Metal Inert Gas (MIG) Welding Techniques

Unit: Structural Systems

Problem Area: Metal Fabrication

Lesson: Metal Inert Gas (MIG) Welding Techniques

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Explain the advantages of the metal inert gas (MIG) welding process.**
2. **Describe the equipment, types of shielding gases, and electrodes used in the MIG welding process.**
3. **Describe the types of metal transfer patterns used in MIG welding, and relate their applications.**
4. **Identify safety practices that should be observed in MIG welding.**
5. **Describe and demonstrate the correct techniques for starting, controlling, and stopping a MIG bead.**
6. **Explain and demonstrate how to adjust and maintain the MIG welder.**

Resources.

The following resources may be useful in teaching this lesson:

E-unit(s) corresponding to this lesson plan. CAERT, Inc. http://www.mycaert.com.

Herren, Ray V. *Agricultural Mechanics: Fundamentals & Applications*, 6th ed. Cengage Learning, 2010.

Jeffus, Larry. *Metal Fabrication Technology for Agriculture*, 2nd ed. Cengage Learning, 2012.

Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Key Terms.

The following terms are presented in this lesson (shown in bold italics):

- burnback
- ductility
- globular transfer
- inert gas
- short arc transfer
- spray arc transfer
- stickout
- transition current
- travel angle
- whiskers

Interest Approach.

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

> *Show students welds that have been done with fuel gas, arc, and MIG welding processes. Do not tell them which process did the welds. Ask them to note the differences. Lead a discussion on the advantages and disadvantages of each.*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Explain the advantages of the metal inert gas (MIG) welding process.

Anticipated Problem: What are the advantages of the MIG welding process?

I. Metal inert gas welding (MIG)—also known as gas metal arc welding (GMAW)—is a process in which a consumable wire electrode is fed into an arc and weld pool at a steady but adjustable rate, while a continuous envelope of inert gas flows out around

the wire and shields the weld from contamination by the atmosphere. The MIG welding process has several advantages that account for its popularity and increased use in the agricultural and welding industries.

A. Welding jobs can be performed faster with the MIG process. The continuous wire feed eliminates the need to change electrodes.

B. Weld cleaning and preparation time is less for MIG welding than for stick electrode welds. Since the gaseous shield protects the molten metal from the atmospheric gases, there is no flux or slag. In addition, spatter is minimal.

C. Little time is required to teach individuals how to MIG weld.

D. Because of the fast travel speed at which MIG welding can be completed, there is a smaller heat-affected zone than with the shielded metal arc welding process. The smaller heat-affected-zone results in less grain growth, less distortion, and less loss of temper in the base metal.

E. Thick and thin metals can be welded successfully and economically with the MIG process.

F. Less time is needed to prepare weld joints since the MIG welds are deep penetrating. Narrow weld joints can be used with MIG welding and still secure sound weldments.

G. The MIG welding process can be used to join ferrous and nonferrous metals. The development of electrode wire and the use of spool guns have made the MIG process widely used for aluminum, stainless steel, high-carbon steel, and alloy steel fabrication.

H. The weld visibility is generally good. There is less smoke and fumes, so operator environment is improved.

Teaching Strategy: *Use VM–A to illustrate the MIG welding process. An alternative approach is to transfer the information from the lesson to a multimedia presentation. Use text material to strengthen student understanding of concepts.*

Objective 2:

Describe the equipment, types of shielding gases, and electrodes used in the MIG welding process.

Anticipated Problem: What equipment, types of shielding gases, and electrodes are used in the MIG welding process?

II. To understand the MIG welding process, it is necessary to understand the equipment needed: a welder, a wire feed system, cable and welding gun assembly, shielding gas supply, and electrode wire.

A. Most welders used for MIG welding are direct current machines of the constant voltage type.

B. MIG welding machines must be designed to produce a constant voltage. With a constant voltage MIG machine, the output voltage will change very little with large changes in current.

C. Welding voltage has an effect on bead width, spatter, undercutting, and penetration.

D. The constant voltage welding machines are designed so when the arc voltage changes, the arc current is automatically adjusted or self-corrected.

E. Most MIG welding units have three adjustments that must be in balance to achieve a quality weld: voltage control, wire feed speed, and shielding gas flow rate.

   1. The wire feeder continually draws a small diameter electrode wire from the spool and drives it through the cable assembly and gun at a constant rate of speed.
   2. The constant rate of wire feed is necessary to assure a smooth and even arc. This must be adjustable to provide for different welding current settings that may be desired.
   3. Wire speed varies with the metal thickness being welded, type of joint, and position of the weld.

F. To move the electrode wire from the spool to the MIG welding gun, the wire must be run through a conduit and system of drive wheels. These drive wheels, depending upon their location in the wire feed unit, are the pull type or the push type.

   1. The pull-type drive wheels are located relatively close to the MIG gun and exert a pulling action on the wire. Pull-type drive wheels are used on most spool guns.
   2. With the push-type drive wheels, the wire goes through the wheels. They are pushed through the electrode lead and out through the MIG gun.

