable variables in FCAW and FCAW/MC, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-3 Describe and Select Filler Metal and Shielding Gases for GMAW

Learning Objectives:
The learner will be able to select filler metal and shielding gases for GMAW based on their knowledge of the construction and operation of GMAW, and the CSA and AWS classification systems and specifications for GMAW low carbon steel filler metal. They will also be able to identify the application for commonly used GMAW low carbon steel filler metal and the basic care, handling and storage procedures for GMAW filler metal.

LEARNING TASKS

1. Review low carbon steel filler metal for GMAW.
   - Low carbon steel filler metal classifications
   - GMAW or solid filler metal:
     - Deoxidizers in GMAW wires
     - ER49S-1 to 7 (ER70S-1 to 7)
     - ER49S-G (ER70S-G)
   - Carbon dioxide
   - Inert shielding gases – argon and helium:
     - Density
     - Thermal conductivity
     - Ionization potential
   - Gas mixtures:
     - Argon-oxygen mixtures
     - Helium-argon mixtures
     - Specific gas mixtures to suit applications
   - Shielding gas cylinders:
     - Carbon dioxide cylinders
   - Regulators
   - Flowmeters
   - Manifold systems
   - Gas mixers
   - Flowrates for shielding gases
   - Solutions for regulator “freeze-up”
   - Safe handling of shielding gas cylinders and regulators

2. Review the shielding gases for GMAW.

NOTE: Refer To Current Welder Training Program Curriculum Module/Line P8 (Includes Reference to Review P6), and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on selecting filler metal and shielding gases for GMAW, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-11 Use the GMAW-P Process to Weld Groove Welds on Low Carbon Steel Plate

Learning Objectives:
The learner will be able to weld groove welds on single-bevel butt joints with backing and single-vee butt joints without backing.

LEARNING TASKS

1. Weld groove welds in the flat position (1G) on butt joints on low carbon steel plate.
   - Multi-pass groove weld on single-vee butt joint in the 1G position - refer to practical competency for Weld Procedure Specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure

2. Weld groove welds on butt joints in the horizontal (2G) position on low carbon steel plate.
   - Multi-pass groove weld on open root, single-vee butt joint in the 2G position - refer to practical competency for Weld Procedure Specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure

3. Weld groove welds on butt joints in the vertical (3G) position (downhill) on low carbon steel plate.
   - Multi-pass groove weld on open root, single-vee butt joint in the 3G position (downhill) - refer to practical competency for Weld Procedure Specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure

4. Weld groove welds on butt joints in the vertical (3G) position (uphill) on low carbon steel plate.
   - Multi-pass groove weld on open root, single-vee butt joint in the 3G position (uphill) - refer to practical competency for Weld Procedure Specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure

5. Weld groove welds on butt joints in the vertical (4G) position.
   - Multi-pass groove weld on open root, single-vee butt joint in the 4G position - refer to practical competency for Weld Procedure Specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure
NOTE: Refer To Current Welder Training Program Curriculum Module/Line P8-4, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to perform groove welds in the 1G, 2G, 3G, and 4G positions on steel plate, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P8-4. This evaluation must meet section IX ASME code.
**LINE F:** PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

**Competency:** F-12 Use the GMAW and GMAW-P Processes to Weld Groove Welds on Low Carbon Steel Pipe

**Learning Objectives:**
The learner will be able to use the GMAW and GMAW-P processes to weld groove welds in the 2G and 5G (downhill) positions on low carbon steel pipe.

**LEARNING TASKS**

1. Welds groove welds in the horizontal (2G) position on low carbon steel pipe.

   **CONTENT**
   - Multi-pass groove weld on single-vee butt joint in the 2G position - refer to practical competency for Weld Procedure Specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure

2. Welds groove welds in the vertical (5G) position (downhill) on low carbon steel pipe.

   **CONTENT**
   - Multi-pass groove weld on single-vee butt joint in the 5G position (downhill) - refer to practical competency for Weld Procedure Specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure

**NOTE:** Refer To Current Welder Training Program Curriculum Module/Line P8-5, and Amendments by the BC Welding Articulation Committee

**Achievement Criteria:**
The learner will be evaluated on their ability to perform groove welds in the 2G and 5G (downhill) positions on steel pipe, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P8-5. This evaluation must meet section IX ASME code.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-14 Describe and Demonstrate GMAW-P Groove Welds Using Stainless Steel Filler Metal on Low Carbon Steel Sheet and Plate (e.g. 18 Gauge and Thicker)

Learning Objectives:
The learner will be able to use GMAW-P on groove welds using stainless steel filler metal on low carbon steel sheet and plate.

LEARNING TASKS

1. Review specific safety precautions when welding stainless steel.

2. Review proper handling and preparation procedures for materials and consumables.

3. Review the principal considerations in the GMAW-P welding of stainless steel.

4. Weld groove welds in the flat (1G) position on low carbon steel sheet and plate.
   - Single-pass square groove weld in the 1G position on low carbon steel sheet – refer to practical competency for Weld Procedure Specification (WPS)
   - Multi-pass groove weld in the 1G position on low carbon steel plate – refer to practical competency for Weld Procedure Specification (WPS)

5. Weld groove welds in the horizontal (2G) position on low carbon steel sheet and plate.
   - Single-pass groove weld in the 2G position on low carbon steel sheet- refer to practical competency for Weld Procedure Specification (WPS)
   - Multi-pass groove weld in the 2G position on low carbon steel plate – refer to practical competency for Weld Procedure Specification (WPS)
6. Weld groove welds in the horizontal (3G) position on low carbon steel sheet and plate.

   - Single-pass groove weld in the 3G position (downhill) on low carbon steel sheet - refer to practical competency for Weld Procedure Specification (WPS)
   - Multi-pass groove weld in the 3G position on low carbon steel plate – refer to practical competency for Weld Procedure Specification (WPS)

7. Weld groove welds in the horizontal (4G) position on low carbon steel plate.

   - Multi-pass groove weld in the 4G position on low carbon steel plate – refer to practical competency for Weld Procedure Specification (WPS)

NOTE: Refer To Current Welder Training Program Curriculum Module/Line P8 (Includes Reference to Review P6), and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to demonstrate GMAW-P groove welds using stainless steel filler metal on low carbon steel sheet and plate, as part of a practical shop project as per the practical components in the current curriculum module/line P8. This evaluation must meet CSA W59 standards for cyclically loaded structures.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-15 Describe and Demonstrate GMAW-P Groove Welds Using Stainless Steel Filler Metal on Low Carbon Steel Pipe

Learning Objectives:
The learner will be able to use GMAW-P on groove welds using stainless steel filler metal on low carbon steel pipe.

LEARNING TASKS

1. Weld groove welds in the horizontal (2G) position on low carbon steel pipe.

2. Weld groove welds in the vertical (5G) position on low carbon steel pipe.

CONTENT

- Multi-pass groove weld in the 2G position on low carbon steel pipe – refer to practical competency for Weld Procedure Specification (WPS)

- Multi-pass groove weld in the 5G position on low carbon steel pipe – refer to practical competency for Weld Procedure Specification (WPS)

Achievement Criteria:
The learner will be evaluated on their ability to demonstrate GMAW-P groove welds using stainless steel filler metal on low carbon steel pipe, as part of a practical shop project as per the practical components in the current curriculum module/line P8-5, face and root bend tests. This evaluation must meet section IX ASME code.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-16 Describe and Demonstrate Procedures Specific to GMAW and GMAW-P on Aluminum Plate

Learning Objectives:
The learner will be able to use the precautions and procedures specific to GMAW and GMAW-P on aluminum plate.

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<td>• Reflective radiation</td>
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<th>LEARNING TASKS</th>
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<tbody>
<tr>
<td>1. Review specific safety precautions when welding aluminum.</td>
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<td>o Rigging and tooling</td>
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<td>• Set welding variables</td>
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<td>• Shielding gases</td>
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<td>• Surface oxidation of weld area</td>
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<td>• Distortion</td>
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<th>CONTENT</th>
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<tbody>
<tr>
<td>• Single-pass fillet weld lap joint in the 2F position – refer to practical competency for Weld Procedure Specification (WPS)</td>
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<tr>
<td>• Multi-pass fillet weld tee joint in the 2F position – refer to practical competency for Weld Procedure Specification (WPS)</td>
</tr>
<tr>
<td>• Multi-pass fillet weld tee joint in the 3F and 4F position – refer to practical competency for Weld Procedure Specification (WPS)</td>
</tr>
</tbody>
</table>

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P8-1, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to describe and demonstrate the precautions and procedures specific to GMAW and GMAW-P on aluminum plate, as part of a practical shop project as per the practical components in the current curriculum module/line P6 (addendum). This evaluation must meet CSA W59 standards for cyclically loaded structures.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-17 Use the GMAW and GMAW-P Processes to Weld Groove Welds on Aluminum Plate

Learning Objectives:
The learner will be able to use GMAW and GMAW-P to weld groove welds on aluminum plate in the 1G, 2G, 3G and 4G positions.

LEARNING TASKS

1. Weld groove welds in the flat (1G) position.

2. Weld groove welds in the horizontal (2G) position on aluminum plate.

3. Weld groove welds in the vertical (3G) position (uphill).

4. Weld groove welds in the overhead (4G) position.

CONTENT

- Multi-pass groove weld in the 1G position – refer to practical competency for Weld Procedure Specification (WPS)

- Multi-pass groove weld in the 2G position – refer to practical competency for Weld Procedure Specification (WPS)

- Multi-pass groove weld in the 3G position – refer to practical competency for Weld Procedure Specification (WPS)

- Multi-pass groove weld in the 4G position – refer to practical competency for Weld Procedure Specification (WPS)

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P8-3, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to use GMAW and GMAW-P to weld groove welds on aluminum plate in the 1G, 2G, 3G and 4G positions, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P8-3 face and root bend tests. This evaluation must meet CSA W59 standards for cyclically loaded structures.
Competency: F-18 Describe and Select Filler Metals and Shielding Gases for FCAW and FCAW/MC

Learning Objectives:
The learner will be able to select filler metals and shielding gases for FCAW and FCAW/MC based on their knowledge of the construction and operation of FCAW and FCAW/MC filler metals, the CSA and AWS classification systems and specifications for FCAW and FCAW/MC low carbon steel filler metals. The learner will also be able to identify the application for commonly used FCAW and FCAW/MC low carbon steel filler metals and the basic care, handling and storage procedures for FCAW and FCAW/MC filler metals.

