

Lesson Three – Weld Techniques

Lesson Overview

Making a good weld takes practice. There are a lot of tips and tricks that students will acquire along the way. This lesson teaches students the five essentials to making a good weld. Students should think about these before and during a weld, and then reflect on them while inspecting their weld bead.

Lesson Objectives

After completing this lesson, participants will be able to:

- Understand the standard requirements in the five essentials to making a good weld: heat, distance, angle, speed, and manipulation

Lesson at a Glance

Activity	Materials	Preparation	Approximate class time
FOCUS	• Whiteboard and markers • Common Welding Joints Kit • Common Welding Joints Flashcards • <i>Weld Parts Guide</i> • <i>Weld Positions Guide</i>	1. Print/photocopy the <i>Weld Parts Guide</i> and the <i>Weld Positions Guide</i> (one per participant).	10 minutes
LEARN	• <i>Welding Basics</i> slide presentation • <i>Welding Basics Student Notes Sheet</i> • <i>Welding Basics Fact Sheet</i>	1. Prepare to show <i>Welding Basics</i> slide presentation. 2. Print/photocopy the <i>Welding Basics Student Notes Sheet</i> and the <i>Welding Basics Fact Sheet</i> (one per participant).	30-40 minutes
REVIEW	• <i>Welding Basics Quiz</i> • <i>Welding Basics Quiz – Answer Key</i>	1. Print/photocopy the <i>Welding Basics Quiz</i> (one per participant).	10-15 minutes

Lesson Three – Weld Techniques

FOCUS: Brainstorming discussion: What does it take to make a good weld?

10 minutes

Purpose:

This activity will begin the discussion of what it takes to make a good weld versus a poor weld. Students will brainstorm an initial list and see if they are right.

Materials:

- Whiteboard and markers
- Common Welding Joints Kit
- Common Welding Joints Flashcards
- *Weld Parts Guide*
- *Weld Positions Guide*

Facilitation Steps:

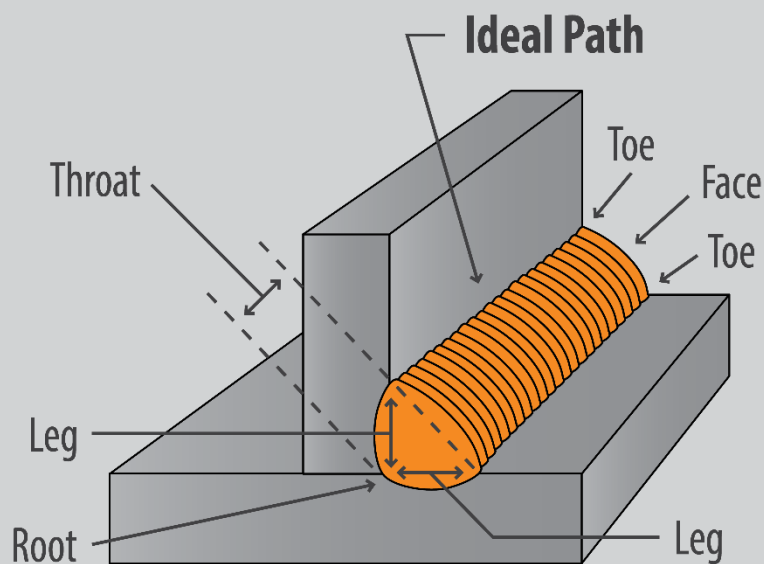
1. Display the Common Welding Joints Kit on a table for students to see the different types of welds that you will be talking about in Lesson 3 and Lesson 4.
2. Optional: Hand welds around so students can touch the different welds and get a good look at welds that have been welded correctly.
3. Hand out the *Weld Parts Guide* and *Weld Positions Guide*.
4. Ask students what makes a good weld versus a poor weld. Write the observations on the board.
5. Tell students that they are going to look at the five basic essentials to making a good weld.

6. Start with the *Weld Parts Guide* and ask students what would be most difficult to weld, in their opinion. Then ask students to brainstorm/discuss what weld positions may be most difficult while referencing the *Weld Positions Guide*.
7. Write the observations from the students on the board.