G. Correct tension on the wire feed drive wheels is important.

   1. Too little tension results in drive wheel slippage, which causes the wire to be fed into the puddle at an uneven rate, giving a poor-quality weld.
   2. Too much tension on the wire feed wheels results in deformation of the wire shape. This altered wire shape can make it difficult to thread the electrode through the conduit and the contact tip in the MIG gun.

H. When a blockage or burnback occurs, the MIG gun should be turned off immediately to prevent entanglement. A ***burnback*** is a situation in which the electrode wire is fused to the contact tip.

I. The wire feeders have different sizes of drive rolls, so they can accommodate different sizes and types of wire.

J. The electrode holder is commonly referred to as the MIG gun. The MIG gun has a trigger switch for activating the welding operation, a gas nozzle for directing the flow of the shielding gas, and a contact tip.
    1. The nozzle on the MIG gun directs the shielding gas over the puddle during welding. A nozzle that is too large or too small may result in air from the atmosphere reaching the puddle and contaminating the weld.
    2. The nozzle is made of copper alloy to help remove the heat from the welding zone.

K. When welding outside where the weld zone is subjected to drafts and wind currents, the flow of shielding gas needs to be strong enough so drafts do not blow the shielding gas from the weld zone.

L. The contact tip guides the wire electrode into the puddle and transmits the weld current to the electrode wire. The electrode wire actually touches the contact tip as it is fed through the MIG gun. During this contact, the weld current is transmitted to the electrode.

M. The shielding gas displaces the atmospheric air with a cover of protective gas. The welding arc is then struck under the shielding gas cover, and the molten puddle is not contaminated by the elements in the atmosphere.

N. Inert and non-inert gases are used for shielding in MIG welding. An ***inert gas*** is a substance whose atoms are stable and will not react easily with atoms of other elements.
    1. Argon has a low ionization potential and, therefore, creates a stable arc when used as a shielding gas. The arc is quiet and smooth sounding and has little spatter.
        a. Argon is a good shielding gas for welding sheet metal and thin metal sections. Pure argon is also used for welding aluminum, copper, magnesium, and nickel.
        b. Pure argon is not recommended for use on carbon steels.
    2. Helium gas conducts heat well and is preferred for welding thick metal stock. It is good for welding metals that conduct heat well (e.g., aluminum, copper, and magnesium).
        a. Helium requires higher arc voltages than argon.
        b. Helium-shielded welds are wider. They also have less penetration and more spatter than argon-shielded welds.
    3. Carbon dioxide is the most often used gas in MIG welding because it gives good bead penetration, wide beads, no undercutting, and good bead contour. It costs much less than argon or helium.
        a. The main application of carbon dioxide shielding gas is welding low and medium carbon steels.
        b. When using carbon dioxide shielding gas, the arc is unstable, which causes a lot of spatter.

c. Carbon dioxide gas has a tendency to disassociate. At high temperatures encountered in the arc zone, carbon dioxide will partially break up into oxygen and carbon monoxide.
d. Good ventilation is essential to remove this deadly gas.

4. When used in a mixture with argon, oxygen helps stabilize the arc, reduce spatter, eliminate undercutting, and improve weld contour. The mixture is primarily used for welding stainless steel, carbon steel, and low alloy steel.
5. An argon-helium mixture is used for welding thick non-ferrous metals. The mixture gives the same arc stability as pure argon, with little spatter, and produces a deep penetrating bead.
6. The argon-carbon dioxide mixture is used mainly for carbon steel, low alloy steel, and some stainless steel. The gas mixture stabilizes the arc, reduces spatter, eliminates undercutting, and improves metal transfer straight through the arc.
7. The fabrication of austenitic stainless steel by the MIG process requires a helium, argon, carbon dioxide shielding gas mixture. The mixture allows a weld with very little bead height to be formed. The tank supplying the shielding gas will have a gauge and a gas flow meter. The volume of gas directed over the weld zone is regulated by the flow meter.

O. The selection of the correct electrode wire is an important decision, and the success of the welding operation depends on the correct selection. Various factors must be considered when selecting the correct electrode, such as:

1. A person must know the type of metal to be welded and should choose a filler wire to match the base metal in analysis and mechanical properties.
2. The joint design must be considered. Thicker metals and complicated joint designs usually require filler wires that provide high ductility. ***Ductility*** is the ability to be fashioned into a new form without breaking.
3. The surface condition of the metal to be welded must be examined. If it is rusty or scaly, it will have an effect on the type of wire selected.
4. It is important to consider the service requirements that the welded product will encounter.

P. MIG electrode wire is classified by the American Welding Society (AWS). An example is ER70S6. For carbon-steel wire, the “E” identifies it as an electrode; “R” notes it is a rod; the first two digits relate the tensile strength in 1,000 pounds psi; the “S” signifies the electrode is a solid bare wire; and any remaining number and symbols relate the chemical composition variations of electrodes.

Teaching Strategy: *Use VM–A. You may want to share the following video with the class: https://www.youtube.com/watch?v=U1GTgDQFE4A.*

Objective 3: Describe the types of metal transfer patterns used in MIG welding, and relate their applications.