LEARNING TASKS

1. Review the selection of low carbon steel filler metals for FCAW and FCAW/MC.
   - Major classifications of FCAW low carbon filler metals:
     - T-1 to T-11 Classification
     - T-G Classification
   - Major classifications of FCAW/MC low carbon filler metals
   - Metal cored filler metal
   - Shielded/self-shielded filler metals
   - Characteristics of shielding gases
   - Filler metal handling procedures
   - Filler metal storage requirements
   - Detect damage or defects in consumables
   - Follow manufacturers’ recommendations

2. Review the selection of shielding gases for FCAW and FCAW/MC.
   - Carbon dioxide:
     - Cathode jet
   - Inert shielding gases – argon and helium:
     - Density
     - Thermal conductivity
     - Ionization potential
   - Gas mixtures:
     - Argon-oxygen mixtures
     - Helium-argon mixtures
     - Quaternary mixtures
   - Shielding gas cylinders:
     - Carbon dioxide cylinders
     - Regulator “freeze-up”
   - Regulators
   - Flowmeters
   - Gas mixers
   - Flowrates for shielding gases
   - Safe handling of shielding gas equipment
NOTE: Refer To Current Welder Training Program Curriculum Module/Line P6, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 10 question test on selecting filler metals and shielding gases for FCAW and FCAW/MC, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-19 Use the FCAW Self-Shielded Process to Weld Fillet Welds on Low Carbon Steel Plate

Learning Objectives:
The learner will be able to weld fillet welds in the 3F and 4F positions on tee joints using self-shielded wire.

LEARNING TASKS

1. Weld fillet welds in the vertical (3F) position using self-shielded wire.

   CONTENT
   - Weld fillet weld on tee joint in the vertical 3F (downhill) - refer to practical competency for Weld Procedure Specification (WPS)
   - Weld fillet weld on tee joint in the vertical 3F (uphill) - refer to practical competency for Weld Procedure Specification (WPS)

2. Weld fillet welds in the overhead (4F) position using self-shielded wire.

   CONTENT
   - Weld fillet weld on tee joint overhead 4F - refer to practical competency for Weld Procedure Specification (WPS)

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P9-3, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to weld fillet welds in the 3F and 4F positions on tee joints using self-shielded wire, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P9-3. This evaluation must meet CSA W59 standards for cyclically loaded structures.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-21 Use the FCAW Self-Shielded Process to Weld Groove Fillets on Low Carbon Steel Plate

Learning Objectives:
The learner will be able to use the FCAW self-shielded process to weld fillet groove welds on low carbon steel plate.

LEARNING TASKS

1. Weld fillet groove with backing in the flat (1GF), horizontal (2GF), vertical (3GF), and overhead (4GF) positions on butt joints on low carbon steel plate.

CONTENT
- Multi-pass groove weld on single bevel butt joint (with backing) in the 1GF position - refer to practical competency for Weld Procedure Specification (WPS)
- Multi-pass groove weld on single bevel butt joint (with backing) in the 2GF position - refer to practical competency for Weld Procedure Specification (WPS)
- Multi-pass groove weld on single bevel butt joint (with backing) in the 3GF position (uphill) - refer to practical competency for Weld Procedure Specification (WPS)
- Multi-pass groove weld on single bevel butt joint (with backing) in the 4GF position (uphill) - refer to practical competency for Weld Procedure Specification (WPS)

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P9-3, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to use the FCAW self-shielded process to weld fillet groove welds on low carbon steel plate, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P9-3 procedure C, side bends. This evaluation must meet CSA W59 standards for cyclically loaded structures.
### LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

**Competency:** F-22 Use the FCAW Process to Weld Groove Welds on Low Carbon Steel Plate

**Learning Objectives:**
The learner will be able to weld multi-pass fillet groove welds on low carbon steel plate.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>CONTENT</th>
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<tbody>
<tr>
<td>1. Weld groove welds in the vertical (3GF) position using gas-shielding wire.</td>
<td>• Multi-pass groove fillet weld on butt joint in the 3GF position - refer to practical competency for Weld Procedure Specification (WPS)</td>
</tr>
<tr>
<td>2. Weld groove welds in the overhead (4GF) position using gas-shielding wire.</td>
<td>• Multi-pass groove fillet weld on butt joint in the 4GF position - refer to practical competency for Weld Procedure Specification (WPS)</td>
</tr>
</tbody>
</table>

**NOTE:** Refer to Current Welder Training Program Curriculum Module/Line P9-4, and Amendments by the BC Welding Articulation Committee

**Achievement Criteria:**
The learner will be evaluated on their ability to weld multi-pass fillet groove welds on low carbon steel plate, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P9-4 procedure C, side bends. This evaluation must meet CSA W59 standards for cyclically loaded structures.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-24 Use the FCAW/MC Process to Weld Groove Welds on Low Carbon Steel Plate

Learning Objectives:
The learner will be able to weld groove welds using the FCAW/MC process on low carbon steel plate.

LEARNING TASKS

<table>
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<th>CONTENT</th>
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<tr>
<td>Multi-pass square groove weld on butt joint (both sides) in the 1G position - refer to practical competency for Weld Procedure Specification (WPS)</td>
</tr>
</tbody>
</table>

NOTE: Refer To Current Welder Training Program Curriculum Module/Line P6, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to weld groove welds using the FCAW/MC process on low carbon steel plate as per the acceptance criteria in the current curriculum module/line P9 visual evaluation. This evaluation must meet CSA W59 standards for cyclically loaded structures.
**LINE F:** Performs Semi-Automatic Welding (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

**Competency:** F-25 Use the GMAW, FCAW and FCAW/MC Process to Weld Groove Welds on Low Carbon Steel Pipe

**Learning Objectives:**
The learner will be able to weld groove welds using the GMAW, FCAW and FCAW/MC process on low carbon steel pipe.

**LEARNING TASKS**

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<tbody>
<tr>
<td>1. Weld groove welds in the flat rolled (1G) position on butt joints on low carbon steel pipe.</td>
</tr>
</tbody>
</table>

**NOTE:** Refer to Current Welder Training Program Curriculum Module/Line P9, and Amendments by the BC Welding Articulation Committee

**Achievement Criteria:**
The learner will be evaluated on their ability to weld groove welds using the GMAW, FCAW and FCAW/MC process on low carbon steel pipe as per the acceptance criteria in the current curriculum module/line P9 visual evaluation. This evaluation must meet CSA W59 standards for cyclically loaded structures.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-26 Describe and Demonstrate FCAW Fillet Welds Using Stainless Steel Filler Metal on Low Carbon Steel Plate

Learning Objectives:
The learner will be able to demonstrate FCAW fillet welds using stainless steel filler metal on low carbon steel plate.

LEARNING TASKS

1. Weld fillet welds in the horizontal (2F) position on lap joints on low carbon steel sheet.
   - Single-pass fillet weld on lap joint in the 2F position - refer to practical competency for Weld Procedure Specification (WPS)

2. Weld fillet welds in the horizontal (2F) position on tee joint on low carbon steel plate.
   - Multi-pass fillet weld on tee joint in the 2F position – refer to practical competency for Weld Procedure Specification (WPS)

Achievement Criteria:
The learner will be evaluated on their ability to demonstrate FCAW fillet welds using stainless steel filler metal on low carbon steel plate, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P9. This evaluation must meet CSA W59 standards for cyclically loaded structures.
LINE F: PERFORMS SEMI-AUTOMATIC WELDING (GMAW) (GMAW-P) (FCAW) (FCAW/MC)

Competency: F-27 Hardsurface Low Carbon Steel Plate

Learning Objectives:
The learner will be able to describe and use the hardsurfacing process on low carbon steel plate.

LEARNING TASKS

1. Describe the hardsurfacing process and its application.

   - Procedures
   - Types of wear
   - Materials
   - Surface preparations
   - Deposition
   - Pre-heat
   - Types of hardsurfacing patterns
   - Problems in hardsurfacing

2. Build up and hardsurface in the flat position on low carbon steel plate.

   - Build up and hardsurface in the flat position on low carbon steel plate - refer to practical competency for Weld Procedure Specification (WPS)

Achievement Criteria:
The learner will be evaluated on their ability to demonstrate the hardsurfacing process on low carbon steel plate, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P9-2 visual evaluation.
LINE G: DESCRIBES BASIC METALLURGY RELATING TO PRODUCTION, PROPERTIES AND WELDABILITY

Competency: G-4 Describe the Grain Structure of Metals

Learning Objectives:
The learner will be able to describe the grain structure in metals, dendritic growth, space-latticed types in metals and changes in grain structure that result from welding.

LEARNING TASKS

1. Describe the microstructure of metals.
   - Crystalline or grain structure
   - Grain size in metal
   - Grain structure in pure iron
   - Grain structure of carbon steels

2. Identify changes in grain structure that result from welding.
   - Heat zones in welds
   - Grain characteristics in welds
   - Preheating

NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK7-1, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on the grain structure in metals, dendritic growth, space-latticed types in metals and changes in grain structure that result from welding, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE G: DESCRIBES BASIC METALLURGY RELATING TO PRODUCTION, PROPERTIES AND WELDABILITY

Competency: G-5 Describe the Alloy Content and Heat Treatments on the Weldability of Steel

Learning Objectives:
The learner will be able to describe the major alloying elements in alloy steels, the types, properties and weldability of the low alloy steels, the high strength, low alloy steels and stainless steels, the heat treatment and the mechanical treatment of steel.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Identify alloy steels and their weldability. | • Low alloy steels  
• Weldability of low alloy steels  
• High strength low alloy steels (HSLA)  
• Weldability of HSLA steels  
• Weldability of stainless steels:  
  o Welding process  
  o Preparation of base metal  
• Duplex stainless:  
  o 2205 (SMO, HMO)  

| 2. Describe heat treatment of steel. | • Full annealing  
• Normalizing  
• Spherodizing  
• Stress-relief annealing  
• Process annealing  
• Quench hardening  
• Tempering or drawing stress relief  
• Vibratory stress relief  
• Peening |

NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK7-2, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on the major alloying elements in alloy steels, the types, properties and weldability of the low alloy steels, the high strength, low alloy steels and stainless steels, the heat treatment and the mechanical treatment of steel, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE G: DESCRIBES BASIC METALLURGY RELATING TO PRODUCTION, PROPERTIES AND WELDABILITY

Competency: G-6 Describe Aluminum, Aluminum Alloys and Their Weldability

Learning Objectives:
The learner will be able to describe aluminum and its alloys, the effects of alloying elements on the weldability of aluminum, the problems and solutions encountered in welding aluminum and its alloys, and the four types of heat treatments used with aluminum.

