



# Prince Edward Island Technology Education Curriculum

Education and Early  
Childhood Development  
English Programs

## Career and Technical Education

**Welding 701A**  
Introduction to  
Welding Technology

# CURRICULUM



2010

**Prince Edward Island Department of Education  
and Early Childhood Development**

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# Welding Technology

## Introduction to Welding (WEL701A)

### Course Description

Introduction to Welding introduces students to tools, equipment, theories, and practices common to the trade. Welding can be a hazardous occupation if you are an unsafe worker; the welding program will therefore have a constant emphasis on safe work habits. Students will develop attention and concentration skills that will allow them to minimize the hazards of the trade; learn to select and use the proper tools to complete welding tasks; learn to safely handle materials related to welding; and be introduced to multiple welding techniques and processes.

### Classroom Component—Suggested time: 18 hours

This component of the curriculum is required to teach the knowledge and skills associated with the learning outcomes of the curriculum.

### Skill Development Component—Suggested time: 92 hours

This component of the curriculum is required by the student to apply the knowledge and develop the skills related to the learning outcomes of the curriculum.

SCO - Identifies the <b>Specific Curriculum Outcome (SCO)</b>	
<p><b>Column 1</b>  <b>SCO - Delineations</b>            Describes what the students are expected to know, be able to do, and value in order to achieve the SCO.            The teacher is responsible for the planning and facilitation of learning as well as the assessment of each SCO - Delineation.</p>	<p><b>Column 2</b>  <b>Student Knowledge, Abilities, and Competencies</b>            Provides clarity to the SCO by describing the <b>knowledge, abilities, and competencies</b> that the students develop. This column is designed to indicate the depth and breadth of the SCO.            It is not necessary to use all of these suggestions or that all of the students be engaged in the same learning activity.</p>
<p><b>Column 3</b>  <b>Teacher Lessons / Demonstrations</b>            Provides suggestions for developing and delivering the content for student learning.</p> <p><b>Student Activities / Assessments</b>            Provides suggestions for creating meaningful activities to allow the student to achieve the <b>SCO</b>.</p>	<p><b>Column 4</b>  <b>Resources</b>            Lists a variety of <b>resources</b> that support the teaching and learning related to the SCO. These resources are suggested to support the teacher in developing an effective instructional package for delivery to the students.</p>

Module 1: Welding Safety (-4 hours Classroom Component)

1. **Students will be able to apply safe work practices and procedures when using welding and cutting equipment.**

*Students will be expected to*

- 1.1 *identify physical hazards that are common to welding and cutting equipment*
- 1.2 *identify the use of personal protective equipment for welding and cutting operations*
- 1.3 *identify fire hazards and methods of fire prevention*
- 1.4 *explain the hazards involved with welding fumes and gases*
- 1.5 *identify welding fume ventilation methods*
- 1.6 *identify personal protective equipment for hazardous and toxic materials*
- 1.7 *explain the effects of electricity and precautions used to prevent injury*

Module 2: Hand Tools (-2 hours Classroom Component)

2. **Students will be able to demonstrate the proper and safe use of hand tools.**

*Students will be expected to*

- 2.1 *describe safety precautions for hand tools*
- 2.2 *identify layout and measuring tools and their uses*
- 2.3 *identify clamping tools and their uses*
- 2.4 *identify cutting tools and their uses*
- 2.5 *identify other hand tools used by welders*

Module 3: Oxyfuel Cutting (-8 hours Classroom Component)

3. **Students will be able to perform oxyfuel cutting.**

*Students will be expected to*

- 3.1 *demonstrate the ability to safely operate a hand-held oxyfuel cutting torch on mild steel plate and structural shapes*
- 3.2 *perform straight line, bevel, and shape cutting on mild steel*
- 3.3 *pierce and cut holes in mild steel plate*
- 3.4 *cope 3/8" mild steel to fit a 4" channel member*
- 3.5 *demonstrate the ability to safely operate a cutting machine oxy-fuel torch on mild steel plate*

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Module 4: Shop Lab Practices: SMAW Welds on Mild Steel Plate(-65 of 92 hours Skill Development Component)

4. Students will be able to perform surface welds in the flat position, and 1F, 2F, 3F, and 1GF welds using SMAW.

*Students will be expected to*

- 4.1 *demonstrate the ability to weld surface welds (stringer beads) in the flat position using E4914, E4310, and E4918 electrodes*
- 4.2 *demonstrate the ability to weld fillet welds in the 1F position using E4310, E4311, E4914, and E4918 electrodes*
- 4.3 *demonstrate the ability to weld fillet welds in the 2F position using E4310, E4311, E4914, and E4918 electrodes*
- 4.4 *demonstrate the ability to weld fillet welds in the 3F position using E4310, E4311, E4914, and E4918 electrodes*
- 4.5 *describe guided bend tests*
- 4.6 *demonstrate the ability to weld groove welds on butt joints in the 1G position, root pass using E4310 or E4311, and fill and cap using E4918 filler material*
- 4.7 *demonstrate the ability to weld groove welds on butt joints in the 1G position using E4918 filler material complete with 1/4" backing plate*

Module 5 : Fractions (-4 hours Classroom Component)

5. Students will be able to solve problems involving fractions.

*Students will be expected to*

- 5.1 *identify key terms and concepts used in working with fractions*
- 5.2 *change fractions to a common denominator*
- 5.3 *solve problems using whole numbers and fractions*
- 5.4 *solve problems using whole numbers and fractions in practical applications*



# Welding Safety

(~4 hours Classroom Component)

## Introduction

Welding can be a hazardous occupation. Safety precautions must be followed to minimize the hazards when cutting, welding, and fabricating. Developing the proper attitudes about safety and maintaining a safe working environment are the responsibility of both the employer and the employee.

## Specific Curriculum Outcome

1. Students will be able to apply safe work practices and procedures when using welding and cutting equipment

## SCO - Delineations

*Students will be expected to*

- 1.1 *identify physical hazards that are common to welding and cutting equipment*
- 1.2 *identify the use of personal protective equipment for welding and cutting operations*
- 1.3 *identify fire hazards and methods of fire prevention*
- 1.4 *explain the hazards involved with welding fumes and gases*
- 1.5 *identify welding fume ventilation methods*
- 1.6 *identify personal protective equipment for hazardous and toxic materials*
- 1.7 *explain the effects of electricity and precautions used to prevent injury*

## Assessment Strategies

Paper/Pencil  
Self/Peer-Assessments  
Skills Performance  
Teacher Observation  
Career Portfolio

## Resources

Alberta Module 120101c, *Welding Safety*  
National Occupational Analysis (NOA), Human Resources and Skills Development Canada (HRSDC): Occupational Analyses Series - *Welder*  
Wall Mountain Company Video Series: *Arc Welding I and II; Torch Cutting*  
StudentsAchieve (<http://sas.edu.pe.ca>)

**Welding Safety (~4 hours Classroom Component)**

SCO 1. Students will be able to apply safe work practices and procedures when using welding and cutting equipment.