Anticipated Problem: What are the types of metal transfer patterns used in MIG welding, and when are they used?

III. In MIG welding, the metal from the wire electrode is transferred across the arc plasma to the puddle by globular, short arc, or spray transfer patterns. The type of transfer used for any given weld depends upon the arc voltage, current, kind of shielding gas used, and diameter of the wire electrode.

A. ***Globular transfer*** is a pattern in which the molten metal from the wire electrode travels across the arc in large droplets.

1. Globular transfer pattern occurs at low wire feed rates, low current, and low arc voltage settings.
2. The current for globular transfer is below transition current. ***Transition current*** is the minimum current value at which spray transfer will occur.
3. The molten globules are two to three times larger than the diameter of the electrode. Surface tension holds the globules on the end of the wire electrode. When the globules become too heavy to remain on the electrode, they drop off and move across the arc. The globules, however, do not move across the arc in an even pattern.
4. Welds made with globular transfer have poor penetration, excessive spatter, and are used little in MIG welding.

B. The ***short arc transfer*** is a series of periodic short circuits that occur as the molten tip of the advancing wire electrode contacts the workpiece and momentarily extinguishes the arc.

1. The droplet forms on the end of the electrode and begins to sag while the arc is ignited. The droplet sags further and touches the molten puddle. When the droplet touches the puddle, the arc is short-circuited and extinguished. The droplet continues to melt and breaks off the end of the wire electrode. At this instant, the arc reignites and a new droplet begins to form.
2. New droplet formation and arc shorting may occur from 20 to 200 times per second.
3. Short arc transfer is also known as short circuiting transfer and dip transfer.
   a. Short arc transfer is especially good for welding in the horizontal, vertical, and overhead positions where puddle control is usually hard to maintain.
   b. Short arc welding is most feasible at current levels below 200 amps and with small-diameter electrode wire.

C. ***Spray arc transfer*** is a spray pattern of very fine droplets.

1. Spray arc transfer is a high-heat method of welding with a rapid deposition of metal. It is used for welding all common metals from $^{3}/_{32}$ inch to more than 1 inch in thickness.

2. The transfer occurs only with argon or an argon-oxygen mixture of shielding gas.

Teaching Strategy: *Use VM–B through VM–D. You may want to share some brief videos so students can see these processes. Some examples are https://www.youtube.com/watch?v=NQYI95PBiUY, https://www.youtube.com/watch?v=Rsr_rzAP35A, and https://www.youtube.com/watch?v=IHkbh0oKv_g.*

Objective 4: Identify safety practices that should be observed in MIG welding.

Anticipated Problem: What safety practices are observed in MIG welding?

IV. The following are suggested practices and tips to eliminate shop accidents when MIG welding.

A. All welding cables and their connections should be in good repair. Cracked or cut cables or those with damaged insulation should not be used. Electrical connections on each cable should be tight and should not have frayed ends or bare wires exposed.

B. Welding gloves, a helmet, a leather apron, welding chaps, leather shoes, and other personal protective equipment should be worn to prevent weld burns.

C. When operating a MIG welder, it is important not to touch an electrical connection, a bare wire, or a machine part that may cause electrical shock. Welding should never occur in damp locations because of the shock hazard.

D. A person should never weld with flammables (e.g., matches, butane lighters, or fuel sticks) in his or her pockets.

E. Pliers or tongs should be used to handle hot metal from the MIG welding process. Hot metal should never be left where others may touch it and be burned.

F. The correct shaded lens should be selected for the electrode size being used. Shades 10 and 12 are recommended.

G. All welds should be completed in a well-ventilated area. Welding fumes should be ventilated away from the weldor, not across the weldor's face because shielding gases are asphyxiates and welding fumes are harmful. Well-ventilated areas prevent suffocation or fume sickness.

H. Inert gas cylinders should be stored in a cool, dry storage area. It is critical not to drop or abuse gas cylinders in any way. Cylinders should not be moved unless the valve protection cap is in place and tight. All connections should be checked with soapy water to detect leaks.

I. The welding gun should be hung on a hook when it is not in use. It should not be hung on the flow meter, regulator, or cylinder valve. In addition, a person should not lay the gun on the work or worktable.

J. Other workers should be protected by a welding screen enclosing the welding area. People standing nearby should be warned by the weldor saying "cover," so they know to cover their eyes when the weldor is ready to strike an arc.

K. Before starting to weld, the surrounding area should be cleared of possible fire hazards. Straw, shavings, rags, paper, and other combustible materials should be removed.

L. A weldor should be alert for fires at all times. Because the operator's helmet is lowered, clothing may catch fire without being noticed. A person should depend on his or her senses of touch, smell, and hearing to indicate that something is wrong. In case of a clothing fire, the clothing should be removed if possible. Running fans the flames and should be avoided. Instead, a person should wrap himself or herself in a fire blanket or improvise with a coat or piece of canvas. If there is nothing at hand to wrap in, the person should drop to the floor and roll slowly.