LEARNING TASKS

1. Identify aluminum, aluminum alloys and their designations.
   - Production of aluminum
   - Properties of aluminum and aluminum alloys
   - Casting alloys

2. Identify the effects of alloy content on the weldability of aluminum.
   - Properties of major wrought alloys
     - Hot shortness
     - Filler metal for wrought alloys
   - Properties of major casting alloys
   - Weldability of aluminum casting alloys

3. Identify heat treatments for aluminum and its alloys.
   - Annealing
   - Stress-relieving
   - Solution heat treatments
   - Precipitation-hardening (aging)

NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK7-3, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on the aluminum and its alloys, the effects of alloying elements on the weldability of aluminum, the problems and solutions encountered in welding aluminum and its alloys, and the four types of heat treatments used with aluminum, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE H: PERFORM GAS TUNGSTEN ARC WELDING (GTAW)

Competency: H-1 Describe the GTAW Process and its Application

Learning Objectives:
The learner will be able to describe the GTAW process, the function of electrodes and shielding gases, and be able to identify the basic components of a GTAW work station. The learner will also be able to identify the applications of GTAW and the safety requirements.

LEARNING TASKS

1. Describe the GTAW process and its application.
   - Function of the electrode
   - Function of the filler rod
   - Function of the shielding gas
   - Parts of a GTAW workstation
   - Applications of GTAW
   - Advantages of GTAW
   - Disadvantages of GTAW

2. Identify safety requirements for GTAW.
   - PPE
   - Working safely with electricity
   - Live circuits
   - Power circuit ground
   - Damp ground
   - Welding cables
   - Wiring
   - Fire prevention
   - Ventilation
   - Ozone

3. Describe purging requirements and techniques.
   - Purpose
   - Shielding gas:
     - Argon
     - Nitrogen
   - Equipment
   - Purging calculation charts

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P10-1, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on the GTAW process, the function of electrodes and shielding gases, the basic components of a GTAW work station, the applications of GTAW and the safety requirements, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE H: PERFORM GAS TUNGSTEN ARC WELDING (GTAW)

Competency: H-2 Describe GTAW Equipment

Learning Objectives:
The learner will be able to identify types of GTAW power sources, welding currents and shielding gases, controls on GTAW power sources, shielding gases, leading and trailing gases, flowmeters and gas regulators and the classification and types of GTAW electrodes.

LEARNING TASKS

1. Describe GTAW power sources and their operation.
   - Welding current for GTAW
   - GTAW with DCEN
   - GTAW with DCEP
   - GTAW with AC:
     - High-frequency current
     - Pulsed current
   - Controls on GTAW power source
   - Current controls:
     - High-frequency controls
     - Shielding gas controls
     - Water flow controls
     - Remote controls and contact switches
     - AC frequency adjustments

2. Identify shielding gases used in GTAW.
   - Argon
   - Helium
   - Weld bead contours
   - Leading and trailing shielding gases
   - Cylinders
   - Gas regulators
   - Flowmeters

3. Describe GTAW torches and their components.
   - Air-cooled torches
   - Water-cooled torches
   - Torch components:
     - Torch body
     - Collet body
     - Gas lens (collet body)
     - Collet
     - Back cap
     - Gas nozzles or cups:
       - Ceramic gas cups
       - Alumina cups
       - Fused-quartz cups
4. Identify electrodes used for GTAW.

- Pure tungsten electrodes
- Thoriated tungsten:
  - Non-radioactive:
    - Ceriated
    - Lanthanated
- Zirconium alloyed tungsten
- Electrode classification:
  - Electrode finishes
  - Electrode selection
    - Size
    - Current
- Balled or rounded ends
- Tapered or pointed ends
- Preventing contamination
- Avoiding heat build up

5. Assemble GTAW equipment.

- Power source:
  - Safety procedures
  - Leak tests
- Remote control, welding torch (air-cooled and/or water cooled)
- Shielding gas
- Gas flowmeter
- Tungsten electrode
- Gas cup
- Gas lens
- Collet body
- Collet
- Back cap
- Hoses
- Grounds
- Insulator

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P10-2, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on the types of GTAW power sources, welding currents and shielding gases, controls on GTAW power sources, shielding gases, leading and trailing gases, flowmeters and gas regulators and the classification and types of GTAW electrodes, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE H: PERFORM GAS TUNGSTEN ARC WELDING (GTAW)

Competency: H-3 Use the GTAW Process to Fillet Weld Using Low Carbon Steel Filler Metal on Low Carbon Steel Sheet

Learning Objectives:
The learner will be able to use the GTAW process to weld fillet welds in the 1F, 2F and 3F positions using low carbon steel filler metal on low carbon steel sheet using free-hand and cup-contact method.

LEARNING TASKS

1. Describe the GTAW process and procedures on low carbon steel.
   CONTENT
   - Filler metals for low carbon steel:
     - Deoxidized filler rod
     - Handling and storing filler rod
   - Welding low carbon steel
   - Welding defects:
     - Incomplete and insufficient penetration
     - Excessive penetration
     - Undercut
     - Porosity and dark appearance
     - Burn-through
     - Internal concavity (suck-back)
     - Tungsten inclusion
     - Weld cracking

2. Identify the main factors of GTAW.
   CONTENT
   - Machine setting
   - Welding torch and filler rod variables
   - Electrode stickout
   - Arc length
   - Torch angle and filler metal angle:
     - Butt joints
     - Lap joints
     - Tee joints
     - Corner joints
   - Shielding gas flow
   - Speed of travel
   - Operator comfort and position

3. Strike an arc using three methods.
   CONTENT
   - Methods:
     - Scratch start
     - Lift arc
     - High frequency

4. Weld stringer beads in the flat position.
   CONTENT
   - Weld stringer beads in the flat position – refer to practical competency for weld procedure specification (WPS)

5. Weld fillet welds in the flat (1F) position on corner joints on low carbon steel sheet.
   CONTENT
   - Single-pass fillet weld on corner joint in the 1F position - refer to practical competency for weld procedure specification (WPS)
6. Weld fillet welds in the horizontal (2F) position on lap and tee joints on low carbon steel sheet.
   - Single-pass fillet weld on lap and tee joints in the 2F position - refer to practical competency for weld procedure specification (WPS)

7. Weld fillet welds in the vertical (3F) position (uphill) on lap and tee joints on low carbon steel sheet.
   - Single-pass fillet weld on lap and tee joints in the 3F position - refer to practical competency for weld procedure specification (WPS)

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P10-4, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to use the GTAW process to weld fillet welds in the 1F, 2F and 3F positions using low carbon steel filler metal on low carbon steel sheet using free-hand and cup-contact method, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P10-4. This evaluation must meet CSA W59 standards for cyclically loaded structures.
LINE H: PERFORM GAS TUNGSTEN ARC WELDING (GTAW)

Competency: H-4 Use the GTAW Process to Groove Weld Using Low Carbon Steel Filler Metal on Low Carbon Steel Plate

Learning Objectives:
The learner will be able to bevel and fit up single vee butt joints for GTAW low carbon steel plate and weld groove welds in the 1G, 2G, and 3G positions using free-hand and cup-contact method.

LEARNING TASKS

1. Weld groove welds in the flat (1G) position on low carbon steel plate.

2. Weld groove welds in the horizontal (2G) position on low carbon steel plate.

3. Weld groove welds in the vertical (3G) position (uphill) on low carbon steel plate.

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P10-4, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to bevel and fit up single vee butt joints for GTAW on low carbon steel plate and weld groove welds in the 1G, 2G, and 3G positions on low carbon steel plate using free-hand and cup-contact methods, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P10-4. This evaluation must meet CSA W59 standards for cyclically loaded structures.
LINE H: PERFORM GAS TUNGSTEN ARC WELDING (GTAW)

Competency: H-5 Use the GTAW Process to Groove Weld Using Low Carbon Steel Filler Metal on Low Carbon Steel Pipe

Learning Objectives:
The learner will be able to use the GTAW process to groove weld using low carbon steel filler metal on low carbon steel pipe.

LEARNING TASKS

1. Describe the preparation of pipe for GTAW.
   - Edge preparation
   - Pipe alignment
   - Tacking

2. Weld groove welds in the flat rolled (1G) position on low carbon steel pipe.
   - Multi pass groove weld in the flat rolled 1G position - refer to practical competency for weld procedure specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P10-4, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to use the GTAW process to groove weld using low carbon steel filler metal on low carbon steel pipe, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P10-4. This evaluation must meet section IX ASME code.
**LINE H:** PERFORM GAS TUNGSTEN ARC WELDING (GTAW)

**Competency:**  H-6 Use the GTAW Process to Fillet Weld Using Stainless Steel Filler Metal on Low Carbon Steel Sheet and/or Stainless Steel Sheet

**Learning Objectives:**
The learner will be able to strike an arc using the touch start method and high frequency, weld stringer beads in the flat position on low carbon steel sheet and/or stainless steel sheet. The learner will also be able to weld fillet welds in the 1F, 2F, and the 3F positions (uphill and downhill) on lap and tee joints on low carbon steel sheets.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>LEARNING TASK</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe the GTAW process and procedures on low carbon steel. | • Filler rods for low carbon steel:  
  o Deoxidized filler rods  
  o Handling and storing filler rods  
 • Welding low carbon steel  
 • Welding defects:  
  o Incomplete and insufficient penetration  
  o Excessive penetration  
  o Undercut  
  o Porosity and dark appearance  
  o Burn-through  
  o Internal concavity (suck-back)  
  o Tungsten inclusion  
  o Weld cracking |
| 2. Identify the main factors of GTAW. | • Machine setting  
 • Welding torch and filler rod variables  
 • Electrode stickout  
 • Arc length  
 • Torch angle and filler rod angle:  
  o Butt joints  
  o Lap joints  
  o Tee joints  
  o Corner joints  
 • Shielding gas flow  
 • Speed of travel  
 • Operator comfort and position |
| 3. Strike an arc using three methods. | • Methods:  
  o Scratch start  
  o Lift arc  
  o High frequency |
| 4. Weld fillet welds in the flat (1F) position on corner joints on low carbon steel sheet and/or stainless steel sheet. | • Single pass fillet weld in the 1F position on corner joints - refer to practical competency for weld procedure specification (WPS) |
| 5. Weld fillet welds in the horizontal (2F) position on lap and tee joints on low carbon steel sheet and/or stainless steel sheet. | • Single pass fillet weld in the 2F position on lap and tee joints - refer to practical competency for weld procedure specification (WPS) |
6. Weld fillet welds in the vertical (3F) position (uphill) on lap and tee joints on low carbon steel sheet and/or stainless steel sheet.  
   • Single pass fillet weld in the 3F position (uphill) on lap and tee joints - refer to practical competency for weld procedure specification (WPS)

7. Weld fillet welds in the vertical (3F) position (downhill) on lap and tee joints on low carbon steel sheet and/or stainless steel sheet.  
   • Single pass fillet weld in the 3F position (downhill) on lap and tee joints - refer to practical competency for weld procedure specification (WPS)

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P10-3, and Amendments by the BC Welding Articulation Committee

Achievement Criteria: 
The learner will be evaluated on their ability to strike an arc using the scratch start, lift arc and high frequency methods, to weld stringer beads in the flat position on low carbon steel sheet and/or stainless steel sheet. The learner will also be evaluated on their ability to weld fillet welds in the 1F, 2F, and the 3F positions (uphill and downhill) on lap and tee joints on low carbon steel sheets and/or stainless steel sheet, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P10-3. This evaluation must meet CSA W59 standards.
LINE H: PERFORM GAS TUNGSTEN ARC WELDING (GTAW)

Competency: H-8 Use the GTAW Process to Groove Weld Using Stainless Steel Filler Metal on Thin Wall Stainless Steel Pipe

Learning Objectives:
The learner will be able to use the GTAW process to groove weld using stainless steel filler metal on thin wall stainless steel pipe.