**SCO - Delineations**

*Students will be expected to*

- 1.1 **identify physical hazards that are common to welding and cutting equipment**

**Student Knowledge, Abilities, and Competencies**

*Topic: Workshop Orientation*

- Demonstrate a proactive approach to identifying hazards and employing safety equipment.
- Demonstrate an understanding of the shared responsibility for the safety of everyone in the workshop.
- List types of radiant energy hazards.
- Describe visible light rays, and the associated hazards.
- Describe ultraviolet rays, and the associated hazards.
- Describe infrared rays, and the associated hazards.
- Describe the hazards of x-rays and gamma rays, and explain where they are encountered in the welding trade.
- Give causes of temperature extremes in the welding environment.
- List hazards resulting from excessive heat.
- List hazards of exposure to excessive cold.
- Identify types of burns associated with welding operations.
- Explain first-aid procedures for burns.
- Describe how hot metal should be identified in a welding facility.
- Explain the hazards of frostbite and hypothermia, and describe the appropriate first-aid procedures.
- List the hazardous noise conditions that are considered major contributors to hearing loss.
- Identify warning signs to remind you to wear hearing protection.
- Identify the unit of sound or noise measurement.
- Identify operations in the welding shop that produce over 100 dB of noise.
- Interpret an occupational noise exposure chart for exposure limits.



## Welding Safety (~4 hours Classroom Component)

SCO 1. Students will be able to apply safe work practices and procedures when using welding and cutting equipment.

### Teacher Lessons / Demonstrations

*Topic: Workshop Orientation*

- Guide students through a “walkabout” around the lab, highlighting all of the safety features (e.g., location of fire extinguishers, fire exits, first-aid kits, PPE).

**As a follow up the next day...**

before the class comes in take the time to stage 10 work site safety problems (e.g., remove the fire exit signs, switch the fire extinguishers).

*Literacy*

- *Anticipation Guide* : Use as a pre-reading strategy to help engage the students and guide the reading of pp. 3-7.

*Numeracy*

- Explain decibel(dB) levels and demonstrate how to interpret noise exposure charts.

*CBL*

- Encourage the students to enrol in an emergency first-aid course.

### Student Activities / Assessments

- Prepare a safety plan to be used in the event of an accident.
- Complete a written test.
- Properly store and identify PPE.
- Draw a detailed floor plan of the lab on grid paper and locate all of the safety areas as defined during the walkabout.

**As a follow up the next day...**

circulate through the lab to identify the work site safety problems staged by the instructor.

### Resources

#### Texts / Teacher Resources

Alberta Module 120101c  
*Welding Safety*  
pp. 3-7

#### Software / Databases

NOA, HRSDC: Occupational  
Analyses Series - *Welder*

StudentsAchieve (SAS)

#### Visuals / Handouts / Tests

Wall Moutain Company Video Series:  
*Arc Welding I and II; Torch Cutting*

## Welding Safety (~4 hours Classroom Component)

SCO 1. Students will be able to apply safe work practices and procedures when using welding and cutting equipment.

### SCO - Delineations

*Students will be expected to*

1.2 identify the use of personal protective equipment for welding and cutting operations

1.3 identify fire hazards and methods of fire prevention

1.4 explain the hazards involved with welding fumes and gases

### Student Knowledge, Abilities, and Competencies

*Topic: Personal Protective Equipment*

- Identify appropriate head protection.
- List four types of eye protection commonly used in the welding trade.
- Describe the features of appropriate safety glasses.
- Explain when a full-face visor should be worn.
- Describe the features and use of welding goggles.
- Describe the features and use of arc welding helmets.
- Demonstrate proper use of head and eye protection at all times.
- Demonstrate the use of protective clothing, welding gloves and safety footwear.
- Demonstrate the use of hearing protection.

*Topic: Fire Hazards*

- Explain the concept of the fire triangle.
- List the four classes of fires (A-D).
- Identify and select the correct fire extinguisher for each type of fire.
- Describe the procedure for using each type of fire extinguisher.
- Survey the work site and identify potential fire hazards.
- Demonstrate proactive measures to avoid fires and heat-related hazards.
- Demonstrate the procedure to follow in the event of an oxyfuel equipment fire.

*Topic: Fumes and Gases*

- Describe welding fumes.
- Describe welding gases.
- Identify three toxic gases created during the welding process.
- Explain the term “carcinogen”.
- Explain the term “metal fume fever”.
- Interpret the fumes and welding gases charts, and identify associated hazards.
- Explain occupational exposure limits, listing three different values that are used for exposure limits.
- Describe the consequences of exposure to hydrogen sulfide gas (H<sub>2</sub>S) and sulphur dioxide gas (SO<sub>2</sub>).

## Welding Safety (~4 hours Classroom Component)

SCO 1. Students will be able to apply safe work practices and procedures when using welding and cutting equipment.

### Teacher Lessons / Demonstrations

#### *Topic: Personal Protective Equipment*

- Demonstrate how to assemble a welding helmet.
- Display a variety of welding shields.
- Discuss the uses of the different shields.

#### *Topic: Fire Hazards*

- Develop a slideshow or create overhead transparencies from the welding graphics CD.

#### *Topic: Fumes and Gases*

- Develop a slide show or create overhead transparencies from the Welding Graphics CD.

#### *Literacy*

- *Anticipation Guide:* Use as a pre-reading strategy to support and guide the reading of pp. 7-21.
- *Think Aloud:* Students may struggle with how to interpret information found in tables. Using a Think Aloud will help the students understand how to read and interpret such information.
- *Say Something:* Students in groups of two or three take turns making a comment about what they are reading.

#### *CBL*

- Organize a demonstration from a local fire department on how to safely extinguish a fire.
- Provide students with information regarding upcoming basic first aid, CPR, and WHMIS training opportunities.

### Student Activities / Assessments

- *Component ID:* Use personal protective equipment, lenses and safety equipment.
- Wear PPE while working in the workshop.
- Break down and reassemble a welding helmet.
- Copy and complete figure 10 in the ILM.
- Prepare a fire safety action plan to follow in the event of a fire.
- Compile a list of fire hazards in the welding facility.

### Resources

#### **Texts / Teacher Resources**

Alberta Module 120101c  
*Welding Safety*  
pp. 7-21

#### **Software / Databases**

NOA, HRSDC: Occupational  
Analyses Series - *Welder*

StudentsAchieve (SAS)

#### **Visuals / Handouts / Tests**

Wall Moutain Company Video Series:  
*Arc Welding I and II; Torch Cutting*

Aberta ILM Graphics CD  
*Welding Period 1*

**Welding Safety (~4 hours Classroom Component)**

SCO 1. Students will be able to apply safe work practices and procedures when using welding and cutting equipment.