M. It is important to protect hoses and welding cables from being stepped on or run over by vehicles. They should not be allowed to become tangled or kinked. Also, they should be positioned so they are not a tripping hazard. In addition, they should be protected from flying sparks, hot metal, or open flame as well as from oil and grease that will cause rubber to deteriorate.

N. The welder should always be unplugged, and all equipment should be put away when finished welding for the day.

Teaching Strategy: *Have students watch videos about safety, such as https://www.youtube.com/watch?v=9DP5l9yYt-g&list=PLUMFepIZValMVDomUMGtnGaMHwm28MY8Q.*

Objective 5: Describe and demonstrate the correct techniques for starting, controlling, and stopping a MIG bead.

Anticipated Problem: What is the correct technique for starting, controlling, and stopping an MIG weld?

V. It is necessary to follow proper procedures when starting, controlling, and stopping an MIG weld.

A. In preparation to start welding with the MIG welder, the weldor should make adjustments to the machine.

1. The gun and ground cables must be properly connected.
   a. If possible, the ground should be attached directly to the workpiece, and it is necessary to weld away from the ground.
   b. Long, coiled cables act as reactors and set up stray magnetic fields that affect arc action.
2. It is important to check that the wire type, wire size, and shielding gas are correct for the metal to be welded.

3. It is necessary to set the shielding gas flow rate, proper amperage, and wire speed for the metal being welded.
4. In MIG welding, two types of starts may be employed to get the bead going.
    a. In the fuse start technique, the end of the wire electrode acts like a fuse. The welding current flows through the wire until it becomes hot and begins to melt.
        (1) When the welding gun trigger is "on," the wire is moving out of the wire contact tip.
        (2) The object of a fuse start is to melt the wire fed out of the gun before it touches the base metal.
        (3) When the arc first occurs, it should take place between the tip of the wire and the base metal. If the arc starts at some other point along the wire other than the tip, an unmelted section will reach the base metal. Unmelted electrode wires stuck in the bead are called ***whiskers***.
    b. The scratch start requires the electrode wire to touch and move along the base metal as the arc ignites.
        (1) The contact point between the electrode tip and the base metal acts like a fuse.
        (2) Dragging the wire over the base metal is the preferred method of scratching.
        (3) The lighter the drag pressure, the smaller the amount of current needed and the better the start.

B. When ready to start the welding process, travel speed, stickout, and gun angle are important considerations.
    1. The speed at which the arc is moved across the base metal—travel speed—affects the puddle. Proper control of the puddle provides for good penetration, with correct bead width and bead height, and prevents undercutting.
        a. Travel speed may affect arc stability and the metal transfer pattern.
        b. Travel speeds vary with the size of the electrode wire, current density, metal thickness, weld position, and kind of metal being fabricated.
    2. ***Stickout*** is the tip-to-work distance, which can affect weld penetration and weld shape.
        a. Short stickout distances ($^3/_8$ of an inch or less) are desirable on small-wire, low amperage applications.
        b. It is desirable to keep this distance as short as possible for precision wire alignment over the joint and proper placement in the puddle.
    3. Holding the MIG gun at the correct angle is important since it controls shielding gas distribution, puddle control, and bead formation. Two angles that must be correct to make a quality weld are the travel angle and the work angle.
        a. The ***travel angle*** is the angle at which the MIG gun leans toward or away from the direction of movement.
            (1) A travel angle of 10 degrees to 20 degrees is used for most welding.

(2) Travel angle is sometimes referred to as drag angle.

b. The work angle is perpendicular to the line of travel and varies considerably, depending upon the type of weld being made and the welding position. The work angle for a flat position surfacing weld should be 15 degrees to 25 degrees.

4. The MIG gun may be held in three different ways:
   a. Perpendicular to the base metal
   b. Leaning in the direction of travel, also known as the backhand or pull position
   c. Leaning opposite the direction of travel, also known as the forehand or push position

C. If the weld current is stopped instantly, the weld puddle freezes, gases become entrapped in the bead, and porosity results.
   1. The best stop is achieved by allowing the weld current to taper down.
   2. Stopping the wire feed as quickly as possible after the MIG gun trigger is off is desirable.
   3. Stopping the flow of shielding gas is the last thing to be done when stopping a weld. The shielding gas needs to flow over the puddle until it is fully solidified.

Teaching Strategy: *Use VM–E and VM–F. An alternative approach is to transfer the information from the lesson to a multimedia presentation. Use text material to strengthen student understanding of concepts.*

Objective 6: Explain and demonstrate how to adjust and maintain the MIG welder.

Anticipated Problem: How is the MIG welder adjusted and maintained?

VI. The MIG welder must be set correctly to do the best job. Machine adjustment and maintenance are important.

A. Most MIG machines have a voltage adjustment in addition to the wire feed control.
   1. It is necessary to determine what the voltage should be for the kind and thickness of metal and the shielding gas being used.
   2. Fine adjustments may need to be made so welding occurs with the right sound, bead penetration, shape, and contour.