LEARNING TASKS

1. Assemble and demonstrate purging equipment for GTAW on pipe.

   CONTENT
   - Purge pipe to appropriate cfm prior to welding

2. Weld groove welds in the vertical fixed (2G) position on stainless steel pipe with stainless steel filler material.

   CONTENT
   - Multi pass groove weld in the 2G position on stainless steel pipe - refer to practical competency for weld procedure specification (WPS)
   - Face and root bends tests - refer to practical competency for procedure

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P12-2, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their ability to use the GTAW process to groove weld using stainless steel filler metal on thin wall stainless steel pipe, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P12-2. This evaluation must meet section IX ASME code.
LINE H: PERFORM GAS TUNGSTEN ARC WELDING (GTAW)

Competency: H-10 Use the GTAW Process to Fillet Weld Using Aluminum Filler Metal on Aluminum Sheet

Learning Objectives:
The learner will be able to weld stringer beads on aluminum sheet, and weld fillet welds in the 1F, 2F and 3F positions on aluminum sheet.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe the GTAW process and procedures on aluminum. | • Aluminum filler metal  
• Welding aluminum  
• Joint design for aluminum  
• Preparation of aluminum:  
  o Precleaning aluminum  
  o Post-cleaning aluminum  
  o Recognize weld defects |
| 2. Weld stringer beads in the flat position on aluminum sheet. | • Single-pass bead weld in the flat position - refer to practical competency for weld procedure specification (WPS) |
| 3. Weld fillet welds in the flat (1F) position on tee and corner joints on aluminum sheet. | • Single-pass fillet weld in the 1F position on tee and corner joints - refer to practical competency for weld procedure specification (WPS) |
| 4. Weld fillet welds in the horizontal (2F) position on tee and corner joints on aluminum sheet. | • Single-pass fillet weld in the 2F position on tee and corner joints - refer to practical competency for weld procedure specification (WPS) |
| 5. Weld fillet welds in the vertical (3F) position (uphill) on tee joints on aluminum sheet. | • Single-pass fillet weld in the 3F position (uphill) on tee joints - refer to practical competency for weld procedure specification (WPS) |

NOTE: Refer to Current Welder Training Program Curriculum Module/Line P10-7, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
The learner will be evaluated on their the ability to weld stringer beads on aluminum sheet and weld fillet welds in the 1F, 2F and 3F positions on aluminum sheet, as part of a practical shop project as per the acceptance criteria in the current curriculum module/line P10-7. This evaluation must meet CSA W59 standard.
LINE J: READS AND UTILIZES INDUSTRY DRAWINGS

Competency: J-7 Read and Interpret Piping Drawings

Learning Objectives:
The learner will be able to read and interpret symbols and specifications for pipe, valves, fittings and flanges as well as being able to identify symbols in single and double line drawings.

LEARNING TASKS

1. Identify pipe and pipe fittings and their symbols.
   - Pipe
   - Pipe specifications
   - Pipe fittings:
     - Butt-weld fittings
     - Butt-weld elbows:
       - 180º return elbow
       - 90º elbow
       - 45º elbow
       - Mitre-cut elbows
       - Reducing weld elbow
     - Butt-weld tee
     - Lateral
     - Butt-weld cross
     - Butt-weld reducer
     - Welding cap
     - Welding outlet (weldolet)
   - Butt-weld fitting symbols
   - Welding fitting specifications
   - Threaded fittings
   - Socket-welded fittings
   - Flanged fittings

2. Identify valves, their symbols and specifications.
   - Gate valves
   - Globe valves
   - Check valves
   - Safety or relief valves
   - Pressure reducing valves
   - Control valves
   - Valve specifications
   - Screwed flange (Scr’d Flg.)
   - Weld-neck flange (W.N.fig.)
   - Slip-on flanges (S.O.Mg.)
   - Socket-weld flange (S.W.Flg.)
   - Lap-joint flange (L.J.Flg.)
   - Special purpose flanges:
     - Blind flange (B.F.)
     - Spectacle blind (Fig. 8 Blind)
     - Reducing flanges (Red. Flg.)
   - Flange facings
   - Flange specifications

3. Identify flanges, their symbols and specifications.
4. Interpret basic piping drawings.

- Types of piping drawings:
  - Process flow drawings and P&ID
  - Site plans
  - Plan views, elevations and sections
  - Single-line isometrics
  - Spool drawings
  - Drawing views

**NOTE:** Refer to Current Welder Training Program Curriculum Module/Line RK6-1, and Amendments by the BC Welding Articulation Committee

**Achievement Criteria:**
Given a 20 question test on reading and interpreting symbols and specifications for pipe, valves, fittings and flanges as well as being able to identify symbols in single and double line drawings, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE J: READS AND UTILIZES INDUSTRY DRAWINGS

Competency: J-8 Perform Basic Pipe Layout

Learning Objectives:
The learner will be able to prepare a template to perform a basic pipe layout.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Perform a basic pipe layout. | - Pipe bending  
- Bend allowance  
- Templates  
- Parallel-line development:  
  - Principles of parallel-line development  
  - Placement and number of views  
  - Number of elements  
  - Computing the length of the stretch-out  
- Pipe dimensions:  
  - Angles of cut  
- Tools for pipe layout:  
  - Centering head  
  - Pipefitter’s level  
  - Contour marker |
| 2. Layout a two-piece 45° elbow. | - Use parallel line development to layout a template on 4” pipe for K-6 pipe fabrication project |
| 3. Layout a two-piece 90° tee connection. | - Use parallel line development to layout a template for a 3” to 4” pipe tee connection K-6 pipe fabrication project |

NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK6-2, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a practical project preparing a template for performing a basic pipe layout, the learner will be assessed using 70% as the passing criteria.
LINE K: LAYOUT AND FABRICATE COMPONENTS

Competency: K-1 Interpret and Apply Mechanical Drawings

Learning Objectives:
The learner will be able to interpret and apply mechanical drawings.

LEARNING TASKS

1. Describe types of mechanical drawings.
   - Orthographic
   - Isometric
   - Oblique
   - Detail drawings
   - Spool sheets

2. Describe mechanical drawings applications.
   - Industrial
   - Commercial
   - Oil and gas
   - Marine

3. Explain why applicable standards and codes must be followed when interpreting mechanical drawings.
   - CSA standards
   - ASME standards:
     - B31.3
     - B31.1
   - API standards

4. Explain the use of drawing notes and their applications.
   - Reference points
   - Details
   - Tolerances
   - Specifications
   - Working from centerlines

5. Describe the use of drawing scales.
   - Interpreting dimensions
   - Metric or imperial
   - Use of auto cad (e.g. computer space scaled to paper space)

6. Explain how multiple views of a part or assembly relate to each other on a drawing.
   - Multiple views
   - Detail views
   - Assembly views
   - Detail/assembly views
   - Procedures

7. Explain the relationship between drawing numbers, part numbers and drawing revision.
   - Drawing number identifies specific project
   - Part number identifies assembly components (includes spooling numbers)
   - Latest revised drawing must be used for construction or assembly
NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK6-1, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 10 question test on interpreting and applying mechanical drawings, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE K: LAYOUT AND FABRICATE COMPONENTS

Competency: K-4 Layout Materials

Learning Objectives:
The learner will be able to layout and prepare templates for piping assembly.

LEARNING TASKS

1. Review and expand template development.

    • Construct template (e.g. 3 piece 90 degree elbow and tee connection):
      o Template materials
      o Measuring tools
      o Conform to dimensional tolerances

2. Interpret and transfer dimensions from drawings to materials.

    • Transfer methods:
      o Measuring tools
      o Layout tools
      o Conform to dimensional tolerances

Achievement Criteria:
Given a 10 question test on laying out and preparing templates for piping assembly, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE K: LAYOUT AND FABRICATE COMPONENTS

Competency: K-5 Prepare Materials

Learning Objectives:
The learner will be able to prepare pipe for fabrication project.

LEARNING TASKS

1. Prepare pipe for cutting.
   - Check templates to verify accuracy
   - Apply to pipe
   - Mark accordingly

2. Cut materials to dimensions.
   - Safe work practices specific to cutting – refer to WorkSafeBC requirements
   - Cutting sequence
   - Tolerances and bevel
   - Select cutting equipment

   - Safe work practices specific to grinding – refer to WorkSafeBC requirements
   - Check joint preparation and geometry
   - Select abrasives
   - Perform grinding

Achievement Criteria:
Given a practical project preparing pipe for fabrication, the learner will be assessed using 70% as the passing criteria.
LINE K: LAYOUT AND FABRICATE COMPONENTS

Competency: K-6 Fabricate Project(s)

Learning Objectives:
The learner will be able to fit and weld a pipe assembly project.