**SCO - Delineations**

*Students will be expected to*

1.5 identify welding fume ventilation methods

1.6 identify personal protective equipment for hazardous and toxic materials

1.7 explain the effects of electricity and precautions used to prevent injury

**Student Knowledge, Abilities, and Competencies**

*Topic: Ventilation*

- Demonstrate proper welding position (keeping your head out of the welding plume).
- Demonstrate safe practices in using natural and mechanical ventilation systems.

*Topic: Toxic Materials*

- Identify and select the appropriate face pieces and respirators for various welding operations.
- Demonstrate a face piece fit test.
- Identify the various types of respirators common to the welding trade.

*Topic: Electrical*

- Identify the risk of electrical shock in welding operations.
- List conditions that increase the risk of electrical shock.
- Identify factors affecting the severity of electrical shock.
- List and describe guidelines to follow to avoid electrical shock while using welding equipment and accessories (six categories in table 10).
- Explain the rescue procedures for a victim of electrical shock.
- List steps to follow in providing first aid to a victim of electrical shock.

## Welding Safety (~4 hours Classroom Component)

SCO 1. Students will be able to apply safe work practices and procedures when using welding and cutting equipment.

### Teacher Lessons / Demonstrations

#### *Topic: Ventilation*

- Demonstrate proper set-up and use of the welding fume extractor system.

#### *Topic: Toxic Materials*

- Demonstrate the use of various respirators.
- Develop a slideshow or overheads from the ILM to show the proper fit of a respirator.

#### *Topic: Electrical*

- Discuss how to avoid electrical shock.
- Discuss the importance of proper equipment maintenance.

#### *Literacy*

- *Anticipation Guide:* Use as a pre-reading strategy to support and guide the reading of pp. 22-32.

### Student Activities / Assessments

- Fit respirators for comfort and function.
- Properly use the fume extractor system when working on welding and cutting projects.
- Develop a “Hot Work Area Checklist” to refer to prior to using welding or cutting equipment.
- Develop procedures to follow when marking and identifying hot metal.

### Resources

#### **Texts / Teacher Resources**

Alberta Module 120101c  
*Welding Safety*  
pp. 22-32

#### **Software / Databases**

NOA, HRSDC: Occupational  
Analyses Series - *Welder*

StudentsAchieve (SAS)

#### **Visuals / Handouts / Tests**

Wall Moutain Company Video Series:  
*Arc Welding I and II; Torch Cutting*

Aberta ILM Graphics CD  
*Welding Period 1*



# Hand Tools

(~2 hours Classroom Component)

**Introduction** Hand tools are used by welders to perform a wide range of tasks. The proper selection and safe use of hand tools are essential skills for every welder—to ensure that a job is done effectively and efficiently.

**Specific Curriculum Outcome** 2. Students will be able to demonstrate the proper and safe use of hand tools.

SCO - Delineations *Students will be expected to*

- 2.1 *describe safety precautions for hand tools*
- 2.2 *identify layout and measuring tools and their uses*
- 2.3 *identify clamping tools and their uses*
- 2.4 *identify cutting tools and their uses*
- 2.5 *identify other hand tools used by welders*

**Assessment Strategies** Paper/Pencil  
Self/Peer-Assessments  
Skills Performance  
Teacher Observation  
Career Portfolio

**Resources** Alberta Module 120101d, *Hand Tools*  
National Occupational Analysis (NOA), Human Resources and Skills Development Canada (HRSDC): Occupational Analyses Series - *Welder*  
Wall Mountain Company Video Series: *Arc Welding I and II; Torch Cutting*  
StudentsAchieve (<http://sas.edu.pe.ca>)

## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

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### SCO - Delineations

*Students will be expected to*

2.1 describe safety precautions for hand tools

### Student Knowledge, Abilities, and Competencies

*Topic: Safety*

- Identify safety hazards that relate to the workspace and the use of hand tools.
- Demonstrate an understanding of safe work practices and safety hazards for each of the following categories of hand tools:
  - hammers
  - screwdrivers
  - chisels
  - punches
  - files
  - hacksaws
  - wrenches
  - metal cutting snips and shears
- Demonstrate the ability to select the right tool for a particular job.
- Demonstrate the ability to properly care for the tools listed above.



## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

### Teachers Lessons / Demonstrations

*Topic: Safety*

- Develop a pre-test with a slide show of all the tools in your shop (e.g., matching test).
- Use the supporting graphics CD for images of tools.
- Demonstrate the safe and proper care of each of the tools listed.

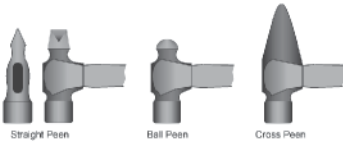
*Literacy*

- *Anticipation Guide:* Use this tool as a pre-reading strategy for each of the outcomes in this module.

### Student Activities / Assessments

\*\* Note: This activity is designed to be a 5-min daily activity for each student until they have gone through the entire tool box. Instructor should have a master list for easy evaluation.\*\*

- Select a tool from a tool box that contains 25 to 30 various hand tools common to the welding industry. Copy and complete the table shown below.

<p><b><u>Supporting Detail</u></b></p> <p>The peen of the hammer is used for riveting work and some shaping of metal</p>	<p><b><u>Supporting Resource</u></b></p> <p>ILM Hand Tools . Pg 35</p>
<p><i>Hand Tool Name</i></p> <p><b>Peening Hammer</b></p>	
<p><b><u>Supporting Detail</u></b></p> <p>The ball peen is the most common, ranging in size from 55 g to 1400 g. The smaller sizes are used for layout work and the larger sizes are used more in general fabrication work.</p>	<p><b><u>Supporting Sketch</u></b></p>  <p style="font-size: small; text-align: center;">Straight Peen      Ball Peen      Cross Peen</p>

*Literacy*

- *Component Guide:* Use as a during-reading strategy. Create a web that helps you to categorize hand tools.

### Resources

#### Texts / Teacher Resources

Alberta Module 120101d  
*Hand Tools*  
pp. 2-3

#### Software / Databases

NOA, HRSDC: Occupational Analyses Series - *Welder*

StudentsAchieve (SAS)

#### Visuals / Handouts / Tests

Wall Mountain Company Video Series:  
*Arc Welding I and II; Torch Cutting*

Aberta ILM Graphics CD  
*Welding Period 1*

## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

### SCO - Delineations

*Students will be expected to*

- 2.2 **identify layout and measuring tools and their uses**

### Student Knowledge, Abilities, and Competencies

*Topic: Layout and Measuring Tools*

- Identify and describe three general categories of measuring and layout tools.
- Interpret measurements from common rules in metric (millimetres) and imperial (inches) measure.
- Perform measurements to an accuracy of 1/64" of an inch.
- Describe the function of straightedges.
- Compare and contrast short-line tapes and long-line tapes.
- Identify and describe the function of each of the following layout tools:
  - carpenter square
  - try square
  - combination square
  - steel ruler
  - square head
  - bevel protractor
  - centre head
  - level
  - wraparound
  - contour marker
- Demonstrate an understanding of the function of each of the above layout tools.
- Select the proper layout tool for any given job.
- Identify and describe the function of each of the following marking tools:
  - soapstone
  - chalk line
  - scriber
  - dividers
  - trammel point
  - centre punch
  - prick punch
- Demonstrate an understanding of the proper use of each of the above marking tools.
- Select the proper marking tool for any given job.

