Department of Education
SPTVE
Shielded Metal Arc Welding (SMAW) 9
Essentials of Welding
Quarter 2: Week 3 Module

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EXPECTATIONS

At the end of the module, you should be able to:

1. identify the 5 essentials of welding;
2. discuss the essentials of welding; and
3. appreciates the essentials of welding.

PRE-TEST

Directions: Read the statement carefully and choose the letter of the correct answer. Use separate paper for your answer sheet.

1. This is the rate at which the electrode moves along the work.
   A. arc length C. electrode size
   B. travel speed D. electrode angle

2. This is used to control the shape of the weld puddle and the amount of penetration.
   A. arc length C. electrode size
   B. travel speed D. electrode angle

3. The distance from the tip of the electrode core wire to the weld puddle.
   A. arc length C. electrode size
   B. travel speed D. electrode angle

4. This measures the amperes, or amps for optimum performance.
   A. current C. electrode size
   B. arc length electrode angle

5. This tells the type, position, preparation of the joint, the ability of the electrode to carry high current values, etc.
   A. arc length C. electrode size
   B. travel speed D. electrode angle

6. If current is too high, the electrode melts too fast and your molten pool is:
   A. large and regular C. small and irregular
   B. small and regular D. large and irregular

7. If the current is too low, there is not enough heat to melt the base metal and your molten pool is:
   A. large and regular C. small and irregular
   B. small and regular D. large and irregular

8. If the arc is too long or voltage too high the metal melts off the electrode giving:
   A. large and regular bead C. spattered and regular bead
   B. large and irregular bead D. spattered and irregular bead

9. If the arc is too short, or voltage too low, there is not enough heat to melt the base metal properly and the electrode quite often sticks to the work, giving:

   A. even bead
   B. uneven bead
   C. regular ripples
   D. irregular ripples with poor fusion

10. If the electrode travels too slow, it gives:
   A. wide weld bead
   B. longer than normal in length
   C. narrow thinner bead deposit
   D. elongated ripples sometimes with undercut

LOOKING BACK

Directions: Complete the table. Use separate sheet of paper for your answer.

	Tensile Strength	Welding Position	Welding Current
1. E7018			AC or DCEP
2. E6010	60,000 psi		
3. E6011		all position	
4. E6012	60,000 psi		
5. E6013			AC, DCEP or DCEN

BRIEF INTRODUCTION

Here are the 5 essentials of shielded metal arc welding:

1. ELECTRODE SIZE

Electrodes for Shielded metal arc welding range in diameter from 3/32 to 3/16 of an inch. You may also come across some ¼ inch electrodes. They are commonly found in 9, 14 and 18-inch lengths.

Electrode diameter is based on the thickness of the base metal, the welding position, and the type of joint to be welded. Larger diameter electrodes are used on thicker metals and for flat position welding because they offer higher deposition rates.

Smaller diameter electrodes are used for horizontal, vertical and overhead welding, because they produce a smaller weld puddle that is easier to control than the bigger puddle produced by larger diameter electrodes.

Joint design also affects electrode diameter. On groove welds for example, the electrode has to be small enough to access the root of the joint. he welder's skill also has a bearing on electrode diameter because a more capable welder can control a larger, more fluid weld puddle.

As a general rule, when there is no welding procedure specification, use the largest diameter electrode possible. Larger diameter electrodes produce welds of the required dimensions in the least amount of time and at lower cost, because they have higher deposition rates and allow faster travel speeds.

2. CURRENT

Current is measured in amperes, or amps. Each type of electrode has recommended amperage ranges for optimum performance. Amperage ranges are usually specified in the welding procedure or in the manufacturers' data sheets.
If the amperage is set above the suggested operating range, the electrode melts too fast. This increases deposition and the weld puddle becomes too large to control. It could also cause the electrode coating to overheat and break down.

Amperage too high – The weld bead is wide and flat with excessive penetration and spatter and undercutting frequently occurs along the toes. If the amperage is set below the designated range, there is insufficient heat to melt the base metal, and the weld puddle is too small for proper control. The droplets forming on the end of the electrode may bridge to the weld puddle periodically extinguishing the arc. The weld bead will be irregular with a crowned appearance and insufficient penetration.

Amperage too low -The weld bead will be irregular with a crowned appearance and insufficient penetration

3. ARC LENGTH

Arc length is the distance from the tip of the electrode core wire to the weld puddle. Arc length can be deceiving, because the core wire is recessed inside a cup that forms at the tip of the electrode. You must take this into consideration when gauging arc length.

The correct arc length varies according to the electrode classification, diameter, and composition of the flux coating, as well as the amperage and welding position.

As a general rule, when amperage is set within the specified range, arc length should not exceed the diameter of the core wire. Increasing the arc length increases the arc voltage and reduces the amperage slightly.

If the arc is too long, the metal core melts off in large globules that wobble from side to side and drop onto the work as spatter, rather than forming useful weld metal. The weld bead is wide with excessive spatter and undercut. The base metal is not properly melted, so the weld metal is deposited on top of the plate with incomplete

penetration, and slag inclusions will probably occur. Long arcing is often used to preheat the base metal directly after striking the arc.

Shortening the arc length reduces the arc voltage and increases the amperage slightly. If the arc length is too short, the arc tends to short out and the electrode freezes to the work.

4. TRAVEL SPEED

Travel speed is the rate at which the electrode moves along the work. The key to correct travel speed is "reading" the weld puddle because the weld puddle is a liquid version of the weld bead.

