Apprenticeship Curriculum Standard

Welder

Level 2

456A

2002
Please Note:

Apprenticeship Training and Curriculum Standards were developed by the Ministry of Training, Colleges and Universities (MTCU). As of April 8th, 2013, the Ontario College of Trades (College) has become responsible for the development and maintenance of these standards. The College is carrying over existing standards without any changes.

However, because the Apprenticeship Training and Curriculum Standards documents were developed under either the Trades Qualification and Apprenticeship Act (TQAA) or the Apprenticeship and Certification Act, 1998 (ACA), the definitions contained in these documents may no longer be accurate and may not be reflective of the Ontario College of Trades and Apprenticeship Act, 2009 (OCTAA) as the new trades legislation in the province. The College will update these definitions in the future.

Meanwhile, please refer to the College’s website (www.collegeoftrades.ca) for the most accurate and up-to-date information about the College. For information on OCTAA and its regulations, please visit: www.collegeoftrades.ca/about/legislation-and-regulations.
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**NOV04 changes**
Refs to L1 only changed
INTRODUCTION

This new Curriculum Standard for the Welder Trade was designed by the Welder Curriculum Development Committee to meet the General Performance Objectives and Performance Objectives in the Industry-approved Welder Apprenticeship Training Standard. The Welder Project Steering Committee validated this project.

This Curriculum Standard is organized into three levels of in-school-training, each including reportable subjects containing like or similar learning outcomes to reflect the units of the Training Standard. The hours chart indicates how the Curriculum can be delivered in a block-release format and summarizes the hours of training for each reportable subject by level. Since all reportable subjects are divisible by three they can be adapted to accommodate a more flexible training delivery.

Reportable subjects are cross-referenced to the Training Standard for ease of comparison.

Additional learning outcomes, fundamental for learning this trade, have been added to those found in the Training Standard. Safety has been stressed throughout to provide the apprentices the ability to work safely and to assist employers in maintaining accident-free workplaces.

Each reportable subject and learning outcome identifies a recommended number of training hours, broken into hours for theory training and hours for practical applications. The division of the Curriculum into reportable subjects that follow a natural progression of learning throughout the three levels will allow training providers and apprentices flexibility in program delivery while still observing the importance of sequencing learning in a logical progression.

The Curriculum Standard focuses on the in-school training of apprentices to acquire the theoretical knowledge required to master the performance objectives of the Training Standard. Employers are expected to expand the apprentice’s knowledge and skills through appropriate training at the workplace.

Regular evaluations and testing of the apprentice’s knowledge and skills are to be conducted throughout training to assure that all apprentices have achieved the learning outcomes identified in the Curriculum Standard.
## ONTARIO WELDER APPRENTICESHIP PROGRAM I

Suggested minimum equipment list for Training Delivery Agencies.

<table>
<thead>
<tr>
<th>POWER SOURCES AND EQUIPMENT</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMAW (CC) (AC/DC) power source and equipment</td>
<td>1 per apprentice</td>
</tr>
<tr>
<td>GMAW / FCAW / MCAW (CV) power source and equipment (Capable of Spray-transfer)</td>
<td>1 per apprentice</td>
</tr>
<tr>
<td>GMAW-PULSED power source and equipment</td>
<td>1 per 5 apprentices</td>
</tr>
<tr>
<td>GTAW (CC), AC/DC, High Frequency, Square wave, Pulsed power source and equipment, Water-cooled torch, Foot controller</td>
<td>1 per 5 apprentices</td>
</tr>
<tr>
<td>Plasma Arc Cutting power source and equipment</td>
<td>1 per 5 apprentices</td>
</tr>
<tr>
<td>Air-Carbon-Arc-Gouging power source and equipment</td>
<td>1 per 5 apprentices</td>
</tr>
<tr>
<td>Oxy-Fuel-Gas Manual Cutting equipment</td>
<td>1 per apprentice</td>
</tr>
<tr>
<td>Oxy-Fuel-Gas Semi-Automatic Cutting equipment</td>
<td>1 per 5 apprentices</td>
</tr>
<tr>
<td>Oxy-Fuel-Gas-Heating Torch and equipment</td>
<td>1 per 5 apprentices</td>
</tr>
<tr>
<td>Approved Electrode Storage Oven</td>
<td>1 per shop</td>
</tr>
<tr>
<td>Compressed Air Supply (80-100 PSI)</td>
<td>1 per shop</td>
</tr>
</tbody>
</table>

## OPTIONAL POWER SOURCES AND EQUIPMENT

<table>
<thead>
<tr>
<th>POWER SOURCES AND EQUIPMENT</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma Arc Welding power source and equipment</td>
<td>1 per shop</td>
</tr>
<tr>
<td>Sub-Arc Welding power source and equipment</td>
<td>1 per shop</td>
</tr>
<tr>
<td>Stud welding power source and equipment</td>
<td>1 per shop</td>
</tr>
</tbody>
</table>