B. Specifications should be checked to see what the correct gas volume should be for the weld.
   1. It is important to stand to one side of the regulator and to open the tank valve completely.
   2. The flow meter must be adjusted to the predetermined gas volume.
   3. The MIG gun should be held “on” to set to the correct operating volume.

C. Some machines have a self-contained coolant system, while others must be connected to a water source. If it is water cooled, the water must be turned on.

D. The nozzle should be kept clean and free of spatter to properly direct the flow of shielding gases over the puddle.
   1. If filled with spatter, the nozzle may be cleaned with a nozzle reamer or a round file. It is critical to avoid deforming the tip while cleaning.
   2. Anti-spatter dip or spray may be put on the nozzle to prevent spatter build-up and to make cleaning easier.

E. Contact tips need to be sized to fit the diameter of the electrode wire being used.
   1. The current is transmitted to the wire electrode in the contact tip.
   2. Tips are usually threaded into the MIG gun so good electrical contact is made.

Teaching Strategy: *Use text material to strengthen student understanding of concepts. An alternative approach is to transfer the information from the lesson to a multimedia presentation. Assign LS–A.*

Review/Summary.

Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. If a textbook is being used, questions at the ends of chapters may be included in the Review/Summary.

Application.

Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson. It is understood that before attempting the lab activities, proper safety precautions in the agriculture mechanics shop must be covered thoroughly.

Evaluation.

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance, on the application activities. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1. h
2. d
3. c
4. b
5. a
6. f
7. e
8. g

Part Two: Completion

1. Inert gas
2. voltage, wire speed, gas flow rate
3. flux, slag, spatter
4. globular, short arc, spray
5. 10 degrees, 20 degrees
6. contact tip

Part Three: Short Answer

1. E is electrode; R is rod; 70 is 70,000 psi; and S is solid bare wire.
2. The MIG welding process is faster. Also, the cleaning and preparation time is less. It is easy to learn, with less distortion. You can weld thin and thick metals. In addition, less time is needed to prepare joints, and both ferrous and non-ferrous metals can be joined. Visibility is good, too.
3. Too little tension results in drive wheel slippage, which causes an uneven feeding rate and results in poor quality welds. Too much tension results in deformation of the wire shape, which makes it hard to thread through the unit.

Sample Test

Name _____

Metal Inert Gas (MIG) Welding Techniques

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. burnback
b. ductility
c. globular transfer
d. whiskers
e. spray arc transfer
f. stickout
g. travel angle
h. short arc transfer

_____1. A spray pattern of very fine droplets

_____2. Unmelted electrode wires stuck in the bead

_____3. A pattern in which the molten metal from the wire electrode travels across the arc in large droplets

_____4. The ability to be fashioned into a new form without breaking

_____5. A situation in which the electrode wire is fused to the contact tip

_____6. The tip-to-work distance, which can affect weld penetration and weld shape

_____7. A spray pattern of very fine droplets

_____8. The angle at which the MIG gun leans toward or away from the direction of movement

Part Two: Completion

Instructions: **Provide the word or words to complete the following statements.**

1. _____ is a gas whose atoms are very stable and will not react easily with atoms of other elements.

2. The three adjustments that must be in balance to achieve a quality weld with MIG welding are _____, _____, and _____.

3. In MIG welding, the gaseous shield protects the molten metal from the atmosphere, so there is no _____ or _____, and _____ is minimal.

4. In MIG welding, the metal from the wire electrode is transferred across the arc plasma to the puddle by _____, _____, or _____ transfer patterns.