A properly formed weld bead has an oval shape with an oval crater and uniform ripple pattern. Travel speed is influenced by the type of welding current (DCEN, DCEP or AC), amperage, welding position, electrode melt rate, material thickness, surface condition of the base metal, type of joint, joint fit up and electrode manipulation.

If you travel too fast, the puddle cools too quickly trapping gasses and slag. The ripples are pointed and narrow with irregular penetration and undercut along the toes.

If you travel too slowly, the weld metal piles up forming a high, wide weld-bead with too much reinforcement that may result in overlap. So read the puddle and keep the arc on the leading edge.

5. ELECTRODE ANGLE

In shielded metal arc welding, the work and travel angles are used to control the shape of the weld puddle and the amount of penetration. The travel angle is the angle between the joint and the electrode along the axis of the weld.

A ***push*** angle exists when the electrode points in the direction of travel.
A ***drag*** angle points away the direction of travel.

When all other essentials are under control, a change in the direction of travel changes the heat input to the puddle. A drag travel angle increases heat input because the arc is pointing into the puddle. A push travel angle reduces heat input because the arc is pointing away from the puddle.

The ***work angle*** is pointing between the electrode and the work surface along the work plane, which runs perpendicular to the axis of the weld. An incorrect work angle can cause you to favor one side of the joint more than another. The result is undercut and lack of fusion.

ACTIVITIES

Directions: Create an infographic about the 5 essentials of welding.
Use separate sheet of paper for your answer.

Directions: Read the sentences carefully and write TRUE if the statement is correct and FALSE if the statement is wrong. Write your answer in a separate sheet of paper.

1. The correct choice of electrode size involves consideration of a variety of factors.

2. If current on equipment is too high or too low, you are certain to be disappointed in your weld.

3. If too low, the electrode melts too fast and your molten pool is large and irregular.

4. If too high, there is not enough heat to melt the base metal and your molten pool will be too small, will pile up, and look irregular.

5. If the arc is too long or voltage too high the metal melts off the electrode in large globules which wobble from side to side as the arc wavers, giving a wide,

spattered and irregular bead-with poor fusion between original metal and deposited metal.

6. If arc is too short, or voltage too low, there is not enough heat to melt the base metal properly and the electrode quite often stick to the work, giving a high, uneven bead, having irregular ripples with poor fusion.

7. When your speed is too slow your pool does not last long enough, impurities and gas are locked in the bead is narrow and ripples pointed.

8. When speed is too fast the metal piles up, the bead is high and wide, with a rather straight ripple.

9. The electrode should be held so that it bisects the angle between the plates and is perpendicular to the line of weld.

10. If undercut occurs in the vertical member, higher the angle of the arc and direct the arc toward the horizontal member.

REMEMBER

- There are 5 essentials of welding. These are the following:
    1. Electrode Size
    2. Current
    3. Arc Length
    4. Travel Speed
    5. Electrode Angle

- Electrode diameter is based on the thickness of the base metal, the welding position, and the type of joint to be welded.

- Current output is the most important factor in Arc Welding.

- When arc welding with electrodes, it is important that the arc be kept as short as possible in order to avioid the formation of pores and toprevent slag becoming embedded in the weld.

- Move the electrode at an even rate in the welding direction, with or without weaving. Correct rate of travel is important to achieve a good weld.

- The electrode must be held at the correct angle during the welding operation.

CHECK YOUR UNDERSTANDING

Directions: Write a reflection about importance of the 5 essentials of welding. Use separate sheet of paper for your answer.

POST TEST

Directions: Read the statement carefully and choose the letter of the correct answer. Use separate paper for your answer sheet.

1. If the arc is too short, or voltage too low, there is not enough heat to melt the base metal properly and the electrode quite often sticks to the work, giving:
   A. even bead C. regular ripples
   B. uneven bead D. irregular ripples with poor fusion
2. If the electrode travels too slow, it gives:
   A. wide weld bead
   B. longer than normal in length
   C. narrow thinner bead deposit
   D. elongated ripples sometimes with undercut
3. If the current is too low, there is not enough heat to melt the base metal and your molten pool is:
   A. large and regular C. small and irregular
   B. small and regular D. large and irregular
4. If the arc is too long or voltage too high the metal melts off the electrode giving:
   A. large and regular bead C. spattered and regular bead
   B. large and irregular bead D. spattered and irregular bead
5. This is the rate at which the electrode moves along the work.
   A. arc length C. electrode size
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8. This measures the amperes, or amps for optimum performance.
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   B. arc length D. electrode angle
9. This tells the type, position, preparation of the joint, the ability of the electrode to carry high currents values, etc.
   A. arc length C. electrode size
   B. travel speed D. electrode angle
10. If current is too high, the electrode melts too fast and your molten pool is:
   A. large and regular C. small and irregular
   B. small and regular D. large and irregular

REFERENCES:

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Welding Guide Fabrication Shop, Ismael V. Palabrica

Metal Works 1, SEDP Series, Industrial Technology

Basic Manual Metal Arc Welding, National Training Center for Technical Education and Staff Development

Welding Principles and Applications, Larry Jeffus and Harold V. Johnson

Key to Correction

Pretest

1. B
2. D
3. A
4. A
5. C
6. D
7. C
8. D
9. D
10. A

Posttest

1. D
2. A
3. C
4. D
5. B
6. D
7. C
8. D
9. A
10. A