© Ontario College of Trades
FABRICATION MACHINES (1 each per shop)

Plate Shear  
Brake Press  
Roll Bending Machine  
Band Saw  
Nibbler  
Ironworker  
Pedestal grinders  
Cut-off abrasive wheel saw  
Weld-bevel preparation equipment for plate and pipe  
Weld-coupon bending apparatus  
Approved smoke extraction/air make-up unit  
Welding and Fabricating shops must be well lit, appropriately heated and ventilated

BASIC HAND TOOLS AND EQUIPMENT (1 per apprentice)

Adjustable wrenches (various sizes)  
Allen wrenches (metric and imperial)  
Bench vice  
“C” clamps (various sizes)  
Chalk-line  
Cold chisels (various sizes)  
Electric extension cords  
Files (flat, half-round, rat-tail, bastard)  
Friction lighter  
Grinding and sanding disks (for carbon steel, aluminum and stainless steel)  
Hacksaw  
Hammers (chipping, ball peen, claw, sledge, various sizes)  
Hand shears  
Layout table  
Magnets  
Metal markers  
Pipe clamps  
Pipe cutter  
Pipe wrenches  
Pliers (needle nose, slip joint)  
Positioners  
Pry bars  
Punches  
Screwdrivers (flat, Phillips, Robertson, various sizes)  
Scribers  
Snips (heavy duty sheet metal cutting)  
Soapstone markers  
Socket sets (metric and imperial)  
Temperature indicating crayons  
Tip cleaners  
Toolboxes  
Tungsten sharpening grinders  
Vice grips (various sizes and types)  
Wire brushes (for carbon steel, aluminum and stainless steel)  
Wire cutters  
Work bench  
Wrench sets (open and closed ends, both metric and imperial)

MEASURING TOOLS (1 per apprentice)

Drafting equipment  
Fillet gauges  
Vernier caliper  
Micrometer  
Scriber  
Combination square  
Spirit level  
Square  
Straight edge  
Tape measure

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**POWER TOOLS AND EQUIPMENT** (1 per 5 apprentices)

- Electric drills [9mm (3/8”) to 12.5mm (1/2”)
  chuck size]
- Grinders, electric and/or pneumatic (wire brush, angle grinders)
- Sanders
- Wire wheel (angle grinder with wire brush)

**HOISTING AND LIFTING EQUIPMENT** (1 per shop)

- Rope
- Slings
- Chains
- Chokers
- Come-along (cable or chain)
- Forklift
- Overhead hoist or crane

**SAFETY EQUIPMENT** (1 per apprentice)

- Earplugs and muffs
- Face shields
- Fire blankets
- Fire extinguishers
- Goggles
- Leather gloves
- Leather jackets
- Masks (particle, vapor)
- Respirators
- Safety glasses

**RESOURCE MATERIALS**

- Codebooks
- Engineering specifications
- Manufacturers’ specifications, manuals and charts
- Safety manuals
PERSONAL AND SAFETY EQUIPMENT

Personal protective equipment is at the discretion of the training delivery agent who must conform to Ontario Provincial Health and Safety Regulations.

Welder apprentices may supply their own work clothing, boots, coveralls and prescription (safety) glasses.

Items such as hard hats, eye and hearing protection, and all other tools and equipment are frequently the responsibility of the employer.

Resource materials, charts, regulations, specifications, service bulletins, manufacturers’ manuals, and logbooks are supplied by the employer or equipment owner.
# PROGRAM SUMMARY

(In-school training hours)

<table>
<thead>
<tr>
<th>Level</th>
<th>Theory hours</th>
<th>Practical hours</th>
<th>Total hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I</td>
<td>138</td>
<td>162</td>
<td>300</td>
</tr>
<tr>
<td>Level II</td>
<td>53</td>
<td>127</td>
<td>180</td>
</tr>
<tr>
<td>Level III</td>
<td>126</td>
<td>114</td>
<td>240</td>
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<tr>
<td>TOTAL HOURS</td>
<td>324</td>
<td>396</td>
<td>720</td>
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# PROGRAM SUMMARY BY LEVEL