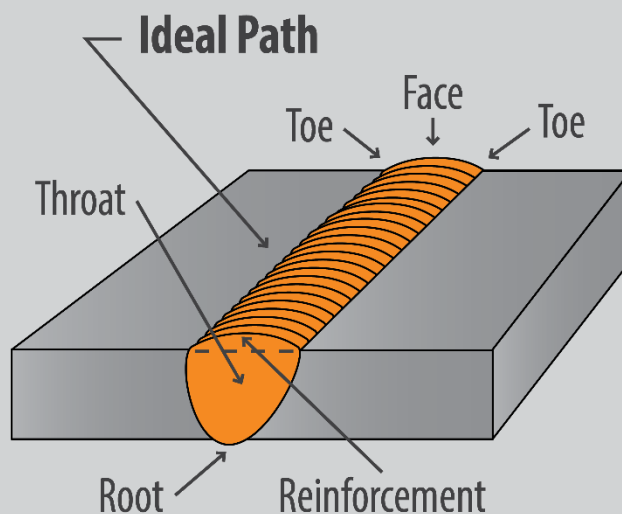
NOTE: Keep/save the observations on the board; you will want to use them to refresh knowledge before the Review section of this lesson.

Weld Parts Guide

Fillet Welds



Groove Welds



Terms & Definitions

Face: The exposed surface of the weld.

Leg: The distance from the root to the toe of the weld.

Reinforcement: Excess filler required to fill the throat of a weld.

Root: The area of the weld or throat opening where the nearest base metals contact is located. This may be a point, line or area.

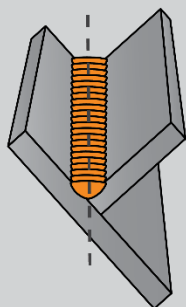
Throat: The open area required to be filled by the weld.

Toe: The intersection between the face of the weld and the base metal.

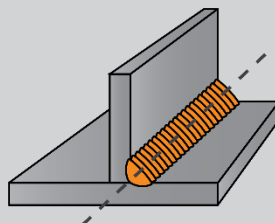
Weld Positions Guide

Fillet Welds

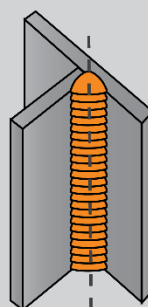
1F
FLAT POSITION



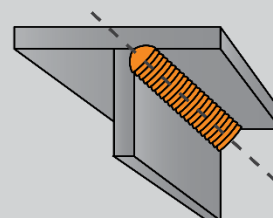
2F
HORIZONTAL POSITION



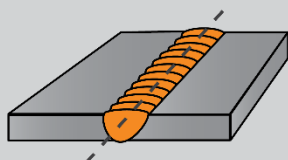
3F
VERTICAL POSITION



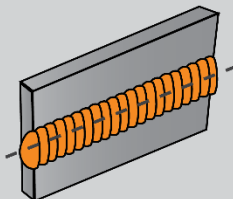
4F
OVERHEAD POSITION



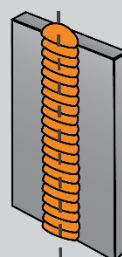
1G
FLAT POSITION



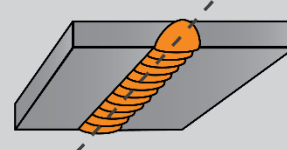
2G
HORIZONTAL POSITION



3G
VERTICAL POSITION

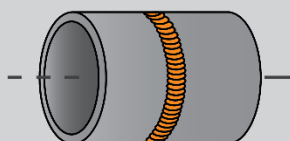


4G
OVERHEAD POSITION

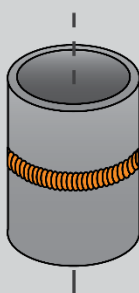


Groove Welds

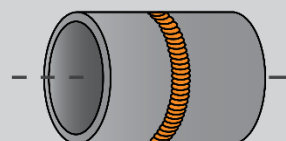
1G FLAT
Pipe is turned or rolled while welding.