5. A travel angle of _____ to _____ is used for most welding.

6. The current is transmitted to the wire electrode in the _____.

Part Three: Short Answer

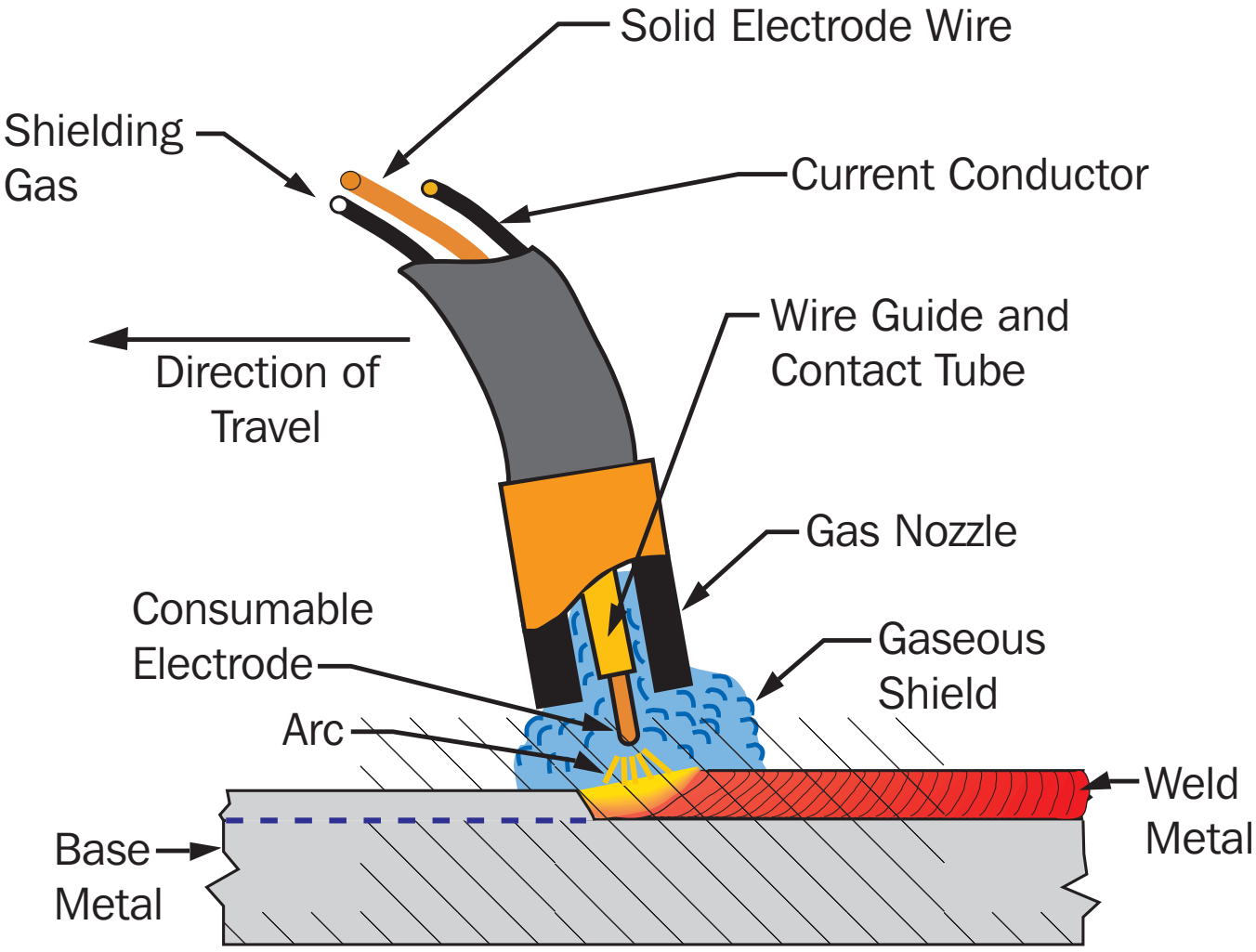
Instructions: **Answer the following.**

1. What does ER 10S6 mean or stand for?

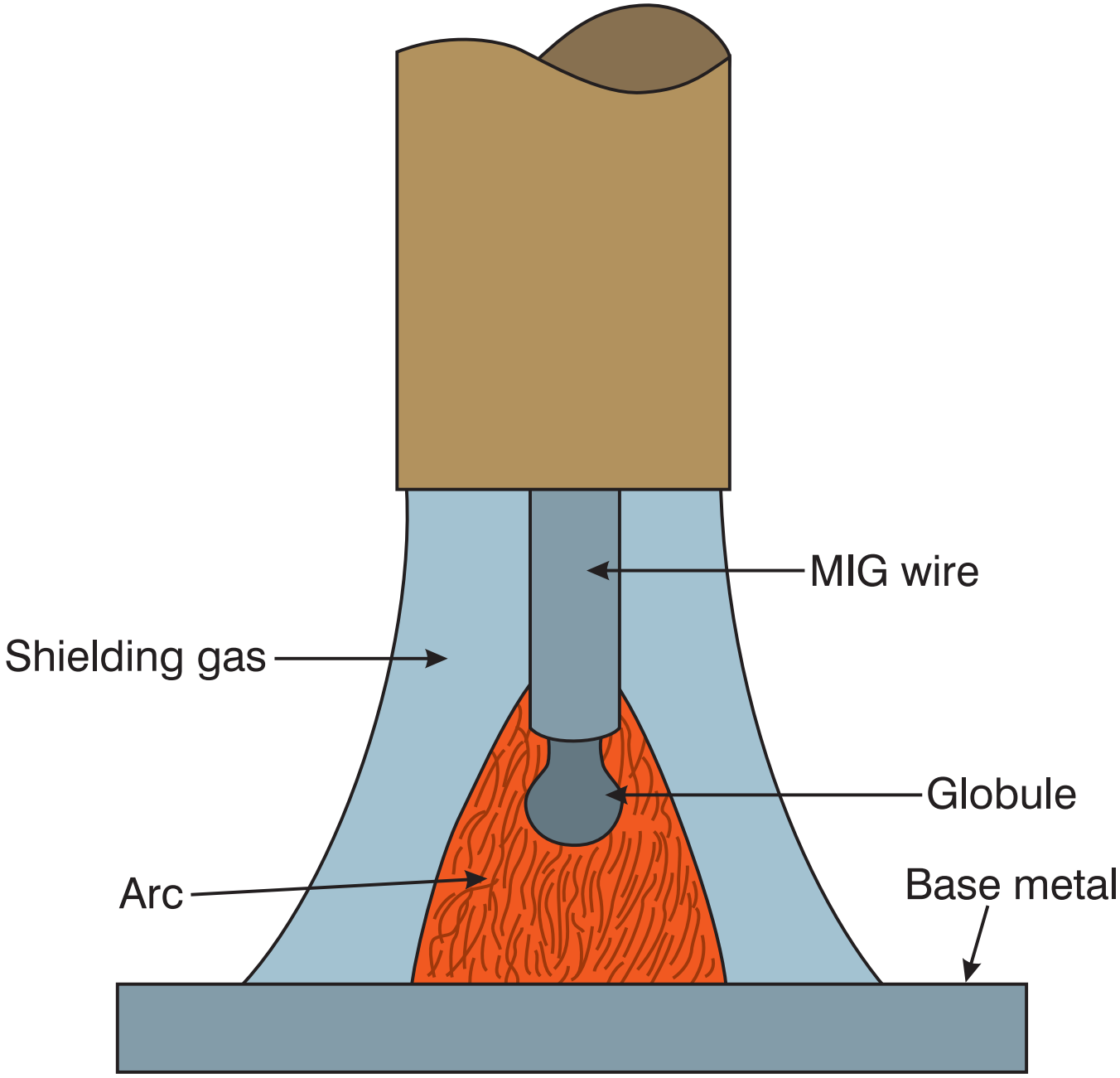
2. What are the advantages of the MIG welding process?