## LEVEL I:

<table>
<thead>
<tr>
<th>Reportable Subjects</th>
<th>Total</th>
<th>Theory</th>
<th>Practical</th>
<th>Prerequisite:</th>
<th>Co-requ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Trade Practices</td>
<td>33</td>
<td>28</td>
<td>5</td>
<td>None</td>
<td>None</td>
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<tr>
<td>2. Applied Blueprint Reading</td>
<td>60</td>
<td>39</td>
<td>21</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>3. Welding Theory I</td>
<td>30</td>
<td>30</td>
<td>0</td>
<td>Unit 1</td>
<td>Unit 4, 5, 6</td>
</tr>
<tr>
<td>4. Material and Process Quality I</td>
<td>27</td>
<td>27</td>
<td>0</td>
<td>Unit 1, 3</td>
<td>Unit 5, 6</td>
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<tr>
<td>5. Shielded Metal Arc Welding (SMAW) Practical I</td>
<td>69</td>
<td>3</td>
<td>66</td>
<td>Unit 1, 3</td>
<td>Unit 4, 6</td>
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<tr>
<td>6. Gas Shielded Semi-Automatic Welding Practical I</td>
<td>54</td>
<td>2</td>
<td>52</td>
<td>Unit 1, 3</td>
<td>Unit 4, 5</td>
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<tr>
<td>7. Thermal Cutting</td>
<td>27</td>
<td>9</td>
<td>18</td>
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<tr>
<td>Total</td>
<td>300</td>
<td>138</td>
<td>162</td>
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## LEVEL II:

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<th>Practical</th>
<th>Prerequisite:</th>
<th>Co-requ.</th>
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</thead>
<tbody>
<tr>
<td>1. Blueprint Reading / Fitting</td>
<td>39</td>
<td>27</td>
<td>12</td>
<td>L I, Unit 2</td>
<td></td>
</tr>
<tr>
<td>2. Welding Theory II</td>
<td>18</td>
<td>17</td>
<td>1</td>
<td>L I, Unit 3</td>
<td>Unit 3, 4, 5, 6</td>
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<tr>
<td>3. Shielded Metal Arc Welding (SMAW) Practical II</td>
<td>54</td>
<td>2</td>
<td>52</td>
<td>L I, Unit 4</td>
<td>Unit 2, 3, 5</td>
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<tr>
<td>4. Semi-Automatic Welding Practical II</td>
<td>39</td>
<td>4</td>
<td>35</td>
<td>L I, Unit 5</td>
<td>Unit 3, 4</td>
</tr>
<tr>
<td>5. Gas Tungsten Arc Welding (GTAW) I</td>
<td>30</td>
<td>3</td>
<td>27</td>
<td>Unit 2</td>
<td></td>
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<tr>
<td>Total</td>
<td>180</td>
<td>53</td>
<td>127</td>
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### LEVEL III:

<table>
<thead>
<tr>
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<th>Practical</th>
<th>Prerequisite</th>
<th>Co-requ.</th>
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</thead>
<tbody>
<tr>
<td>1. Fitting</td>
<td>87</td>
<td>54</td>
<td>33</td>
<td>L II, Unit 1</td>
<td></td>
</tr>
<tr>
<td>2. Quality</td>
<td>39</td>
<td>33</td>
<td>6</td>
<td>L II, Unit 3</td>
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<td>3. Gas Tungsten Arc Welding (GTAW) Practical II and Plasma Arc Welding (PAW)</td>
<td>42</td>
<td>24</td>
<td>18</td>
<td>L II, Unit 6</td>
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<tr>
<td>4. Automatic and Semi-Automatic Processes</td>
<td>27</td>
<td>12</td>
<td>15</td>
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<td>Unit 5</td>
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<tr>
<td>5. Shielded Metal Arc Welding (SMAW) Practical III</td>
<td>45</td>
<td>3</td>
<td>42</td>
<td>L II, Unit 5</td>
<td>Unit 4</td>
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<tr>
<td>Total</td>
<td>240</td>
<td>126</td>
<td>114</td>
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EVALUATION AND TESTING

LEVEL I:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course</th>
<th>Theory Testing</th>
<th>Practical Application Exercises</th>
<th>Research Project</th>
<th>Notebook and Organizational Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Trade Practices</td>
<td>60%</td>
<td>20%</td>
<td>10%</td>
<td>10%</td>
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<tr>
<td>Unit 2</td>
<td>Applied Blueprint Reading</td>
<td>70%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
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<tr>
<td>Unit 3</td>
<td>Welding Theory I</td>
<td>80%</td>
<td>0%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Unit 4</td>
<td>Material &amp; Process Quality I</td>
<td>80%</td>
<td>0%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Unit 5</td>
<td>SMAW Practical I</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>Unit 6</td>
<td>Semi-Automatic Welding Practical I</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Unit 7</td>
<td>Thermal Cutting</td>
<td>30%</td>
<td>50%</td>
<td>10%</td>
<td>10%</td>
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</table>

LEVEL II:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course</th>
<th>Theory Testing</th>
<th>Practical Application Exercises</th>
<th>Research Project</th>
<th>Notebook and Organizational Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Blueprint Reading/Fitting</td>
<td>50%</td>
<td>30%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Unit 2</td>
<td>Welding Theory II</td>
<td>70%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Unit 3</td>
<td>Shielded Metal Arc Welding (SMAW) Practical II</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Unit 4</td>
<td>Semi-Automatic Welding Practical II</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Unit 5</td>
<td>Gas Tungsten Arc Welding (GTAW) I</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>0%</td>
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</table>
EVALUATION AND TESTING (continued)