LEARNING TASKS

1. Fit and tack components.

   CONTENT
   - Select required fitting equipment:
     - Wedges
     - Clamps
     - Hand tools
     - Pipe stands
   - Welding process and consumables
   - Organize work in sequential order
   - Fitting techniques:
     - Use of fitting equipment
     - Tack techniques
     - Distortion control
   - Follow specifications

2. Assemble fabrication project.

   CONTENT
   - Assemble the three piece elbow
   - Assemble tee to pipe stub
   - Attach pipe stub to elbow
   - Mount flange to project
   - Conforms to dimensions
   - Conforms to specifications

3. Weld weldment.

   CONTENT
   - Check tacks and alignment
   - Welding procedures
   - Welding symbols

4. Layout, assemble and weld Level B Final Practical Examination.

   CONTENT
   - Use templates developed in J-8 (Performs Basic Pipe Layout) to cut, fit and weld Level B Final Practical Examination
   - Present welded assembly for end project evaluation

Achievement Criteria:
Given a practical project fitting and welding a pipe assembly project, the learner will be assessed using criterion reference standard (pass/fail), as per the guidelines for practical examinations (pg. 90).
LINE L: DESCRIBES QUALITY CONTROL AND INSPECTION

Competency: L-1 Identify Types and Uses of Destructive Testing Methods

Learning Objectives:
The learner will be able to describe types of destructive testing, the advantages and disadvantages of destructive testing methods, the methods of conducting guided bend tests and the results required of a sound weld.

LEARNING TASKS

1. Describe methods used for destructive testing.

CONTENT

- Destructive testing
- Guided bend tests
- Nick-break tests
- Impact test:
  - Charpy and izod tests
- Tensile tests
- Fillet weld break tests
- Etching

NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK4-1 and RK4-2, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on types of destructive testing, the advantages and disadvantages of destructive testing methods, the methods of conducting guided bend tests and the results required of a sound weld, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE L: DESCRIBES QUALITY CONTROL AND INSPECTION

Competency: L-2 Identify Types and Uses of Non-Destructive Testing Methods

Learning Objectives:
The learner will be able to describe uses of non-destructive testing, identify the symbols of non-destructive testing methods and visual defects of a weld.

LEARNING TASKS

1. Describe the uses of non-destructive testing methods.
   - Non-destructive testing and visual inspection:
     - Equipment
   - Radiographic tests:
     - Types
     - Testing methods
     - Interpretation of radiographs
     - Radiation safety
     - Radiation warning symbol
   - Magnetic particle, ultrasonic, eddy current and dye penetrant testing:
     - Magnetic-particle testing
     - Ultrasonic testing
     - Eddy current testing
     - Dye penetrant testing
     - Ultrasound thickness test
   - Hydrostatic, light oil, acoustic, emission and vacuum box tests:
     - Hydrostatic testing
     - Light oil testing
     - Acoustic emission tests
     - Vacuum box test
   - Hardness testing:
     - File test
     - Brinnell hardness test
     - Rockwell hardness testing
     - Vickers hardness test
   - Side significance
   - Multiple tests
   - Dimensions
   - Test all-around and field test symbols
   - Combining welding and testing symbols

2. Identify non-destructive testing symbols

3. Identify visual defects, both relevant and non-relevant indications.
   - Power piping code (B31-1)
   - Process piping code (B31-3)
   - ASME section IX
   - CSA standard W59
   - CSA standard Z662
NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK4-2, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 20 question test on the uses of non-destructive testing, identifying the symbols of non-destructive testing methods and visual defects of a weld, the learner will demonstrate their knowledge by correctly answering 14 questions or more.
LINE L: DESCRIBES QUALITY CONTROL AND INSPECTION

Competency: L-3 Comply with Weld Procedure Specifications (WPS) and Data Sheets

Learning Objectives:
The learner will be able to comply with weld procedure specifications (WPS) and data sheets.

LEARNING TASKS

1. Describe requirements for destructive and non-destructive testing.

CONTENT

- Requirements as outlined in the WPS:
  - QW482
  - QW483
  - QW484
- Certified testing agencies
- Complete documentation
- Engineer approval

Achievement Criteria:
Given a 10 question test on weld procedure specifications (WPS) and data sheets, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
Competency: L-4 Describe the Scope of the Welding Supervisor and Inspector Responsibilities

Learning Objectives:
The learner will be able to describe the scope of the Welding Supervisor and Inspector responsibilities.

LEARNING TASKS

1. Examine levels of supervision.
   - Journeyperson
   - Leadhand
   - Supervisor
   - Superintendent
   - Manager

2. Describe the scope of the Welding Supervisor.
   - Ensuring safe work practices
   - Coordinating work
   - Quality control
   - Project start up
   - Material and time estimations
   - Inventory control
   - Purchasing
   - Record and time keeping
   - Documentation use/control
   - Effective communications/conflict resolution
   - Meeting deadlines
   - Training workers
   - Progress reports
3. Describe the scope of the Welding Inspector.

- Adherence to job specifications, codes and standards
- Adherence to acceptable welding practices:
  - Material preparation
  - Filler metal handling and storage
- Visual inspections
- Weld procedures specifications (WPS)
- Verifies weld acceptability through destructive and non-destructive testing methods
- Welder performance qualification tests
- Material and consumables documented:
  - Mill certification
  - Filler metal certification

**Achievement Criteria:**
Given a 10 question test on the scope of the Welding Supervisor and Inspector responsibilities, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE M: DESCRIBES SCOPE OF WELDING STANDARDS, CODES, SPECIFICATIONS AND WELDER QUALIFICATIONS

Competency: M-1 Identify Applicable Standards, Codes and Specifications

Learning Objectives:
The learner will be able to identify welding codes, standards and specifications, the governing agencies and qualification testing.

LEARNING TASKS

1. Describe the scope of welding codes, standards and specifications.

CONTENT

- Codes
- Specifications
- Standards:
  - Standardization
  - Relationship of terms
- Agencies that set codes and standards
- Codes governing welding of steel structures
- Codes for the welding of boilers and pressure vessels
- International Standards Organization (ISO)
- American Bureau of Shipping (ABS) and Lloyds of London
- American Petroleum Institute (API)

NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK5-1, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 10 question test on identifying welding codes, standards and specifications, the governing agencies and qualification testing, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE M: DESCRIBES SCOPE OF WELDING STANDARDS, CODES, SPECIFICATIONS AND WELDER QUALIFICATIONS

Competency: M-2 Describe Materials and Filler Metal Classification Systems

Learning Objectives:
The learner will be able to describe materials and filler metal classifications.

LEARNING TASKS

1. Describe materials and filler metal classification systems.

CONTENT

- Base metal classifications:
  - P-numbers and the ASME code
- Filler metal classification:
  - CSA standards
  - AWS specifications:
    - SFA 5.1 (Standard Filler Alloy)
    - SFA 5.2
    - SFA 5.4
    - SFA 5.5
    - SFA 6.9
  - ASME groupings
- Weld metal analysis

NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK5-1, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 10 question test on materials and filler metal classifications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE M: DESCRIBES SCOPE OF WELDING STANDARDS, CODES, SPECIFICATIONS AND WELDER QUALIFICATIONS

Competency: M-3 Describe Welding Procedure and Performance Qualification Tests

Learning Objectives:
The learner will be able to describe welding procedure and performance qualification tests.

LEARNING TASKS

1. Describe welding procedure qualification tests.

   CONTENT
   - Testing a procedure
   - CSA regulations:
     - Forms used
     - Approving agency
     - Appendix A – welding procedure specification suggested general form
     - Appendix B – typical information that may appear on a welding procedure data sheet
     - Appendix C – sample of welding procedure qualification test report
   - ASME regulations
   - Approving agency
   - Forms used

2. Describe welder performance qualification tests.

   CONTENT
   - CWB performance qualifications tests
   - S and T classifications
   - Extent of qualifications
   - ASME performance qualification tests
   - CSA Z662 Requirements

NOTE: Refer to Current Welder Training Program Curriculum Module/Line RK5-1, and Amendments by the BC Welding Articulation Committee

Achievement Criteria:
Given a 10 question test on welding procedure and performance qualification tests, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE M: DESCRIBES SCOPE OF WELDING STANDARDS, CODES, SPECIFICATIONS AND WELDER QUALIFICATIONS

Competency: M-4 Describe BCSA Jurisdiction

Learning Objectives:
The learner will be able to identify BC Safety Authority (BCSA) jurisdiction relating to welding.

LEARNING TASKS

1. Describe the services performed by BCSA.
   - Issuing permits
   - Inspecting technical work and equipment
   - Certifying individuals and licensing contractors to meet regulatory requirements
   - Educating the public about safety issues
   - Reviewing regulations for each industry sector overseen
   - Investigating incidents
   - Registering new equipment designs

2. Describe the responsibilities of the BCSA.
   - Amusement rides and recreational railways
   - Boilers, pressure vessels and refrigeration systems
   - Electrical equipment and systems
   - Elevating devices such as elevators and escalators
   - Gas appliances and systems, including hydrogen
   - Passenger ropeways such as ski lifts
   - Railways

Achievement Criteria:
Given a 10 question test on BC Safety Authority (BCSA) jurisdiction relating to welding, the learner will demonstrate their knowledge by correctly answering 7 questions or more.

NOTE: for additional information see http://www.safetyauthority.ca/?q=aboutbcسا_overview
**LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)**

**Competency:** O-1 Describe Orbital Welding

**Learning Objectives:**
The learner will be able to describe orbital welding and its applications.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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</table>
| 1. Describe orbital welding and its applications. | • Definition  
• History  
• Process types  
• Industry applications  
• Advantages and disadvantages  
• Equipment |

**Achievement Criteria:**
Given a 10 question test on orbital welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-2 Describe Plastic Welding

Learning Objectives:
The learner will be able to describe the plastic welding and its applications.

LEARNING TASKS

1. Describe plastic welding and its applications.

CONTENT

- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on plastic welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-3 Describe Thermal Spray Process

Learning Objectives:
The learner will be able to describe the thermal spray process welding and its applications.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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<tbody>
<tr>
<td>1. Describe the thermal spray process welding and its applications.</td>
<td>• Definition</td>
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<td>• Advantages and disadvantages</td>
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<td>• Equipment</td>
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Achievement Criteria:
Given a 10 question test on the thermal spray process and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-4 Describe Thermit Welding

Learning Objectives:
The learner will be able to describe thermit welding and its applications.

LEARNING TASKS

1. Describe thermit welding and its applications.

CONTENT
- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on thermit welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-5 Describe Electro-Gas Welding

Learning Objectives:
The learner will be able to describe electro-gas welding and its applications.

LEARNING TASKS

1. Describe electro-gas welding and its applications.

CONTENT
- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on electro-gas welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-6 Describe Electro-Slag Welding

Learning Objectives:
The learner will be able to describe electro-slag welding and its applications.