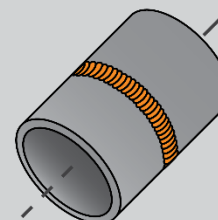
2G HORIZONTAL



5G POSITION
Pipe is not turned or rolled while welding.



6G POSITION



Lesson Three – Weld Techniques

LEARN: Welding Basics

30-40 minutes

Purpose:

The purpose of this activity is to have participants learn the five basics to good GMAW and SMAW welding: heat, distance, angle, speed, and manipulation.

Materials:

- *Welding Basics* slide presentation
- *Welding Basics Student Notes Sheet*
- *Welding Basics Fact Sheet*

Facilitation Steps:

1. Prepare the *Welding Basics* slide presentation for viewing in class. Use the information on the slide presentation as you present to the class.
2. Hand out the *Weld Basics Student Notes Sheet* slide presentation to each student. Students should insert information from the presentations as you discuss. This will help them focus and retain information.
3. Hand out the *Welding Basics Fact Sheet*. This contains all the detailed information from the presentations and is a good reference sheet for students to prepare for the assessment.

Name: _____ Class: _____

Welding Basics Presentation Student Notes Sheet

Five Basics

- 1.
- 2.
- 3.
- 4.
- 5.

Welding Machine Settings

GMAW Settings Troubleshooting

SMAW Settings Troubleshooting

Distance

GMAW Distance

SMAW Distance

Angle

Two types:

-
-

Travel Angle

Work Angle

Speed

Manipulation

Welding Basics Fact Sheet

As you begin your journey as a welder, know that making a good weld takes practice. There are a lot of tips and tricks that you will acquire along the way. This lesson will give you the five essentials to making a good weld. Think about these before and during a weld, and then reflect on them while inspecting your weld bead. These five basics are historically taught for SMAW and GMAW welding.

Five Basics

1. Welding Machine Settings
2. Distance (arc length/wire stick-out)
3. Angle (work and travel)
4. Speed (travel speed)
5. Manipulation

Welding Machine Settings

- How a welding machine is set is imperative to a good weld.
- Observe welding machine settings charts based on material thickness, electrode type, and electrode diameter.
- GMAW welders use volts and wire feed speed settings
- SMAW welders use amperage settings

Distance

- Distance refers to the arc length while welding
- With GMAW, this can mean the distance from the contact tube to the base metal (electrode stick out), but voltage affects arc length while welding
- Distance or arc length is directly related to the heat of the arc
- Lengthening the arc results in hotter arc and a wider, flatter bead
- Shortening the arc results in a cooler arc and a narrower, more built-up bead

GMAW Distance

- Distance refers to the arc length while welding and is directly related to the heat of the arc:
 - Lengthening the arc results in hotter arc and a wider, flatter bead
 - Shortening the arc results in a cooler arc and a narrower, more built-up bead
- The distance from the contact tube of the welding gun to the base metal (electrode “stick out”)
 - Voltage affects arc length while welding

SMAW Distance

- Distance refers to the arc length while welding
 - With SMAW, this means the distance from the electrode’s core wire to the base metal
 - Distance or arc length is directly related to the heat of the arc
 - Lengthening the arc results in hotter arc and a wider, flatter bead
 - Shortening the arc results in a cooler arc and a narrower, more built-up bead

Angle

- There are two types of angles that deal with welding:
- **Work angle** is the angle of the electrode in relation to the weld joint
- **Travel angle** is the angle of the electrode in relation to the direction of travel
- Work angles should be adjusted so there are equal amounts of weld metal on either side of the joint
- Work angles are typically 90 degrees or 45 degrees depending on the joint design and position
- Travel angles typically range 0-30 degrees and can be either a push or drag angle depending on the welding process and position
 - Push angle: top of electrode or torch is tipped away from the direction of travel
 - Pull angle: top of electrode or torch is tipped toward the direction of travel
- Work and travel angles directly affect penetration
- Off-center work angles will result in shallow penetration and the weld metal will penetrate off-center of the joint
 - Too-low travel angles will result in shallow penetration and risk slag inclusions in SMAW