LEVEL III:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Module</th>
<th>Theory Testing</th>
<th>Practical Application Exercises</th>
<th>Research Project</th>
<th>Notebook and Organizational Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Fitting</td>
<td>50%</td>
<td>30%</td>
<td>10%</td>
<td>10%</td>
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<tr>
<td>Unit 2</td>
<td>Quality</td>
<td>60%</td>
<td>20%</td>
<td>10%</td>
<td>10%</td>
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<tr>
<td>Unit 3</td>
<td>Gas Tungsten Arc Welding (GTAW) Practical II</td>
<td>50%</td>
<td>30%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Plasma Arc Welding (PAW)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Unit 4</td>
<td>Automatic and Semi-Automatic Processes</td>
<td>30%</td>
<td>50%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Unit 5</td>
<td>Shielded Metal Arc Welding (SMAW) Practical III</td>
<td>10%</td>
<td>90%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Implementation:

January 2003
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Summary of Total Program In-School Training Hours ...........................................................1

1. Blueprint Reading / Fitting ..........................................................................................2
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   4.2 Groove Welds with Gas Metal Arc Welding (GMAW) Practical II ...................26
   4.3 Fillet Welds with Flux Cored Arc Welding (FCAW) Practical II .......................28
   4.4 Groove Welds with Flux Cored Arc Welding (FCAW) Practical II ...................30

5 Gas Tungsten Arc Welding (GTAW) I .......................................................................32
   5.1 Gas Tungsten Arc Welding (GTAW) Practical I ..............................................32

Reference Material ............................................................................................................35

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# Welder – Level II

## Summary of Total Program In-School Training Hours

<table>
<thead>
<tr>
<th>Reportable Subjects</th>
<th>Total</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Blueprint Reading / Fitting</td>
<td>39</td>
<td>27</td>
<td>12</td>
</tr>
<tr>
<td>2. Welding Theory II</td>
<td>18</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>3. Shielded Metal Arc Welding (SMAW) Practical II</td>
<td>54</td>
<td>2</td>
<td>52</td>
</tr>
<tr>
<td>4. Semi-Automatic Welding Practical II</td>
<td>39</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>5. Gas Tungsten Arc Welding (GTAW) I</td>
<td>30</td>
<td>3</td>
<td>27</td>
</tr>
</tbody>
</table>

| Total                                                   | 180   | 53     | 127       |
Welder – Level II

Number: 1

Title: Blueprint Reading / Fitting

Duration: 39 Total Hours

  Theory: 27 hours  Practical: 12 hours

Prerequisites: Level I, Unit 2

Co-requisites: None

1.1 – Blueprint Reading II

  24 Total Hours  Theory: 24 hours  Practical: 0 hours

1.2 – Fitting I

  15 Total Hours  Theory: 3 hours  Practical: 12 hours
1.1 – Blueprint Reading II

Cross-Reference to Learning Outcomes:

6004.01; 6006.01, .02; 6003.03

Duration: 24 Total Hours  Theory: 24 hours  Practical: 0 hours

General Learning Outcome:

Demonstrate a working knowledge of blue print reading and basic drafting.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

1.1.1 Describe the various methods of presenting information on drawings.

[3/0]

- notes and specifications
- title block
- specification attachments
- tolerances
- unilateral
- bilateral
- limit dimensioning
- holes
- dimensioning
- countersink
- counter bore
- threads
- internal and external
- classifications
- metric and imperial
- threads per inch
- diameter and pitch
- welding symbols
- dimensioning
- locating of welds
  - plug and slot
  - surfacing
  - spot and projection welds
  - stud welds
- welding procedures and specifications, notes
- testing methods

1.1.2 Explain methods of estimating material requirements for weldments and fabrications.
[2/0]

- material “take-off”
  - bill of materials
  - break out
    - cutting list
  - efficient and economic use of materials
- estimation
  - calculate weight (mass)
  - take off list
  - standard tables
  - cost of materials
    - standard weight tables
    - current prices

1.1.3 Perform assigned classroom projects – drawings.
[19/0]

- sketching
  - views
  - scales
  - drawing techniques
    - protractor
    - compass
  - dimensioning
  - symbols
  - notes and specifications
- material take-off
  - bill of material
  - cutting list
  - estimation
    - weight
    - cost
1.2 – Fitting I

Cross-Reference to Learning Outcomes:

6000.01, .04

Duration:  15 Total Hours   Theory: 3 hours   Practical: 12 hours

General Learning Outcome:

Demonstrate a working knowledge of layout and fitting techniques.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

1.2.1 Explain various layout techniques.

[3/0]