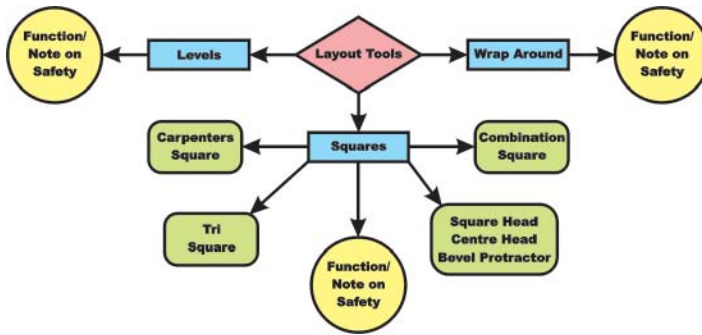
## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

### Teachers Lessons / Demonstrations

*Literacy*

*Component Guide:* Use as a during-reading strategy. Students will create a web that helps them to categorize hand tools.



### Student Activities / Assessments

- Use appropriate measurement and layout tools while completing shop activities.
- Selecting a block from a box that contains a variety of different-sized blocks, students will correctly measure and calculate the following values:
  - overall dimensions
  - volume
  - surface area

#	Overall Dimensions	Volume	Surface Area

### Resources

**Texts / Teacher Resources**

Alberta Module 120101d  
*Hand Tools*  
 pp. 4-16

**Software / Databases**

NOA, HRSDC: Occupational Analyses Series - *Welder*  
 StudentsAchieve (SAS)

**Visuals / Handouts / Tests**

Wall Mountain Company Video Series:  
*Arc Welding I and II; Torch Cutting*

**Hand Tools (~2 hours Classroom Component)**

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

**SCO - Delineations**

*Students will be expected to*

- 2.3 **identify clamping tools and their uses**

**Student Knowledge, Abilities, and Competencies**

*Topic: Clamping Tools*

- Describe the basic purpose of clamping tools.
- Identify and describe the function of each of the following sets of pliers:
  - tongue and groove pliers
  - slip-joint pliers
  - interlocking joint pliers
  - side-cutting pliers
  - needle-nose pliers
  - locking pliers
  - welding pliers
- Demonstrate an understanding of the proper use of each of the above sets of pliers.
- Identify and describe the function of each type of clamp:
  - c-clamps
  - bar clamps
  - spring clamps
  - parallel clamps
  - pipe clamps
  - vises
  - special application vises
  - drill press vises
- Demonstrate an understanding of the proper use of each of the above clamps.

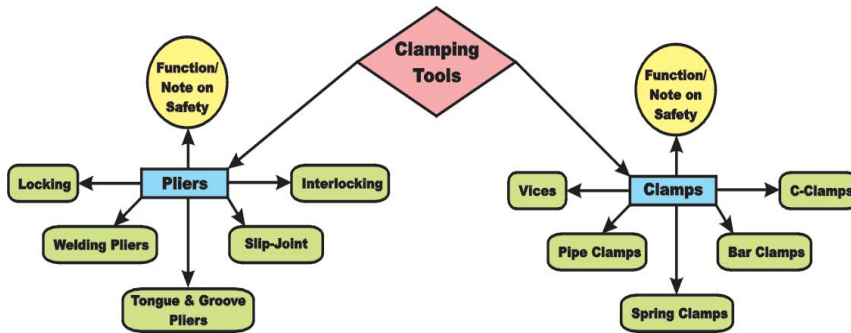
## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

### Teachers Lessons / Demonstrations

#### Literacy

*Component Guide:* Use as a during-reading strategy. Students will create a web that helps them to categorize hand tools



### Student Activities / Assessments

- *Component ID:* Correctly identify clamping tools from a display of all tools in the welding facility.
- Use appropriate clamping tools while completing shop activities.

### Resources

#### Texts / Teacher Resources

Alberta Module 120101d  
*Hand Tools*  
pp. 17-24

#### Software / Databases

NOA, HRSDC: Occupational  
Analyses Series - *Welder*

StudentsAchieve (SAS)

#### Visuals / Handouts / Tests

Wall Mountain Company Video Series:  
*Arc Welding I and II; Torch Cutting*

## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

### SCO - Delineations

*Students will be expected to*

2.4 identify cutting tools and their uses

### Student Knowledge, Abilities, and Competencies

*Topic: Cutting Tools*

- Identify and describe the function of a hacksaw.
- Demonstrate how to properly install a hacksaw blade.
- Set proper blade tension.
- Describe the characteristics of hacksaw blades.
- Define “saw blade pitch”.
- Select the appropriate pitch for any given job.
- Define “kerf”.
- Define “set”.
- Compare the three kinds of set:
  - alternate set
  - raker set
  - undulated set
- Demonstrate an ability to properly and safely perform cutting operations with a hacksaw.
  
- Explain the general classifications of files.
- Identify the parts of a file.
- Identify and describe cutting characteristics for each type of file.
  - single-cut
  - double-cut
  - rasp (bastard cut)
  - curved tooth
- Identify the nine different file shapes most common to industry: flat, half round, hand, knife, pillar, round, square, three-square, and warding.
- Demonstrate the ability to properly care for, handle, and store files.
  
- Identify and describe the functions of chisels.
- Identify the four basic types of chisels:
  - flat (cold) chisel
  - cape chisel
  - round nose chisel
  - diamond point chisel
- Describe the proper function of each of the basic chisel types.
- Demonstrate the ability to properly handle, care for, and safely use chisels.
- Sharpen a chisel.
- Demonstrate an understanding of the safe operation of metal shears.
- Explain the purpose of diagonal pliers and bolt cutters.
- Demonstrate an understanding of the safe operation of hand shears.

## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

### Teachers Lessons / Demonstrations

#### *Topic : Cutting Tools*

- Demonstrate proper care, handling, and storage of hacksaws, files, and punches.
- Demonstrate proper cutting technique and use of hacksaws, files, and punches.

#### *Literacy*

- *Component Guide:* Use as a during-reading strategy. Students can create a web that helps them to categorize hand tools (see examples on previous page).

### Student Activities / Assessments

- *Component ID:* Correctly identify cutting tools from a display of all tools in the welding facility.
- Use cutting tools for their intended function.
- Complete a sample task block using hacksaws, files and punches.
- Use appropriate cutting tools while completing shop activities.