3. What affect does tension have on wire feed drive wheels?

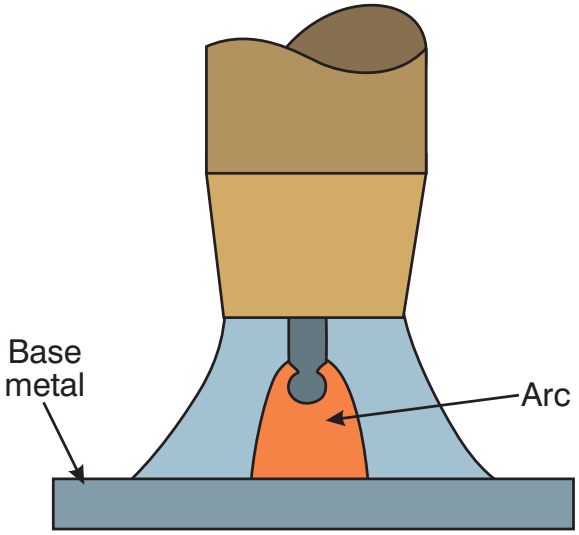
MIG WELDING PROCESS



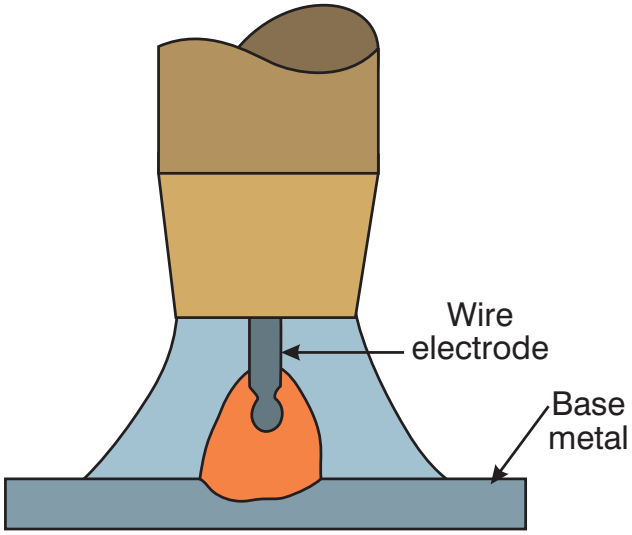
GLOBULAR TRANSFER



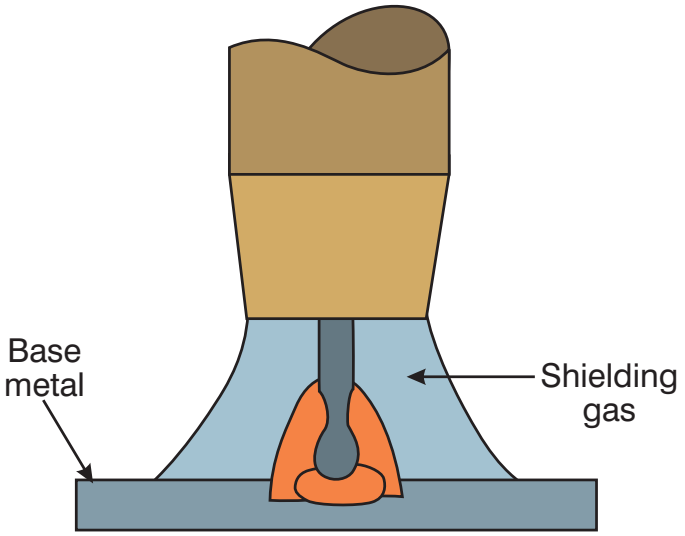