- layout tools
  - imperial and metric
  - rulers
  - scales
  - micrometers
  - verniers
  - squares
  - levels
  - compass
  - protractor
- marking lines
  - soap stone line
  - chalk line
  - paint stick
  - centre punch line
  - scribing
- layout math skills
  - fractions
  - addition
  - subtraction
  - angle measurement
  - joints
  - butt
- lap
- corners
- miter
- cope
- structural shapes intersections
  - angles
  - channels
  - beams
  - HSS

1.2.2 Perform assigned shop projects – layout and fitting. [0/12]
- layout project(s)
  - preparing material
    - plate
    - structural shapes
    - HSS
  - layout and mark cut lines
    - shapes
    - corners
    - 90 degree miter
    - cope corner
  - manual flame cutting
    - dimensioning material
    - edge preparation
  - semi-automatic flame cutting
    - dimensioning material
    - edge preparation
  - saws
    - hacksaw
    - cut-off abrasive wheel saw
    - band saws
  - hand grinders
    - edge and surface preparation
- fitting and assembly parts
  - corners
  - miter
  - lapped
  - coped
  - dimensional accuracy
  - squareness
    - diagonal measurement
    - 3-4-5 triangle
  - tack weld assembly with prescribed process
**Evaluation:**

The following evaluation structure is only a suggested format. Specific evaluation of theory and practical components of training varies due to the resource material and training aides utilized.

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<td>Notebook and Organizational Skills</td>
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</table>
Welder – Level II

Number: 2
Title: Welding Theory II
Duration: 18 Total Hours

Theory: 17 hours Practical: 1 hours

Prerequisites: Level I, Unit 3
Co-requisites: Unit 3, 4, 5, 6

2.1 – Brazing
3 Total Hours Theory: 2 hours Practical: 1 hours

2.2 – Metallurgy
9 Total Hours Theory: 9 hours Practical: 0 hours

2.3 – Inspection and Testing
6 Total Hours Theory: 6 hours Practical: 0 hours
2.1 – Brazing

Cross-Reference to Learning Outcomes:

6017.01, .02, .05; 6013.01, .02, .03, .04; 6015.02

Duration: 3 Total Hours Theory: 2 hours Practical: 1 hours

General Learning Outcome:

Demonstrate a working knowledge of brazing of deoxidized copper with the oxy-fuel equipment

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

2.1.1 Describe general safety related concepts.

[.5/0]

- personal protection
- fumes
- flashback / reverse flow
- fuel gases
- cylinders (basic construction and features i.e. fusible plugs, rupture disk)
- regulators
- brazing in confined spaces

2.1.2 Explain the operation and handling of equipment and consumables.

[1/0]

- secure cylinders
- regulators and gauges
- hoses
- torches
- fittings
- flashback arrestors
- tips (installing, types, size selection, cleaning)
- pressures
- speed of travel
- types of joints
- joint cleaning and preparation
- post-cleaning
- filler metals
  - brass
  - bronze
  - silver
  - alloys
  - copper phosphorous
    - adhesion joining
- material types
- fluxes
  - coated rod
  - powder
  - liquid
- material thickness
- quality control
- qualification tests

2.1.3 Explain set up and shut down of oxy-fuel equipment. [.5/0]

- set up
- shut down

2.1.4 Perform Brazing on deoxidized copper. [0/1]

- oxy-fuel gas equipment parameters
- tip size
- adjustment of flame
- fuel gas pressure
- filler metal selection
  - size and type
- material preparation
- material fit up to parameters
  - lap length
  - joint clearance
- braze laps and tee joints
2.2 – Metallurgy

Cross-Reference to Training Standard Performance Objectives:

6003.03; 6015.02; 6016.02; 6005.05

Duration: 9 Total Hours  Theory: 9 hours  Practical: 0 hours

General Learning Outcome:

Describe the characteristics of metals and their alloys, classifications and effects of welding heat in accordance with metallurgy principles in accordance with government safety regulations, manufacturer’s recommendations and approved industry standards.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

2.2.1 Define metals and their properties.

2.2.2 Describe the processes used to produce metals and alloys.

2.2.3 Identify steel types and classification systems.

2.2.4 Explain the purpose and effects of heat-treatments on steel.

2.2.5 Describe properties of metals and their effect on material selection, fabrication and welding considerations.

Learning Content:

2.2.1 Define metals and their properties.

[1/0]

- metals
- properties of metals affecting weldability
  - alloys
  - mechanical properties
  - tensile strength
  - impact strength
  - hardness
  - ductility
  - chemical properties
  - corrosion resistance
2.2.2 Describe the processes used to produce metals and alloys.
[2.5/0]
- blast furnace
- pig-iron
- cast-iron
- steel
  - continuous casting
- steel refining furnaces
  - basic oxygen furnace
  - electric arc furnace
  - stainless steel
- material forming methods
  - wrought
  - cast metals
- structural shapes
  - HSS
  - plate
  - hot rolled
  - cold rolled

2.2.3 Identify steel types and classification systems.
[2.5/0]
- characteristics of
  - low carbon steel
  - medium carbon steel
  - high carbon steel
  - stainless steel
- classification numbering system of plain carbon steels
  - AISI
  - ASTM
  - CSA
- steel and metal identification methods
  - appearance
  - hardness test
  - magnetic test
  - chisel test
  - fracture test
  - flame test
  - spark test
  - weight test
2.2.4 Explain the purpose and effects of heat-treatments on steel.