### Resources

#### **Texts / Teacher Resources**

Alberta Module 120101d

*Hand Tools*

pp. 25-33

#### **Software / Databases**

NOA, HRSDC: Occupational Analyses Series - *Welder*

StudentsAchieve (SAS)

#### **Visuals / Handouts / Tests**

Wall Mountain Company Video Series:

*Arc Welding I and II; Torch Cutting*

## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

### SCO - Delineations

*Students will be expected to*

2.5 identify other hand tools used by welders

### Student Knowledge, Abilities, and Competencies

*Topic: Other Hand Tools*

- Identify and describe the function of each type of hammer:
  - peening hammer
    - > straight peen, ball peen, cross peen
  - sledgehammer
  - chipping hammer
- Demonstrate the ability to properly use each of the above hammers.
- Select the proper hammer for a given job.
  
- Identify the various types of screwdriver:
  - Allen
  - torx
  - Robertson
  - Frearson cross slot
  - Phillips cross slot
  - clutch head
  - cabinet
  - standard, keystone, or slotted
- Select the proper screwdriver for a given job.
  
- Identify and describe the function of each of the following punches:
  - pin punch
  - drift punch
  - pinch bar
  - pry bar
- Select the proper punch for a given job.
- Identify and describe the function of each of the following wrenches:
  - box-end wrench
  - open-end wrench
  - combination wrench
  - socket wrench
  - adjustable wrench
  - Allen wrench
  - pipe wrench
  - chain pipe wrenches
  - strap wrench
- Select the proper wrench for a given job.
- Describe the care and function of wire brushes.
- Demonstrate an understanding of the proper care, handling, and maintenance of all hand tools.



## Hand Tools (~2 hours Classroom Component)

SCO 2. Students will be able to demonstrate the proper and safe use of hand tools.

### Teachers Lessons / Demonstrations

*Topic : Other Hand Tools*

- Create a slide-show using the graphics in the ILM and photographs of some of the tools in your welding facility.
- Demonstrate proper care, handling, and storage of tools identified in the second column.

*Literacy*

- *Component Guide:* Use as a during-reading strategy. Students can create a web that helps them to categorize hand tools (see examples on previous page)

### Student Activities / Assessments

- *Component ID:* Correctly identify tools from a display of all tools in the welding facility.
- Use all hand tools for their intended function.
- Use appropriate hand tools while completing shop activities.

### Resources

#### Texts / Teacher Resources

Alberta Module 120101d

*Hand Tools*

pp. 34-44

#### Software / Databases

NOA, HRSDC: Occupational Analyses Series - *Welder*

StudentsAchieve (SAS)

#### Visuals / Handouts / Tests

Wall Moutain Company Video Series:

*Arc Welding I and II; Torch Cutting*

Aberta ILM Graphics CD

*Welding Period 1*



# Oxyfuel Cutting

(~8 hours Classroom Component)

**Introduction** Apprentices are expected to have a strong working knowledge and high skill level when using oxyfuel cutting equipment. The oxyfuel cutting process is used to prep materials for welding procedures and fabrication needs.

## Specific Curriculum Outcome

3. Students will be able to perform oxyfuel cutting.

SCO - Delineations *Students will be expected to*

- 3.1 *demonstrate the ability to safely operate a hand-held oxyfuel cutting torch on mild steel plate and structural shapes*
- 3.2 *perform straight line, bevel, and shape cutting on available mild steel*
- 3.3 *pierce and cut holes in mild steel plate*
- 3.4 *cope 3/8" mild steel to fit a 4" channel member*
- 3.5 *demonstrate the ability to safely operate a cutting machine oxyfuel torch on mild steel plate*

## Assessment Strategies

Paper/Pencil  
Self/Peer-Assessments  
Skills Performance  
Teacher Observation  
Career Portfolio

## Resources

Alberta Module 120101i, *Oxy-Fuel Cutting*  
National Occupational Analysis (NOA), Human Resources and Skills Development Canada (HRSDC): Occupational Analyses Series - *Welder*  
Wall Mountain Company Video Series: *Arc Welding I and II; Torch Cutting*  
StudentsAchieve (<http://sas.edu.pe.ca>)

## Oxyfuel Cutting (~8 hours Classroom Component)

SCO 3. Students will be able to perform oxyfuel cutting.

### SCO - Delineations

*Students will be expected to*

- 3.1 demonstrate the ability to safely operate a hand-held oxyfuel cutting torch on mild steel plate and structural shapes

### Student Knowledge, Abilities, and Competencies

*Topic: Safety and Principles of Operation*

- Describe the cutting process of rapid oxidation.
- Define “drag”, “heat energy”, “kerf”, “kerf lines”, “torch inclination”.
- Determine problems with cutting speed by visually inspecting kerf lines.
- Identify the gases used for oxyfuel cutting.
- Describe the characteristics of the gases used for oxyfuel cutting.
- Identify and describe the functions of the three types of torches.
- Identify and describe two types of mixing systems on hand torches.
- Identify and describe tracing systems for machine cutting equipment.
- Identify the four basic types of tips and state their basic functions.
  - straight tip
  - scarfing tip
  - gouging tip
  - heavy duty rivet/bolt tip
- Identify factors that will determine which tip to select.
- Demonstrate the proper method for cleaning the tip.
- Demonstrate the ability to properly light the torch.
- Identify problems with the preheat flames and cutting jet stream.
- Describe how to start a cut.
- Demonstrate the proper torch inclination for the gauge of material being cut.
- Demonstrate and describe two methods of piercing a hole through solid plate.
- Describe the process of stack cutting.
- Explain why metals such as cast iron, stainless steel, and non-ferrous metals are difficult to cut using an oxyfuel system.
- Identify and explain corrective measures for common cutting faults.

## Oxyfuel Cutting (~8 hours Classroom Component)

SCO 3. Students will be able to perform oxyfuel cutting.

### Teacher Lessons / Demonstrations

*Topic: Safety and Principles of Operation*

- Show chapters 1-13 of the torch cutting DVD.
- Demonstrate the proper use of the oxyfuel equipment.
- Have examples of different tips/torches/tanks/regulators on display for the students to see while you describe the function of each.
- Demonstrate how to properly clean a tip.
- Demonstrate how to safely and properly light the torch.
- Demonstrate how to properly balance the torch and achieve a neutral flame.
- Demonstrate how to perform a basic straight line cut on mild steel plate.

*Literacy*

- *Anticipation Guide:* Use as a pre-reading strategy for pp. 2-23.

### Student Activities / Assessments

*Literacy*

- *Vocabulary Development* - use as a during reading strategy for pp. 2-14.