LEARNING TASKS

1. Describe electro-slag welding and its applications.

CONTENT

- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on electro-slag welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-7 Describe Laser Welding

Learning Objectives:
The learner will be able to describe laser welding and its applications.

LEARNING TASKS

1. Describe laser welding and its applications.

CONTENT

- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on laser welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-8 Describe Plasma Welding

Learning Objectives:
The learner will be able to describe plasma welding and its applications.

LEARNING TASKS
1. Describe plasma welding and its applications.

CONTENT
- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on plasma welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-9 Describe Flash Butt Welding

Learning Objectives:
The learner will be able to describe flash butt welding and its applications.

LEARNING TASKS

1. Describe flash butt welding and its applications.

CONTENT

- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on flash butt welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-10 Describe Electron Beam Welding

Learning Objectives:
The learner will be able to describe electron beam welding and its applications.

LEARNING TASKS

1. Describe electron beam welding and its applications.

CONTENT
- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on electro beam welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-11 Describe Friction and Friction Stir Welding

Learning Objectives:
The learner will be able to describe friction and friction stir welding and its applications.

LEARNING TASKS

1. Describe friction and friction stir welding and its applications.

CONTENT
- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on friction and friction stir welding and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-12 Describe Stud Arc Welding Process

Learning Objectives:
The learner will be able to describe the stud arc welding process and its applications.

LEARNING TASKS

1. Describe the stud arc welding process and its applications.

CONTENT

- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on the stud arc welding process and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
LINE O: DESCRIBES SPECIALIZED WELDING AND OTHER WELDING PROCESSES (AWS)

Competency: O-13 Describe Resistance Welding Process

Learning Objectives:
The learner will be able to describe the resistance welding process and its applications.

LEARNING TASKS

1. Describe the resistance welding process and its applications.

CONTENT
- Definition
- History
- Process types
- Industry applications
- Advantages and disadvantages
- Equipment

Achievement Criteria:
Given a 10 question test on the resistance welding process and its applications, the learner will demonstrate their knowledge by correctly answering 7 questions or more.
SECTION 3

TRAINING PROVIDER STANDARDS
WELDER B TRAINING PROVIDER STANDARDS

INSTRUCTORS

TRADE QUALIFICATION

➢ Level A Welder with an Inter-Provincial “Red-Seal” endorsement

WORK EXPERIENCE

➢ Must have a minimum of 5 years experience as a journeyperson
➢ Must have diverse industry experience including code work such as shop fabrication, heavy construction, and maintenance/repair (ASME or CSA W59)

TRAINING QUALIFICATIONS

➢ Instructors Certificate (minimum 30 hr course)
➢ Instructors must have or be registered in an Instructor’s Diploma Program, to be completed within a five year period
➢ Or, hold a Bachelors or Masters degree in Education

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INSPECTORS FOR PRACTICAL EXAMINATIONS

➢ All final practical fabrication and welding tests as listed in the appendices to be assessed by a Certified Welding Inspector
WELDER B TRAINING PROVIDER STANDARDS – FACILITIES

CLASSROOM AREA

- Comfortable seating and tables suitable for training, teaching, lecturing
- Compliance with all local and national fire code and occupational safety requirements
- Lighting controls to allow easy visibility of projection screen while also allowing students to take notes
- Windows must have shades or blinds to adjust sunlight
- Heating / Air conditioning for comfort all year round
- In-room temperature regulation to ensure comfortable room temperature
- In-room ventilation sufficient to control training room temperature
- Acoustics in the room must allow audibility of the Instructor
- White marking board with pens and eraser (optional: flipchart in similar size)
- Projection screen or projection area at front of classroom
- Overhead projector and/or multi-media projector

SHOP AREA (fixed properties)

- One welding booth per student (minimum booth size must be 6’ x 6’) fully equipped with:
  - Industrial grade multi-process welding power source or equipment suitable for all Level B required welding processes
  - Welding table (minimum recommended size 18” x 20”)
  - One height adjustable positioning arm for pipe
  - One 115 volt receptacle or pneumatic air supply for grinders
  - Ventilation as per WorkSafeBC standards
  - Task lighting
- Suitable demonstration area of approximately 7’ x 14’
- Aisles size must be a minimum of 6’ wide
- The grinding and test coupon preparation area must be a minimum 300 square feet
- Material storage area (including a separate, secured cylinder storage area)
- Ceiling shall be a minimum height of 16’ or as varied by good engineering practices and code

STUDENT FACILITIES

- Adequate lunch room as per WorkSafeBC requirements
- Adequate washroom facilities as per WorkSafeBC requirements
- Personal storage lockers

MINIMUM SHOP EQUIPMENT FOR LEVEL B TRAINING

- one floor model drill press, ½ hp minimum, ½” x 8”
- one 3’ x 6’ work bench with two vices
- one pedestal grinder, 12” x 2” stone
- one pedestal belt sander with a minimum 3” belt
- one floor model vertical band saw
- one horizontal band saw
- one abrasive chop saw
• one guided bend test jig as per ASME Section IX dimensional specifications
• two track cutters
• two 5” grinders per student (one grinding, one bead brush)
• four 7” grinders (electric or pneumatic) for general shop use
• electrode stabilizing oven (minimum 250 lbs)
• one semi-automatic or automatic submerged arc welder
• six pipe stands
• two pipe positioners
• two pipe beveling machines
• pipe layout hand tools (one set for every two students)
• pipe purging equipment (plugs, caps, flow meters, hose)

**Note:** See booth equipment as outlined in Shop Area

**OPTIONAL EQUIPMENT**

• one ¼” x 4’ hydraulic shear
• one iron worker

**HOISTING AND RIGGING EQUIPMENT**

• one ton overhead jib crane or overhead crane
• rigging hardware -- shackles, cable clamps, swivels, eye bolts, turn buckles, snatch blocks, etc.
• plate clamps
• chain, wire rope and synthetic slings
• come-alongs (chain and cable)
• connectors
• tirfor jacks
• chain fall
WELDER B TOOLS AND EQUIPMENT

Basic Tools and Equipment

Adjustable wrenches (various sizes)
Allen wrenches (metric and imperial)
Ammeter
Bench vise
Broom
Brushes (various bristle brushes for cleaning and scrubbing)
“C” clamps
Center head
Centering pins
Chain hoists
Chalk line
Chokers
Cold chisels (various sizes)
Combination wrenches (metric and imperial)
Come-alongs
Contour marker
Cylinder carts
Cylinder cradles
Dollies
Electric cords
Files (flat, half-round, rat-tail, bastard)
Flange pins
Flashlight
Friction lighter
Funnels
Hack saw
Hammers (chipping, ball peen, claw, sledge, various sizes)
Hand shears
Jacks
Knives
Ladders
Magnets
Metal markers

Mop
Oil can
Pails (plastic and metal)
Paint brushes
Pipe cutters
Pipe stands
Pipe wrenches
Pliers (needle nose, slip joint)
Positioners
Pry bars
Punches
Rollers
Scaffolding (safety)
Scrapers (various sizes)
Screwdrivers (flat, Phillips, Robertson, various sizes)
Shovels (flat mouthed)
Slings
Snips (heavy duty sheet metal cutting)
Soapstone markers
Socket sets (metric and imperial)
Soldering iron
Stamping tools
Temperature sticks
Tip cleaners
Tool boxes
Vice grips
Vices (chain vice, pipe vice)
Water hose
Wire brush
Wire cutter
Wrap arounds
Wrench sets (open and closed ends, both metric and imperial)

Measuring Tools

Calculator
Calipers
Depth gauge
Feeler gauges
Fillet gauges
Laser level
Torpedo level
Micrometer
Plumb bob
Protractor

Scribers
Spirit level
Squares
Stop watch
Straight edges
Tape measure
Tri squares
Vernier calipers
Welding gauges
Testing Equipment

Adapter fittings
Ammeter
Calibrating gauges
Infrared pyrometer
Pressure difference gauges
Pressure gauge kit
Temperature gauges
Temperature sticks

Power Tools and Equipment

Air hose and nozzle
Air monitoring device
Arc welder
Oxy-fuel cutting equipment
Band saw
Buffers
Chop saw (cut-off saw)
Circular saw
Coil heating equipment
Compressors
Cranes (overhead, gantry-type, monorail, boom)
Drills (portable, magnetic base, drill press)
Electric drills
Electronic measuring device (hand-held “electronic tape measure” type)
Feeders-wire
Fork lifts
Gas detector
Grinders (wire brush, angle grinders)
Guns-welding
Hammer drill
Hand-held and stationary radios
Headphones
Heated hoppers
Heaters (electric, natural gas, oil, propane)
Heating torch
Hydraulic press brake
Hydraulic shear
Hydrostatic equipment
Impact wrenches (electric or pneumatic)
Nibblers
Ovens
Oxyacetylene brazing torch
Oxyacetylene cutting torch
Pipe-bevelling machine
Pipe cutters
Reamer (hand held or mounted on power threader)
Reciprocating saw
Routers
Sand-blast equipment
Sanders
Scissor lift
Testing pump
Torchester
Vacuum (wet/dry)
Winches
Wire wheel (body grinder or angle grinder with wire brush)

Hoisting and Lifting Equipment

Cable clamps
Chain block hoist
Chains
Chokers
Come-alongs (chain or cable)
Connectors
Forklift
Overhead hoist
Portable boom
Rope
Slings
Spreader bars
Stands
Supports
Tuggers
Safety Equipment

- Air hoods
- Aprons
- Body harness
- Boots
- Coveralls
- Ear-plugs and muffs
- Eye wash station
- Face shields
- Fire blankets
- Fire extinguishers
- Fire hoses
- Gloves
- Goggles
- Masks (particle, vapour)
- Respirators
- Safety glasses
- Safety helmet
- Welding shield

Resource Material

- Code books
- Drawings
- Engineering specifications
- Job schedules
- Manufacturers’ specifications, manuals, and charts
- Material Safety Data Sheets
- Packing slips
- Pamphlets
- Prints
- Regulatory information
- Safety manuals
- Service bulletins
- Shop manuals
- Specifications
- Waybills
- Written informational or instructional material
PROVINCIAL CURRICULUM MATERIALS

QUEENS PRINTERS WELDER LEVEL B TRAINING PROGRAM MODULES:

WELDER TRAINING PROGRAM LEVEL B MODULE/LINE P07 SHIELDED METAL ARC WELDING SMAW II Goal/Competency P07-P01 to 02 (MN1927)
(7850002773) .......................................................................................................................... ISBN 0-7719-1670-1

WELDER TRAINING PROGRAM LEVEL B MODULE/LINE P07 SHIELDED METAL ARC WELDING SMAW II Goal/Competency P07-P01 to 02 (MN1927)
(7850002591) .......................................................................................................................... ISBN 0-7719-1670-1

WELDER TRAINING PROGRAM LEVEL B MODULE/LINE P08 GAS METAL ARC WELDING (GMAW II) Goal/Competency P08-01 to 05 (MN1927)
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Goal/Competency RK (MN1932)

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(7960002792) .................................................................................................................................. ISBN 0-7719-1676-0

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CSA STANDARDS W59, W47.1, Z662

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Construction Safety Association of Ontario:
http://www.csao.org/

Skill Plan:
http://www.skillplan.ca/English/publications.htm

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APPENDIX ONE
RECOMMENDED
WELDER LEVEL B
FINAL WELD TESTS
GUIDELINES FOR PRACTICAL EXAMINATIONS

- Applicants who are not familiar with the facility used for practical examinations will require safety orientation and/or instruction.
- Each Apprentice will be required to successfully complete the practical (fabrication) examination and all 4 welding tests.
- Apprentices should consult with their Instructor when they feel that they are ready to attempt a Final Practical Examination and a Final Weld Test.
- Applicants who are unsuccessful on their attempt at the Final Practical Examinations will be required to upgrade in the applicable area(s) of error.
- Applicants who are unsuccessful on their attempt at any of the 4 mandatory welding tests will be required to upgrade in the applicable process.
LEVEL "B" FINAL WELD TESTS

All apprentices and challenge candidates must perform all final weld tests.