- annealing
- normalizing
- quenching
- hardening
- tempering
- stress relieving

2.2.5 Describe properties of metals and their effect on material selection, fabrication and welding considerations.

- physical properties
  - mass
  - melting point
  - thermal conductivity
  - coefficient of expansion
  - electrical conductivity
- mechanical properties
  - tensile strength
  - yield strength
  - ductility
  - impact strength
2.3 – Inspection and Testing

Cross-Reference to Training Standard Performance Objectives:

6016.04, .05; 6015.01, .03, 4.2.1, 11.1.7, 11.2.7, 11.3.7

Duration: 2 Total Hours Theory: 2 hours Practical: 0 hours

General Learning Outcome:

Explain the function and application of destructive and non-destructive testing methods for welds in accordance with government safety regulations, manufacturer’s recommendations and approved industry standards.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

2.3.1 Explain the function and application of mechanical test methods.

2.3.2 Explain the function and application of non-destructive examination methods.

Learning Content:

2.3.1 Explain the function and application of mechanical test methods.

[1/0]

- tensile testing
  - reduced section transverse test
  - longitudinal tensile test
- all weld metal tensile test
- yield strength
- elongation
- reduction of area
- impact testing
  - charpy
  - izod
- bend testing
  - face
  - root
  - side
2.3.2 Explain the function and application of non-destructive examination methods. [1/0]

- visual inspection method
- gauges
- pre-weld preparation
- completed weld specifications
- penetrant testing
  - flourescent
  - visible dye
  - leak-through techniques
- magnetic particle testing
  - prod method
  - yoke method
- radiography
  - x-ray method
  - gamma ray method
- interpretation of weld radiographs
- ultrasonic testing
  - instrumentation calibration
  - straight and angle beam methods
  - scanning techniques and defect location

**Evaluation:**

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Welder – Level II

Number: 3
Title: Shielded Metal Arc Welding (SMAW) Practical II
Duration: 54 Total Hours

Prerequisites: Level I, Unit 4
Co-requisites: Unit 2, 3, 5

3.1 – Fillet Weld in all Positions with Shielded Metal Arc Welding (SMAW)
15 Total Hours Theory: 1 hours Practical: 14 hours

3.2 – Groove Weld in all Positions with Shielded Metal Arc Welding (SMAW)
24 Total Hours Theory: 1 hours Practical: 23 hours

3.3 – Perform Shielded Metal Arc Welding (SMAW) Welds and Destructive Testing Methods
15 Total Hours Theory: 0 hours Practical: 15 hours
3.1 – Fillet Weld in all Positions with Shielded Metal Arc Welding (SMAW)

Cross-Reference to Learning Outcomes:

6015.02; 6014.05; 6007.01, .02, .03, .04, .06, .07

Duration: 15 Total Hours  Theory: 1 hours  Practical: 14 hours

General Learning Outcome:

Demonstrate a working knowledge of fillet welding in all positions with the Shielded Metal Arc Welding (SMAW) process.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

3.1.1 Describe the equipment set-up and the process of the Shielded Metal Arc Welding (SMAW).

[1/0]

- power source
- equipment
- consumables
- safety
- personal protection
- material
- technique
- type of welds

3.1.2 Set-up equipment for Shielded Metal Arc Welding (SMAW) applications.

[0/1]

- power sources
  - transformers
  - rectifiers
  - inverters
  - engine driven
- power source controls
  - amperage
  - voltage
  - current type

3.3 Perform Shielded Metal Arc Welding (SMAW) Welds for Destructive Testing
3.1.3 Fillet Weld on mild steel in all Positions.

- welding parameters
- filler metals
  - cellulose
  - rutile
  - basic
- fillet welds
- welding positions
  - flat (1F)
  - horizontal (2F)
  - vertical (3F)
  - overhead (4F)
- joints
  - lap
  - tee
  - corner
- material
  - plate and sheet
  - structural shapes
  - HSS
- fillet welds on studs
Welder – Level II

3.2 – Groove Weld in all Positions with Shielded Metal Arc Welding (SMAW)

Cross-Reference to Learning Outcomes:

6015.02; 6007.01, .02, .03, .04, .06, .07

Duration: 24 Total Hours  Theory: 1 hours  Practical: 23 hours

General Learning Outcome:

Demonstrate a working knowledge of groove welding in all positions with the Shielded Metal Arc Welding (SMAW) process.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