<u>Term / Component</u>	<u>Visual Representation</u>
<i>Kerf</i>	<i>Draw image here. (could be multiple examples)</i>
<u>Definition / Function</u> <i>Describes the cut gap or the width of the cut produced during the cutting process.</i>	

(continued on page 29)

### Resources

#### Texts / Teacher Resources

Alberta Module 120101i  
*Oxyfuel Cutting*  
pp. 2-3

*Cross-Curricular Reading Tools*

#### Software / Databases

NOA, HRSDC: Occupational Analyses Series - *Welder*

StudentsAchieve (SAS)

#### Visuals / Handouts / Tests

Wall Mountain Company Video Series:  
*Arc Welding I and II; Torch Cutting*

## Oxyfuel Cutting (~8 hours Classroom Component)

SCO 3. Students will be able to perform oxyfuel cutting.

### SCO - Delineations

*Students will be expected to*

- 3.1 demonstrate the ability to safely operate a hand-held oxyfuel cutting torch on mild steel plate and structural shapes

(continued from page 26)

### Student Knowledge, Abilities, and Competencies

*Topic: Safety and Principles of Operation*

- Describe the cutting process of rapid oxidation.
- Define “drag”, “heat energy”, “kerf”, “kerf lines”, “torch inclination”.
- Determine problems with cutting speed by visually inspecting kerf lines.
- Identify the gases used for oxyfuel cutting.
- Describe the characteristics of the gases used for oxyfuel cutting.
- Identify and describe the functions of the three types of torches.
- Identify and describe two types of mixing systems on hand torches.
- Identify and describe tracing systems for machine cutting equipment.
- Identify the four basic types of tips and state their basic functions.
  - straight tip
  - scarfing tip
  - gouging tip
  - heavy duty rivet/bolt tip
- Identify factors that will determine which tip to select.
- Demonstrate the proper method for cleaning the tip.
- Demonstrate the ability to properly light the torch.
- Identify problems with the preheat flames and cutting jet stream.
- Describe how to start a cut.
- Demonstrate the proper torch inclination for the gauge of material being cut.
- Demonstrate and describe two methods of piercing a hole through solid plate.
- Describe the process of stack cutting.
- Explain why metals such as cast iron, stainless steel, and non-ferrous metals are difficult to cut using an oxyfuel system.
- Identify and explain corrective measures for common cutting faults.

## Oxyfuel Cutting (~8 hours Classroom Component)

SCO 3. Students will be able to perform oxyfuel cutting.

(continued from page 27)

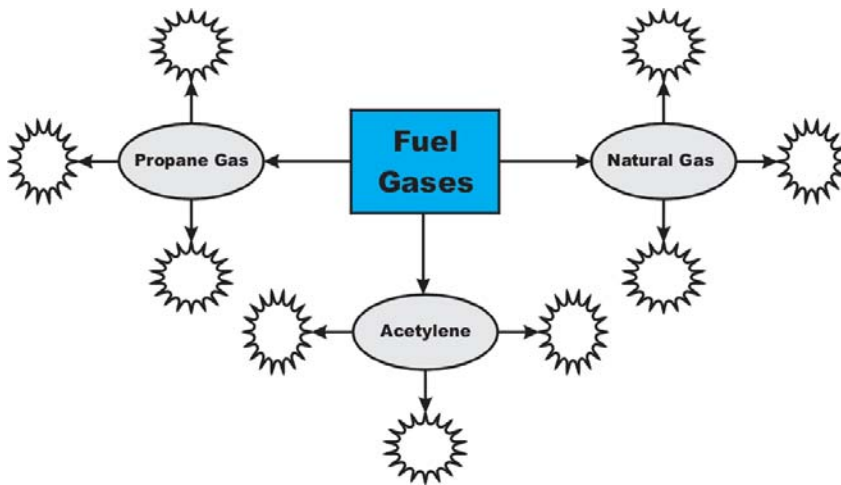
### Teacher Lessons / Demonstrations

### Student Activities / Assessments

- Properly clean and identify various torch tips.
- Select the proper tip for any given cutting operation.
- Safely fire up and shut down the torch assembly.
- Wear appropriate PPE.
- Complete worksheets on how to start up and shut down torches.
- Complete worksheets on how to start a cut.

### Literacy

- *Component Web:* Use as a during-reading strategy to summarize the various fuel gases and their intended use. Create the web using Inspiration software if available.



### Resources

#### Texts / Teacher Resources

Alberta Module 120101i  
*Oxyfuel Cutting*  
pp. 2-23

*Cross-Curricular Reading Tools*

#### Software / Databases

NOA, HRSDC: Occupational  
Analyses Series - *Welder*

StudentsAchieve (SAS)

#### Visuals / Handouts / Tests

Wall Moutain Company Video Series:  
*Arc Welding I and II; Torch Cutting*

## Oxyfuel Cutting (~8 hours Classroom Component)

SCO 3. Students will be able to perform oxyfuel cutting.

### SCO - Delineations

*Students will be expected to*

- 3.2 perform straight line, bevel, and shape cutting on mild steel
- 3.3 pierce and cut holes in mild steel plate
- 3.4 cope 3/8" mild steel to fit a 4" channel member
- 3.5 demonstrate the ability to safely operate a cutting machine oxyfuel torch on mild steel plate

### Student Knowledge, Abilities, and Competencies

*Topic: Cutting Methods*

- Demonstrate and describe the three common methods of controlling the cutting torch:
  - across cut
  - push cut
  - pull cut
- Demonstrate the ability to select and wear the appropriate personal protective equipment.



## Oxyfuel Cutting (~8 hours Classroom Component)

SCO 3. Students will be able to perform oxyfuel cutting.

### Teacher Lessons / Demonstrations

- Demonstrate each of the shop projects covered in the ILM.

### Student Activities / Assessments

- Practise cutting various thicknesses of metal plate.
- Square cut freehand on 3/8" mild steel plate.
- Pierce holes on 3/8" mild steel plate.
- Practise safe work habits and explain the procedures, both verbally and in writing.
- Complete shop projects of Oxyfuel Cutting ILM (pp. 25-28).

### Resources

#### Texts / Teacher Resources

Alberta Module 120101i

*Oxyfuel Cutting*

pp. 24-28

*Cross-Curricular Reading Tools*

#### Software / Databases

NOA, HRSDC: Occupational Analyses Series - *Welder*

StudentsAchieve (SAS)

#### Visuals / Handouts / Tests

Wall Mountain Company Video Series:

*Arc Welding I and II; Torch Cutting*



# Shop/Lab Practices: SMAW Welds on Mild Steel Plate

(~65 of 92 hours Skill Development Component)

**Introduction** A welder apprentice must be able to perform SMAW welds to an acceptable standard. This module is a hands-on practical module that will develop the student's ability to perform SMAW welds on mild steel plate.