<table>
<thead>
<tr>
<th></th>
<th>Processes</th>
<th>Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2G, 5G</td>
<td>SMAW OFC</td>
</tr>
<tr>
<td>2</td>
<td>2F, 3F</td>
<td>GTAW</td>
</tr>
<tr>
<td>2</td>
<td>3G</td>
<td>GTAW</td>
</tr>
<tr>
<td>3</td>
<td>1G, 3G</td>
<td>FCAW AAC OFC</td>
</tr>
<tr>
<td>4</td>
<td>3G</td>
<td>GMAW OFC</td>
</tr>
<tr>
<td>4</td>
<td>2F, 3F</td>
<td>GMAW (Aluminum)</td>
</tr>
</tbody>
</table>
Level "B" Weld Test #1  
Performance Test Procedure (PTP) #1

<table>
<thead>
<tr>
<th>Position</th>
<th>Processes</th>
<th>OFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2G - 5G</td>
<td>SMAW</td>
<td></td>
</tr>
</tbody>
</table>

Joint Design (CSA-W59)  
Suggested Weld Pass Sequence

Base Metals
ASME SA53 ERW Pipe

Filler Metal  
(CSA-W48.5)

<table>
<thead>
<tr>
<th>Classification</th>
<th>SMAW</th>
<th>GMAW</th>
<th>GTAW</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA</td>
<td>E4310 - E4918</td>
<td>E6010 - E7018</td>
<td></td>
</tr>
<tr>
<td>AWS</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Size of filler metal: 3.0 mm

Shielding Gas  
Composition

<table>
<thead>
<tr>
<th>Gas</th>
<th>Mixture</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Position (CSA-W47.1)

<table>
<thead>
<tr>
<th>Position of Fillet</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position of Groove</td>
<td>2G - 5G</td>
</tr>
<tr>
<td>Position of Joint</td>
<td>2G - 5G</td>
</tr>
<tr>
<td>Weld Progression</td>
<td>Up: Yes</td>
</tr>
</tbody>
</table>

Technique (CSA-W47.1)

<table>
<thead>
<tr>
<th>Stringer Root, String or Weave Fill and Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Cup Size: N/A</td>
</tr>
</tbody>
</table>

Instructions

Base Metal: 150mm (6") schedule 80 low carbon steel pipe. Cut two pieces 100mm (4") long of schedule 80.

1) Machine flame cut bevel test nipples at 30" as illustrated above.
2) Prepare root faces by grinding or filing.
3) Tack weld test pieces ensuring proper alignment (four equi-distant feather tacks not to exceed 19mm (3/4") in length.
4) Present tacked and stamped pieces to examiner for visual inspection.
5) This is a combination positional test in the horizontal (2G) and uphill (5G) positions - 3/4 of the circumference welded in the 5G, 1/4 in 2G.
6) Task assembly onto positioner in 2G position.
7) Weld root pass uphill (identified 1/4 section) for 2G test with 3mm (1/8") E4310 (E6010).
8) Detach assembly and tack positioner in 5G position. Positioner must remain fixed through steps 9 and 10.
   Examiner must verify 2G root weldment and reposition the 5G position.
9) Weld 5G root pass (3/4) uphill with 3mm E4310 (E6010).
10) Weld fill and cap 5G section uphill with 3mm E4918 (E7018).
11) Detach assembly and re-tack in 2G position. Examiner must verify repositioning.
12) Weld fill and cap 2G section with 3mm E4918 (E7018).
13) Remove test piece and clean weld area with chipping hammer and wire brush. Present to examiner for visual inspection.
14) Flame cut the eight stamped coupons 36mm x 150mm and prepare for guided bend test (2G - one face and one root bend; 5G three face and three root bends).
15) Present coupons (ground flush) for guided bend tests.

INSPERATORS NOTE: Results for all bend tests to be recorded on Performance Results Sheet (PRS-B)
"B Indicates Level "B"

WELD ACCEPTANCE CRITERIA CSA STANDARD W59
### Level "B" Weld Test #2 Part One

<table>
<thead>
<tr>
<th>Position</th>
<th>Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2F 3F (up)</td>
<td>GTA/W OFC</td>
</tr>
</tbody>
</table>

### Joint Design (CSA-W59)

**Suggested Weld Pass Sequence**

![Diagram of焊接过程](image)

**NOTE:**
- 2F HORIZONTAL
- 3F VERTICAL UP

### Base Metals (CSA-G40.21)

<table>
<thead>
<tr>
<th>Specification Type and Grade (to)</th>
<th>Specification Type and Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA G40.21 Gr 44W / A36</td>
<td>CSA G40.21 Gr 44W / A36</td>
</tr>
</tbody>
</table>

### Filler Metal (CSA-W48.5)

<table>
<thead>
<tr>
<th>Classification</th>
<th>FCAW</th>
<th>GMAW</th>
<th>GTAW</th>
<th>Shielding Gas</th>
<th>Gas</th>
<th>Composition Mixture</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA</td>
<td>ER309</td>
<td>ER309</td>
<td>2.5-3.2 mm</td>
<td>Shielding:</td>
<td>Ar</td>
<td>100%</td>
<td>20 CFH</td>
</tr>
<tr>
<td>AWS</td>
<td></td>
<td></td>
<td></td>
<td>Trailing:</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Size of Filler Metal</td>
<td></td>
<td></td>
<td></td>
<td>Backing:</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Position (CSA-W47.1)

<table>
<thead>
<tr>
<th>Position of Fillet</th>
<th>Position of Groove</th>
<th>Position of Joint</th>
<th>Weld Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>2F 3F</td>
<td>N/A</td>
<td>2F 3F</td>
<td>Up: Yes Down: N/A</td>
</tr>
</tbody>
</table>

### Technique (CSA-W47.1)

- String or Weave: Single Pass
- Gas Cup Size: #6-#8
- Interpass Clearing: N/A

### Instructions

- **Base metal:** Two pieces 3mm x 50mm x 150mm (1/8" x 2" x 6") low carbon steel plate
- 1) Tack weld plates ensuring proper alignment (see diagram).
- 2) Present tacked and stamped plates to examiner for visual inspection.
- 3) Tack weld "T" joint to positioner (positioner must remain fixed during welding).
- 4) Weld in vertical (3F) position first (uphill).
- 5) Have examiner confirm completion of vertical (3F) weld.
- 6) Remove and secure "T" joint in horizontal (2F) position (positioner must remain fixed during welding).
- 7) Complete horizontal (2F) weld.
- 8) Present completed weldment for visual inspection.

**INSPECTORS NOTE:** Results for all bend tests to be recorded on Performance Results Sheet (PRS-B')

*B Indicates Level "B"

**WELD ACCEPTANCE CRITERIA CSA STANDARD W59**
Level "B" Weld Test #2 Part Two

Position
3 G

Processes
GTAW / OFC

Joint Design (CSA-W59)

Suggested Weld Pass Sequence

Base Metals (CSA-G40.21)

Specification Type and Grade
CSA G40.21 Gr 44W / A36

to
CSA G40.21 Gr 44W / A36

Filler Metal (CSA-W48.5)

<table>
<thead>
<tr>
<th>FCAW</th>
<th>GMAW</th>
<th>GTAW</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER 49 S-2</td>
<td>ER 49 S-2</td>
<td>ER 49 S-2</td>
</tr>
</tbody>
</table>

Shielding Gas
Ar

Composition
Gas Mixture Flow Rate
100% 20 CFH

Position (CSA-W47.1)

Position of Fillet: N/A
Position of Groove: 3 G
Position of Joint: 3 G
Weld Progression: Up, Yes, Down: N/A

Technique (CSA-W47.1)
String or Weave: Stringer Root, Weave Fill and Cap
Gas Cup Size: #6-#8
Interpass Cleaning: Wire Wheel

Instructions

Base Metal: 6mm x 75mm x 150mm (1/4" x 3" x 6") low carbon steel plate

1) Machine flame cut plate into two pieces 75mm x 200mm (3" x 8"). Bevel edges to 37 1/2°. Feather edge (no land).

2) Tack weld plate on ends ensuring proper alignment.

3) Present tacked and stamped plates to examiner for visual inspection.

4) Tack assembly onto position in (3G) position.

5) Weld groove weld in the vertical (3G) uphill position. Number of passes at welders discretion.

6) Remove test piece and clean weld area with wire brush. Present to examiner for visual inspection.

7) Machine flame cut (four) stamped coupons 37mm x 150mm (1 1/2" x 6") and prepare for guided test bend (two face bends - two root bends).

8) Present coupons (ground flush) for guided bend test.