3.2.1 Describe equipment set-up and the process of Shielded Metal Arc Welding (SMAW) [1/0]

- power source
- equipment
- consumables
- safety
- personal protection
- material
- technique
- type of welds

3.2.2 Groove Weld on mild steel in all positions. [0/23]

- power sources
- auxiliary equipment
- welding parameters
- filler metals
  - cellulose
  - rutile
  - rutile

3.3 – Perform Shielded Metal Arc Welding (SMAW) Welds for Destructive Testing
- basic
- welding positions
  - flat (1G)
  - horizontal (2G)
  - vertical (3G)
  - overhead (4G)
- joints
  - bevel groove with backing
  - vee-groove
- material
  - plate
3.3  Perform Shielded Metal Arc Welding (SMAW) Welds for Destructive Testing

Cross-Reference to Learning Outcomes:

6015.02; 6007.05; 6016.04; 6004.01, .03; 6016.04

Duration: 15 Total Hours  Theory: 0 hours  Practical: 15 hours

General Learning Outcome:

Demonstrate a working knowledge of preparing and performing destructive testing.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

3.3.1 Perform Welds for Destructive Testing.
   [0/11]
   - groove weld tests in positions to identified procedures
   - joints
     - bevel groove
     - backing
     - vee-groove
   - consumables
     - cellulose
     - basic
     - position
   - 1G, 1GF, flat
   - 2G, 2GF, horizontal
   - 3G, 3GF, vertical
   - 4G, 4GF, overhead

3.3.2 Perform preparatory operations for destructive testing.
   [0/2]
   - remove backing
   - grind surface
   - layout coupons
   - cut coupons
   - grind coupons
3.3.3 Perform destructive testing.

[0/2]

- root bends
- face bends
- side bends

**Evaluation:**

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</table>
Number: 4

Title: Semi-Automatic Welding Practical II

Duration: 39 Total Hours
Theory: 4 hours Practical: 35 hours

Prerequisites: Level I, Unit 5

Co-requisites: Unit 3, 4

4.1 – Fillet Welds with Gas Metal Arc Welding (GMAW) Practical II
9 Total Hours Theory: 1 hours Practical: 8 hours

4.2 – Groove Welds with Gas Metal Arc Welding (GMAW) Practical II
18 Total Hours Theory: 1 hours Practical: 17 hours

4.3 – Fillet Welds with Flux Cored Arc Welding (FCAW) Practical II
6 Total Hours Theory: 1 hours Practical: 5 hours

4.4 – Groove Welds with Flux Cored Arc Welding (FCAW) Practical II
6 Total Hours Theory: 1 hours Practical: 5 hours
Welder – Level II

4.1 – Fillet Welds with Gas Metal Arc Welding (GMAW) Practical II

Cross-Reference to Learning Outcomes:

6015.02; 6016.04; 6004.01, .03

Duration: 9 Total Hours Theory: 1 hours Practical: 8 hours

General Learning Outcome:

Demonstrate a working knowledge of fillet welding with the Gas Metal Arc Welding (GMAW) process (II).

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

4.1.1 Describe equipment set-up and the process of Gas Metal Arc Welding (GMAW).

[1/0]

- power source
- wire feeder
- shielding gas
- consumables
- safety
- personal protection
- material
- technique
- type of welds

4.1.2 Fillet weld with the Gas Metal Arc Welding (GMAW) process.

[0/8]

- positions
  - vertical (3F)
- material
  - mild steel
- modes of metal transfer
  - short circuit transfer
- joints
  - lap
  - tee
- corner
- consumables
  - type
  - size
- shielding gas
  - type
  - flow rate
- stainless steel
  - flat (1F)
  - horizontal (2F)
- aluminum
  - flat (1F)
  - horizontal (2F)
4.2 – Groove Welds with Gas Metal Arc Welding (GMAW) Practical II

Cross-Reference to Learning Outcomes:

6015.02; 6010.04, .06, .07; 6010.05, .06, .07; 6016.04; 6004.01, .03

Duration: 18 Total Hours  Theory: 1 hours  Practical: 17 hours

General Learning Outcome:

Demonstrate a working knowledge of groove welding with the Gas Metal Arc Welding (GMAW) process (II).