Speed

- Travel speed directly affects penetration and is measured in inches per minute
- Travel speed required is dependent on the electrode type and diameter, joint type and position, and the size of the desired weld, or as specified on a procedure
- **Watch the puddle** to determine travel speed
- Maintain a speed that effectively melts the base metal to the desired depth of penetration and adds weld metal to the desired size
- If the ripple pattern is long and the bead is narrow, the travel speed may be too fast
- If the bead is wide and paired with undercut or overlap, the travel speed may be too slow

Manipulation

- There are many ways in which an electrode can be manipulated
- Welding a straight stringer bead, using little or no manipulation, is ideal
- Unnecessary or improper manipulation techniques may result in:
 - Uneven or excessive heat distribution
 - Uneven penetration
 - Slag inclusions (SMAW)
- Weaving is a very common manipulation technique
- Weaving is used to make bigger welds, usually as a cover pass on top of stringer beads
- Weaving is typically used when welding in the vertical position
- Weaving in the horizontal or overhead position is not recommended (think gravity!)

Lesson Three – Weld Techniques

REVIEW: Welding Basics Quiz

10-15 minutes

Purpose:

To review what students have learned about the five basics to making a good weld.

Materials:

- *Welding Basics Quiz*
- *Welding Basics Quiz – Answer Key*

Facilitation Steps:

1. Remind students of their original answers to the question, “What makes a good weld versus a poor weld?” How did their answers compare to what they learned during the lesson?
2. Hand out the *Welding Basics Quiz*. Give students 10 minutes to complete it in class or assign it to take home and return.
3. Use the *Welding Basics Quiz – Answer Key* to correct the quiz.

Name: _____ Class: _____

Welding Basics Quiz

1. Name the five basics to making a good weld.
 - a.
 - b.
 - c.
 - d.
 - e.
2. Name two types of angles that deal with welding.
 - a.
 - b.
3. What is the typical range in degrees for travel angle?
 - a. 0-45
 - b. 0-30
 - c. 15-30
 - d. 0-90
4. What two travel angle welding methods can GMAW welders use?
 - a.
 - b.
5. Distance is also known as what?
C _____ T _____ W _____ D _____
6. What is speed measured in?
 - a. Inches per foot
 - b. Inches per hour
 - c. Inches per minute
 - d. Feet per hour

7. Unnecessary or improper manipulation techniques may result in:
 - a.
 - b.
8. How do you determine the proper travel speed, beside using an accurate technique?
9. SMAW welding machines use amperage settings for heat. True or False (circle one)
10. The distance from the electrode's core wire in SMAW to the base metal should be about an inch away from each other when welding. True or False (circle one)

Welding Basics Quiz – Answer Key

1. Name the five basics to making a good weld.
a. Heat
b. Distance
c. Angle
d. Speed
e. Manipulation
2. Name two types of angles that deal with welding.
a. Work angle
b. Travel angle
3. What is the typical range in degrees for GMAW travel angle?
a. 0-45
b. 0-30
c. 15-30
d. 0-90
4. What two travel angle welding methods can GMAW welders use?
a. Push
b. Pull ("Drag" also acceptable)
5. Distance is also known as what?
Contact To Work Distance
6. What is speed measured in?
a. Inches per foot
b. Inches per hour
c. Inches per minute
d. Feet per hour
7. Unnecessary or improper manipulation techniques may result in: *(need 2 of the 3 answers)*
a. Uneven or excessive heat distribution
b. Uneven penetration
c. Slag inclusions
8. How do you determine the proper travel speed, beside using an accurate technique?
WATCH THE PUDDLE
9. SMAW welding machines use amperage settings for heat. **True** or False (circle one)
10. The distance from the electrode's core wire in SMAW to the base metal should be about an inch away from each other when welding. True or **False** (circle one)