## Specific Curriculum Outcome

4. Students will be able to perform surface welds in the flat position and 1F, 2F, 3F, 1G, and 1GF welds using SMAW.

## SCO - Delineations

*Students will be expected to*

- 4.1 *demonstrate the ability to weld surface welds (stringer beads) in the flat position using E4914, E4310, and E4918 electrodes*
- 4.2 *demonstrate the ability to weld fillet welds in the 1F position using E4310, E4311, E4914, and E4918 electrodes*
- 4.3 *demonstrate the ability to weld fillet welds in the 2F position using E4310, E4311, E4914, and E4918 electrodes*
- 4.4 *demonstrate the ability to weld fillet welds in the 3F position using E4310, E4311, E4914, and E4918 electrodes*
- 4.5 *describe guided bend tests*
- 4.6 *demonstrate the ability to weld groove welds on butt joints in the 1G position, root pass using E4310 or E4311, and fill and cap using E4918 filler material*
- 4.7 *demonstrate the ability to weld groove welds on butt joints in the 1G position using E4918 filler material complete with 1/4" backing plate*

## Assessment Strategies

Paper/Pencil  
Self/Peer-Assessments  
Skills Performance  
Teacher Observation  
Career Portfolio

## Resources

Alberta Module 120102d, *Shop/Lab Practices: SMAW Welds on Mild Steel Plate*  
National Occupational Analysis (NOA), Human Resources and Skills Development Canada (HRSDC): Occupational Analyses Series - *Welder*  
Wall Mountain Company Video Series: *Arc Welding I and II; Torch Cutting*  
StudentsAchieve (<http://sas.edu.pe.ca>)

**Shop/Lab Practices: SMAW Welds on Mild Steel Plate (~65 of 92 hours Skill Development Component)**

SCO 4. Students will be able to perform surface welds in the flat position and 1F, 2F, 3F, 1G, and 1GF welds using SMAW.

**SCO - Delineations**

*Students will be expected to*

- 4.1 demonstrate the ability to weld surface welds (stringer beads) in the flat position using E4914, E4310, and E4918 electrodes
- 4.2 demonstrate the ability to weld fillet welds in the 1F position using E4310, E4311, E4914, and E4918 electrodes
- 4.3 demonstrate the ability to weld fillet welds in the 2F position using E4310, E4311, E4914, and E4918 electrodes

**Student Knowledge, Abilities, and Competencies**

*Topic: Practice Welds*

- Define “welding technique”.
- Assess the value of a welding technique based on requirements of any given job.
- Demonstrate an understanding and application of the following terms prior to performing any of the projects in the module:
  - cover pass
  - electrode angle
  - electrode inclination
  - fill pass and finish pass
  - fillet weld
  - groove weld
  - manipulative welding technique
  - polarity
  - plane
  - post-heat treatment
  - preheat
  - root face
  - root pass
  - stringer bead
  - stringer padding
  - stringer fill
  - tack weld
  - weave bead
  - weave padding
  - weave techniques
  - weld procedure specifications
- Interpret Welding Procedure Specification (WPS) sheets.
- Set the appropriate current and polarity for the electrode being used.
- Describe how to perform a polarity check.
- Demonstrate the two basic methods used to start an arc:
  - tapping method
  - scratch method
- Demonstrate the proper method of restarting an arc.
- Describe the crucible cup effect.
- Describe the effect that arc length has on a weld.
- Perform a visual weld inspection, looking for the following characteristics:
  - weld size
  - weld uniformity
  - weld contour
  - absence of weld defects
  - good penetration, fusion, and tie-ins
  - joint alignment

**Shop/Lab Practices: SMAW Welds on Mild Steel Plate (~65 of 92 hours Skill Development Component)**

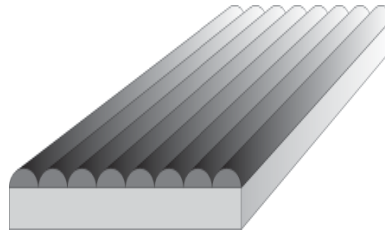
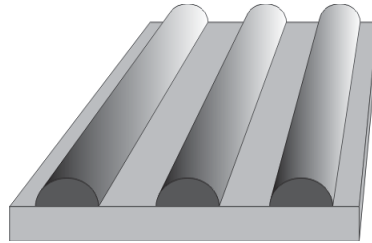
SCO 4. Students will be able to perform surface welds in the flat position and 1F, 2F, 3F, 1G, and 1GF welds using SMAW.

**Teacher Lessons / Demonstrations**

- Create a slideshow from the graphics CD.
- Show *Arc Welding I* (video).
- Develop a worksheet that goes along with the video.
- Demonstrate each of the exercises covered in the ILM.

**Student Activities / Assessments**

- Create a Welding Procedure Specification sheet (WPS) for all shop projects.
- Complete the exercises on pp. 18-34 of *Shop/Lab Practices: SMAW Welds on Mild Steel Plate*.
- Using 3/16" mild steel plate, run 3 stringer beads. Beads must be straight, with no splatter or imperfections, two or three times the width of the electrode.
- Complete a padding on 1/4" mild steel plate 3" x 6".
  - > entirely cover plate
  - > 1/3" to 1/2" overlap.



**Resources**

**Texts / Teacher Resources**

Alberta Module 120102d  
*Shop/Lab Practices: SMAW Welds on Mild Steel Plate*  
pp. 5-27

**Software / Databases**

NOA, HRSDC: Occupational Analyses Series - *Welder*

StudentsAchieve (SAS)

**Visuals / Handouts / Tests**

Wall Mountain Company Video Series: *Arc Welding I and II; Torch Cutting*

Aberta ILM Graphics CD  
*Welding Period 1*

*Literacy*

- *Vocabulary Development:* Use as a during-reading strategy. Complete a table similar to that below, defining key terms selected from the text.

<u>Term</u>	<u>Visual Representation</u>
<i>Cover Pass</i>	<i>Draw image here. (could be multiple examples)</i>
<u>Function</u> <i>Intended to eliminate undercut and produce a finish that is pleasing to the eye.</i>	

**Shop/Lab Practices: SMAW Welds on Mild Steel Plate (~65 of 92 hours Skill Development Component)**

SCO 4. Students will be able to perform surface welds in the flat position and 1F, 2F, 3F, 1G, and 1GF welds using SMAW.