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

4.2.1 Describe equipment set-up and the process of Gas Metal Arc Welding (GMAW).

[1/0]

- power source
- wire feeder
- shielding gas
- consumables
- safety
- personal protection
- material
- technique
- type of welds

4.2.2 Groove weld with the Gas Metal Arc Welding (GMAW) process.

[0/8]

- positions
  - vertical (3G)
- material
  - mild steel
- modes of metal transfers
  - short circuit transfer
- joints
  - square butt groove
- single bevel groove
- single vee-groove
- consumables
  - type
  - size
- shielding gas
  - type
  - flow rate

4.2.3 Perform welds for destructive testing.
[0/6]

- positions
  - 1G flat
  - 2G horizontal
  - 3G vertical

4.2.4 Perform operations for destructive testing.
[0/2]

- remove backing
- grind surfaces
- layout coupons
- cut coupons
- grind coupons

4.2.4 Perform destructive testing.
[0/1]

- root bends
- face bends
- side bends
4.3  – Fillet Welds with Flux Cored Arc Welding (FCAW) Practical II

Cross-Reference to Learning Outcomes:

6015.02

Duration:  6 Total Hours  Theory:  1 hours  Practical:  5 hours

General Learning Outcome:

Demonstrate a working knowledge of fillet welding with the Flux Cored Arc Welding (FCAW) process (II).

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

4.3.1  Describe equipment set-up and the process of Flux Cored Arc Welding (FCAW).

- power source
- wire feeder
- shielding gas
- consumables
- safety
- personal protection
- material
- technique
- type of welds

4.3.2  Fillet weld with the Flux Cored Arc Welding (FCAW) process.

- material
  - mild steel
- positions
  - vertical (3F)
- joints
  - lap
  - tee
  - corner
- consumables
- gas shielded
- self shielded
- type
- size
- shielding gas
- type
- flow rate
4.4 – Groove Welds with Flux Cored Arc Welding (FCAW) Practical II

Cross-Reference to Learning Outcomes:

6010.01, .02, .03, .05, .06, .07; 6016.05

Duration: 6 Total Hours  Theory: 1 hours  Practical: 5 hours

General Learning Outcome:

Demonstrate a working knowledge of groove welding with the Flux Cored Arc Welding (FCAW) process (II).

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

4.4.1 Describe equipment set-up and the process of Flux Cored Arc Welding (FCAW).

- power source
- wire feeder
- shielding gas
- consumables
- safety
- personal protection
- material
- technique
- type of welds

4.4.2 Groove weld using the Flux Cored Arc Welding (FCAW) process.

- material
- mild steel
- positions
- horizontal (2G)
- vertical (3G)
- joints
- single bevel groove/backing
- single vee-groove/backing
- consumables
- gas shielded
- self shielded
- type
- size
- shielding gas
- type
- flow rate

4.4.3 Perform welds for destructive testing.
[0/1.5]
- positions
  - 2G horizontal
  - 3G vertical

4.4.4 Perform operations for destructive testing.
[0/1]
- remove backing
- grind surfaces
- layout coupons
- cut coupons
- grind coupons

4.4.5 Perform destructive testing.
[0/.5]
- root bends
- face bends
- side bends

**Evaluation:**

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</table>
Welder – Level II

Number: 5
Title: Gas Tungsten Arc Welding (GTAW) Practical I
Duration: 30 Total Hours

Theory: 3 hours Practical: 27 hours
Prerequisites: Unit 2
Co-requisites: None

5.1 – Gas Tungsten Arc Welding (GTAW) Practical I

30 Total Hours Theory: 3 hours Practical: 27 hours

Cross-Reference to Learning Outcomes:

5.1 – Gas Tungsten Arc Welding (GTAW) Practical I

6009.01, .02, .03, .04

Duration: 30 Total Hours Theory: 3 hours Practical: 27 hours

General Learning Outcome:

Demonstrate a working knowledge of welding with the Gas Tungsten Arc Welding (GTAW) process.

Learning Outcomes:

Upon successful completion, the apprentice is able to:

Learning Content:

5.1.1 Describe equipment set-up and the process of Gas Tungsten Arc Welding (GTAW).

[3/0]

- power source
- equipment
- electrodes
- consumables
- shielding gas
- safety
- personal protection
- material
- technique
- type of welds

5.1.2 Set-up equipment for a variety of Gas Tungsten Arc Welding (GTAW) applications.
[0/3]

- material preparation and fit-up
  - pre-weld cleaning methods
  - position of welding
- equipment setup
  - current type and polarity
  - amperage
  - arc initiation method
- torch setup
  - collect and body
  - nozzle type and size
  - tungsten electrode type and size
- shielding gas
  - type
  - flow rate (imperial and metric)
  - purging
- filler material
  - type (alloy)
  - size

5.1.3 Perform welds using the Gas Tungsten Arc Welding (GTAW) process.
[0/27]

- materials
  - mild steel
  - stainless steel
- fillet welds
  - tee joints in 1F and 2F positions
  - lap joint in 1F and 2F positions
  - open corner joint in 1F and 2F positions
- groove welds
  - square butt in 1G and 2G positions
- single vee in 1G and 2G positions
- perform post weld operations
- prepare completed welds to specifications
- visually inspect finished welds

**Evaluation:**

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Reference Material:


GCIL Learning Modules 1 to 23, Gooderham Centre for Industrial Learning

Blueprint Reading for Welders, A. E. Bennett


ILM Alberta Learning Module