INSPекторS NOTE: Results for all bend tests to be recorded on Performance Results Sheet (PRS-B*)
"B Indicates Level "B"

WELD ACCEPTANCE CRITERIA CSA STANDARD W59
### Level "B" Weld Test #3

#### Performance Test Procedure (PTP) #3

<table>
<thead>
<tr>
<th>Position</th>
<th>Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 G &amp; 3 G</td>
<td>FCAW / AAC / OFC</td>
</tr>
</tbody>
</table>

#### Joint Design (CSA-W59)

#### Suggested Weld Pass Sequence

#### Base Metals (CSA-G40.21)

<table>
<thead>
<tr>
<th>Specification Type and Grade</th>
<th>Specification Type and Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA G40.21 Gr 44W / A36</td>
<td>CSA G40.21 Gr 44W / A36</td>
</tr>
</tbody>
</table>

#### Filler Metal (CSA-W48.5)

<table>
<thead>
<tr>
<th>Filler Metal</th>
<th>FCAW</th>
<th>GMAW</th>
<th>GTAW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
<td>E 491 T-9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Size of Filler Metal</td>
<td>1.2mm (.045&quot;)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shielding Gas</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>Mixture</td>
</tr>
<tr>
<td>Shielding:</td>
<td>Ar</td>
</tr>
<tr>
<td>Trailing:</td>
<td>N/A</td>
</tr>
<tr>
<td>Backing:</td>
<td>N/A</td>
</tr>
</tbody>
</table>

#### Position (CSA-W47.1)

<table>
<thead>
<tr>
<th>Position of Fillet</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position of Groove</td>
<td>1 G &amp; 3 G</td>
</tr>
<tr>
<td>Position of Joint</td>
<td>1 G &amp; 3 G</td>
</tr>
<tr>
<td>Weld Progression</td>
<td>Up: Yes Down: N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technique (CSA-W47.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>String or Weave:</td>
</tr>
<tr>
<td>Gas Nozzle Size:</td>
</tr>
<tr>
<td>Interpass Cleaning:</td>
</tr>
</tbody>
</table>

### Instructions

- **Base Metal: 13mm x 200mm x 200mm (1/2" x 8" x 8")**
- 1) Manually flame cut plate into two pieces 100mm x 200mm (4" x 8")
- 2) Tack plates ensuring proper alignment
- 3) Present assembly to Inspector for visual inspection and stamping
- 4) Weld arrow side in 1G position (one pass only)
- 5) Back gouge otherside present to Inspector for visual inspection (no grinding)
- 6) Tack assembly to positioning arm and weld otherside in 3G position up hill
- 7) Weld clean areas with chipping hammer and wire brush only and present to Inspector for visual inspection
- 8) Flame out four 10mm (3/8") coupons as marked by Inspector. Use a grinder to prepare coupons for guided bend test (side bends)
- 9) Present coupons for guided bend test

**INSPECTORS NOTE:** Results for all bend tests to be recorded on Performance Results Sheet (PRS-B). *"B" Indicates Level "B"*

**WELD ACCEPTANCE CRITERIA CSA STANDARD W59**
# Level "B" Weld Test #4 Part One

<table>
<thead>
<tr>
<th>Position</th>
<th>Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 G</td>
<td>GMAW / OFC</td>
</tr>
</tbody>
</table>

## Joint Design (CSA-W59)

- 3 mm (1/8")
- 60°

## Suggested Weld Pass Sequence

1. 
2. 
3. 

## Base Metals (CSA-G40.21)

<table>
<thead>
<tr>
<th>Specification Type and Grade</th>
<th>to</th>
<th>Specification Type and Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA G40.21 Gr 44W / A36</td>
<td>to</td>
<td>CSA G40.21 Gr 44W / A36</td>
</tr>
</tbody>
</table>

## Filler Metal (CSA-W48.5)

<table>
<thead>
<tr>
<th>FCAW</th>
<th>GMAW</th>
<th>GTAW</th>
<th>Shielding Gas</th>
<th>Gas Mixture</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER 49 S-6</td>
<td></td>
<td></td>
<td>Ar</td>
<td>Co 2</td>
<td>75% 25%</td>
</tr>
<tr>
<td>ER 70 S-6</td>
<td></td>
<td></td>
<td>Trailing</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>.89 mm (.035&quot;)</td>
<td></td>
<td></td>
<td>Backing</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

## Position (CSA-W47.1)

<table>
<thead>
<tr>
<th>Position of Fillet</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position of Groove</td>
<td>3 G</td>
</tr>
<tr>
<td>Position of Joint</td>
<td>3 G</td>
</tr>
<tr>
<td>Weld Progression</td>
<td>Up: Yes Down: Yes</td>
</tr>
</tbody>
</table>

## Instructions

1. Machine flute cut plate into two pieces 100mm x 200mm (4" x 8")
2. After flute cutting bevels clean using a grinder
3. Tack plates ensuring proper alignment
4. Present assembly to Inspector for visual inspection and stamping
5. Tack assembly to positioning arm for welding in the 3G position (assembly must remain in this position until all welding is complete)
6. Root pass DOWN Fill and Cap UP
7. Clean weld areas with wire brush and present to Inspector for visual inspection
8. Flame cut four 38mm (1 1/2") coupons as marked by Inspector. Use a grinder to prepare coupons for guided bend test (two root, two face)
9. Present coupons for guided bend test

### INSPECTORS NOTE:
Results for all bend tests to be recorded on Performance Results Sheet (PRS-B*)

"B Indicates Level "B"

## WELD ACCEPTANCE CRITERIA:
CSA STANDARD W59
## Level "B" Weld Test #4 Part Two

<table>
<thead>
<tr>
<th>Position</th>
<th>Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2F 3F</td>
<td>GMAW / OFC</td>
</tr>
</tbody>
</table>

### Joint Design (CSA-W59)

![Joint Design Diagram]

**Suggested Weld Pass Sequence**

### Base Metals

Aluminum Plate as supplied

### Filler Metal (CSA-W48.5)

<table>
<thead>
<tr>
<th>Classification (AWS)</th>
<th>FCAW</th>
<th>GMAW</th>
<th>GTAW</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA</td>
<td>4043 - 5356</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AWS</td>
<td>0.9 - 1.2mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Shielding Gas

<table>
<thead>
<tr>
<th>Gas</th>
<th>Mixture</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ar</td>
<td>100%</td>
<td>20 CFH</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Position (CSA-W47.1)

<table>
<thead>
<tr>
<th>Position of Fillet</th>
<th>Position of Groove</th>
<th>Position of Joint</th>
<th>Weld Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>2F 3F</td>
<td>N/A</td>
<td>2F 3F</td>
<td>Up; Yes Down; Yes</td>
</tr>
</tbody>
</table>

### Technique (CSA-W47.1)

- Stringer Root, Weave Fill and Cap
- Gas Nozzle Size: 1/2" - 5/8"
- Interpass Cleaning: SS Wire Brush

### Instructions

1. Machine cut plate into two pieces 75mm x 300mm (3" x 12")
2. Brush clean to remove oxide and tack plates ensuring proper alignment
3. Present assembly to inspector for visual inspection and stamping
4. Clamp assembly to positioning arm for welding in the 3F position and remove to complete the 2F position
   (assembly must remain in position until all welding is complete)
5. Present to inspector for visual inspection as welded

**INSPECTORS NOTE:** Visual test results to be recorded on the Performance Results Sheet (PRS-B*)

*B Indicates Level B

**WELD ACCEPTANCE CRITERIA CSA STANDARD W59**
Pipe fabrication project is intended for implementation in the Welder Level “B” apprenticeship program. It is not intended to be part of the Welder Level “B challenge” assessment.
FINAL PRACTICAL EXAMINATION – Metric

MATERIAL LIST:

A 100mm (4") FLANGE
B 100mm (4") STD PIPE
C 75mm (3") STD PIPE
FINAL PRACTICAL EXAMINATION

MATERIAL LIST

<table>
<thead>
<tr>
<th>MARK</th>
<th>QTY</th>
<th>SYM</th>
<th>DESCRIPTION</th>
<th>LENGTH</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>FLG</td>
<td>100 mm (4&quot;&quot;) IPS Slip-on flange 150 PSI</td>
<td></td>
<td>Supplied</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>PIPE</td>
<td>100 mm (4&quot;&quot;) std. pipe</td>
<td>1200 mm</td>
<td>Cut to Suit</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>PIPE</td>
<td>75 mm (3&quot;&quot;) std. pipe</td>
<td>300 mm</td>
<td>Cut to Suit</td>
</tr>
</tbody>
</table>

**NOTE:** Use templates developed in J-8 Perform Basic Pipe Layout (reference module RK6-2)

**INSTRUCTIONS:**

1) All cutting to be done with the OFC process.

2) Grind and prepare pipe for welding.

3) **DO NOT WELD** any components until assembly is completely fit and tacked.

4) Have Inspector assess for dimensional accuracy.

5) Tack assembly to positioning arm in welding booth where indicated and show Inspector.

6) Weld groove welds ONLY in fixed position **DO NOT MOVE**.

7) When complete, show Inspector for evaluation of welds and assessment of dimensional accuracy.

8) Maximum time allowed for this project is 6 hrs.
# FINAL PRACTICAL EXAMINATION EVALUATION SHEET

**Welder Name:**

**Registration #:**

**Date (dd/mm/yyyy):**

**NOTE:**
- P (pass) = Acceptable Performance
- F (fail) = Unacceptable Performance
- Check the Appropriate Box
- All areas must indicate a pass or final result is a fail.

## STUDENT WORK HABITS:

<table>
<thead>
<tr>
<th>Pass</th>
<th>Fail</th>
<th>Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Personal protective equipment |      |       |
| Job planning                  |      |       |
| Layout techniques             |      |       |
| **TOTAL:**                    |      |       |

## STUDENT SKILLS:

### Flame Cutting:

<table>
<thead>
<tr>
<th>Pass</th>
<th>Fail</th>
<th>Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Edges sharp and square |      |       |
| Drag line vertical    |      |       |
| Nicks or gouges       |      |       |
| **TOTAL:**             |      |       |

### SMAW Quality:

<table>
<thead>
<tr>
<th>Pass</th>
<th>Fail</th>
<th>Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Accurate weld size     |      |       |
| Acceptable weld contours |      |   |
| Undercut               |      |       |
| Cold lap               |      |       |
| Porosity               |      |       |
| Lack of fusion         |      |       |
| Spatter                |      |       |
| Consistency of welds   |      |       |
| **TOTAL:**              |      |       |

## COMPLETED WELDMENT:

<table>
<thead>
<tr>
<th>Pass</th>
<th>Fail</th>
<th>Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Distortion          |      |       |
| Dimensionally correct |      |   |
| Conforms to drawing |      |       |
| **TOTAL:**          |      |       |

## Final Result Pass/Fail

**Inspector:** print: sign:

**NOTE:** Record Results on Performance Results Sheet (PRS-B*)
- *B Indicated Level “B”*