**SCO - Delineations**

*Students will be expected to*

- 4.4 demonstrate the ability to weld fillet welds in the 3F position using E4310, E4311, E4914, and E4918 electrodes
- 4.5 describe guided bend tests
- 4.6 demonstrate the ability to weld groove welds on butt joints in the 1G position, root pass using E4310 or E4311, and fill and cap using E4918 filler material
- 4.7 demonstrate the ability to weld groove welds on butt joints in the 1G position using E4918 filler material complete with 1/4" backing plate

**Student Knowledge, Abilities, and Competencies**

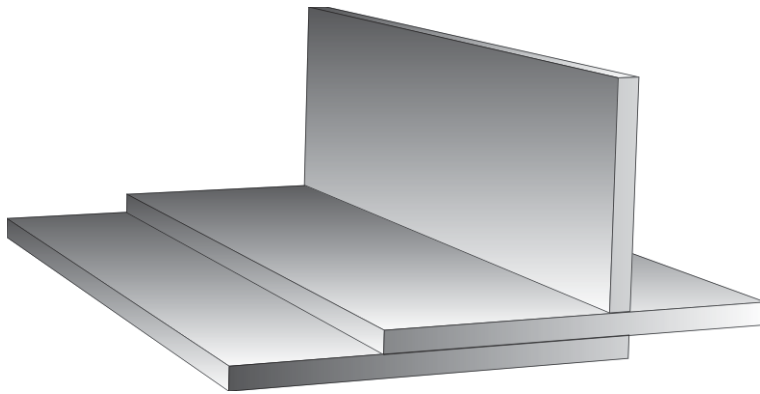
- Prepare a test coupon for a guided bend test.
- Complete the exercises on pp. 40-48 of *Shop/Lab Practices: SMAW Welds on Mild Steel Plate*.
- Perform a visual weld inspection looking for the following characteristics:
  - weld size
  - weld uniformity
  - weld contour
  - absence of weld defects
  - good penetration, fusion, and tie-ins
  - joint alignment

**Shop/Lab Practices: SMAW Welds on Mild Steel Plate (~65 of 92 hours Skill Development Component)**

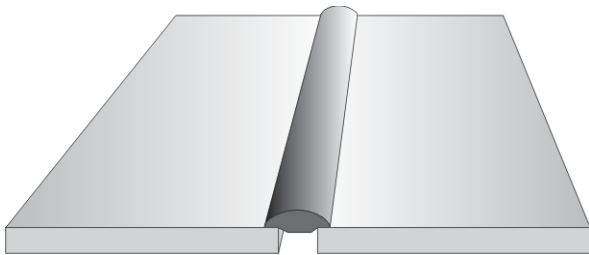
SCO 4. Students will be able to perform surface welds in the flat position and 1F, 2F, 3F, 1G, and 1GF welds using SMAW.

**Teacher Lessons / Demonstrations****Student Activities / Assessments**

- Prepare a test coupon for a guided bend test.
- Perform fillet welds on the following coupon:
  - 1F
  - 2F
  - 3F



- Perform an open root butt joint in the 1G position.

**Resources****Texts / Teacher Resources**

Alberta Module 120102d  
*Shop/Lab Practices: SMAW Welds on Mild Steel Plate*  
 pp. 28-48

**Software / Databases**

NOA, HRSDC: Occupational Analyses Series - *Welder*

StudentsAchieve (SAS)

**Visuals / Handouts / Tests**

Wall Moutain Company Video Series:  
*Arc Welding I and II; Torch Cutting*





# Fractions

(~4 hours Classroom Component)

## Introduction

Tradespeople need to be fluent in the language of mathematics. Measurements rarely work out to be perfect whole numbers, so apprentices need to be familiar with fractions and know how to interpret and manipulate them.

## Specific Curriculum Outcome

5. Students will be able to solve problems involving fractions.

### SCO - Delineations

*Students will be expected to*

5.1 *identify key terms and concepts used in working with fractions*

5.2 *change fractions to a common denominator*

5.3 *solve problems using whole numbers and fractions*

5.4 *solve problems using whole numbers and fractions in practical applications*

## Assessment Strategies

Paper/Pencil  
Self/Peer-Assessments  
Skills Performance  
Teacher Observation  
Career Portfolio

## Resources

Alberta Module 120104a, *Fractions*  
StudentsAchieve (<http://sas.edu.pe.ca>)

## Fractions (~4 hours Classroom Component)

SCO 5. Students will be able to solve problems involving fractions.

### SCO - Delineations

*Students will be expected to*

- 5.1 identify key terms and concepts used in working with fractions
- 5.2 change fractions to a common denominator
- 5.3 solve problems using whole numbers and fractions
- 5.4 solve problems using whole numbers and fractions in practical applications

### Student Knowledge, Abilities, and Competencies

*Topic: Terminology*

- Define the following terms related to fractions:
  - terms
  - numerator
  - denominator
  - fraction
  - proper fraction
  - improper fraction
  - mixed numbers
  - common denominator common factor equivalent fractions
  - prime number
  - reciprocals

*Topic: Common Denominator*

- Describe how to find a common denominator.
- Define “lowest common denominator”.
- Explain why we use common denominators for addition and subtraction.

*Topic: Problem Solving*

- Define “equivalent fractions”.
- Describe how to find equivalent fractions.
- Arrange fractions in order from least to greatest, greatest to least.
- Determine the lowest term of a fraction.
- Express a mixed number as an improper fraction.
- Express an improper fraction as a mixed number.
- Multiply fractions.
- Divide fractions.
- Add fractions.
- Subtract fractions.
- Use fractions in real-world applications.

## Fractions (~4 hours Classroom Component)

SCO 5. Students will be able to solve problems involving fractions.

### Teacher Lessons / Demonstration

#### Literacy

- *Anticipation Guide:* Use as a pre-reading strategy to help determine what the students already know about fractions.

#### Numeracy

\*\*The following model is a 7-step pedagogical model for teaching embedded math concepts in technical education.\*\*

#### 1. Introduce Technical Lesson

*Topic: Weld Layouts*

- Explain the technical lesson.
- Identify the math embedded in the lesson.

#### 2. Assess students' math awareness

- Use a formative assessment.
- Determine whether students use the correct mathematical terms when discussing the lesson topic (e.g., inch, millimetre).
- Use a variety of questioning /discussion techniques to determine students' math awareness.

#### 3. Work through math problems related to the technical lesson.

*Use sample problems from ILM, pp. 26-39.*

- Connect the technical vocabulary to the math vocabulary and gradually integrate the two, being careful to not abandon either set.

#### 4. Work through related contextual examples.

- Provide examples related to weld layouts.
- Use examples with varying levels of difficulty.
- Continue to bridge the gap between the technical concept and the math skills.
- Check for understanding.

#### 5. Work through traditional math examples.

- Provide students with an opportunity to practise, using a worksheet or basic math problems as they would appear on a test.
- Move from basic to advanced examples.
- Check for understanding.

#### 6. Have students demonstrate understanding.

- Provide students with the opportunity to relate the math concept back to the context of welding.
- Conclude the math examples in the context of the technical lesson.

#### 7. Use a formal Assessment

- Include math problems in formal assessments of the technical lesson.

### Student Activities / Assessments

*Complete exercises on p. 5 of ILM 1210104a.*

*Complete all exercises in objectives 3 and 4 of ILM 120104a.*

### Resources

#### Texts / Teacher Resources

Alberta Module 120104a

*Fractions*

pp. 2-34

PEI Department of Education and Early Childhood Development—

*Applied Mathematics* (MAT801A)

#### Software / Databases

StudentsAchieve (SAS)