SHORT ARC TRANSFER



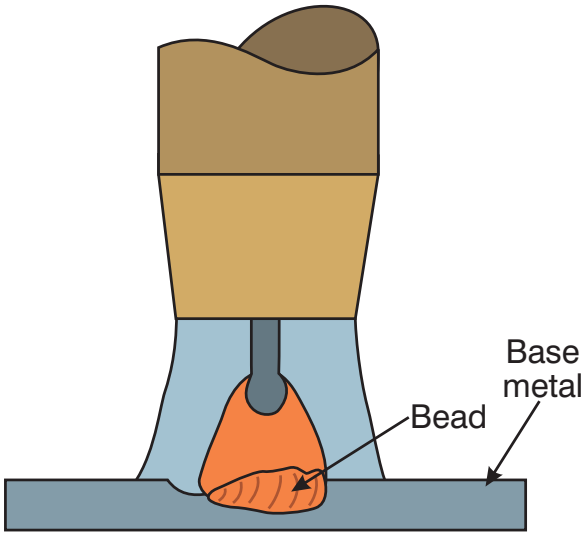
1 **Beginning of the short arc cycle.**



2 **Molten electrode elongates.**

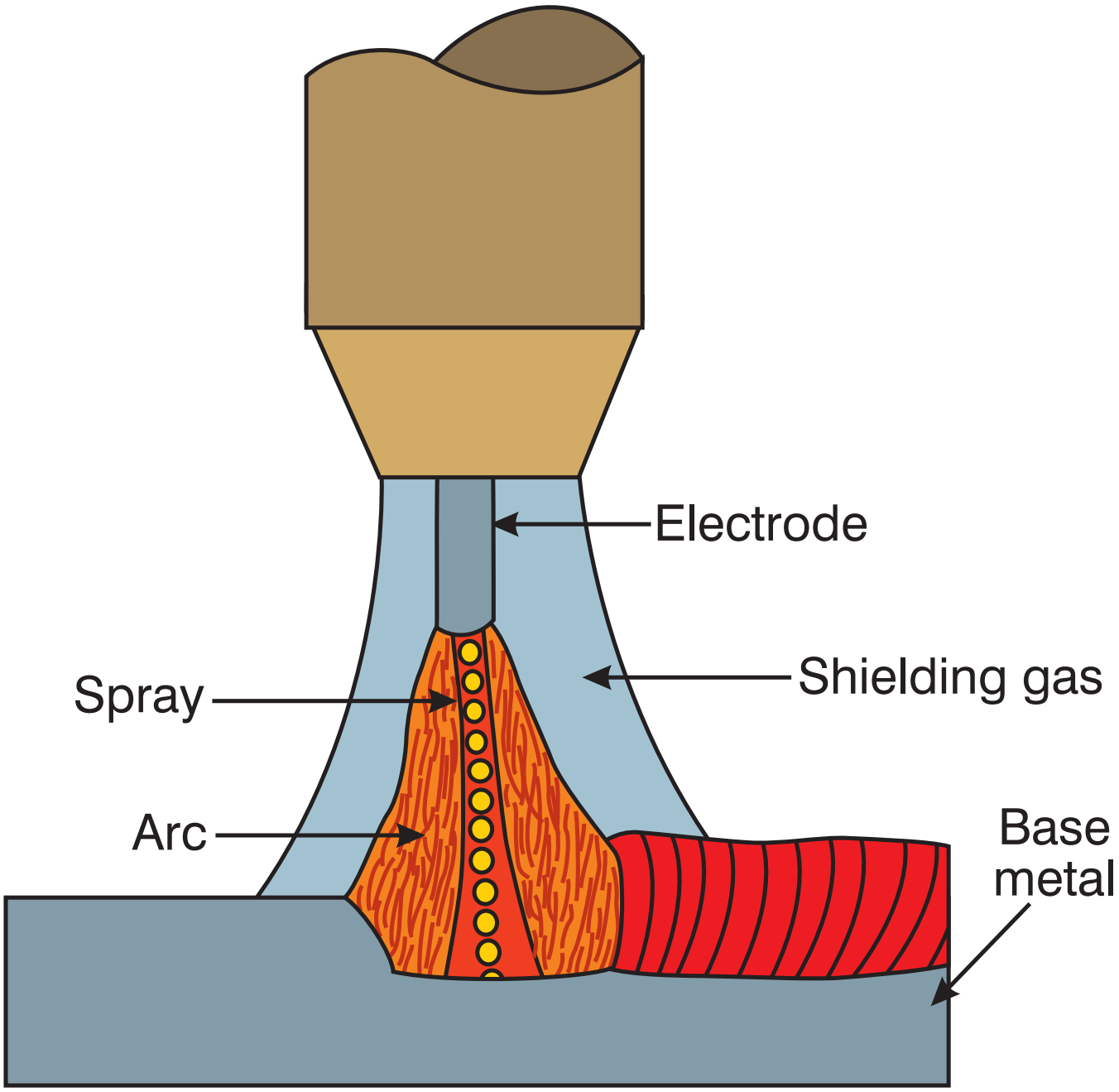


3 **Molten electrode touches puddle and short-circuits.**

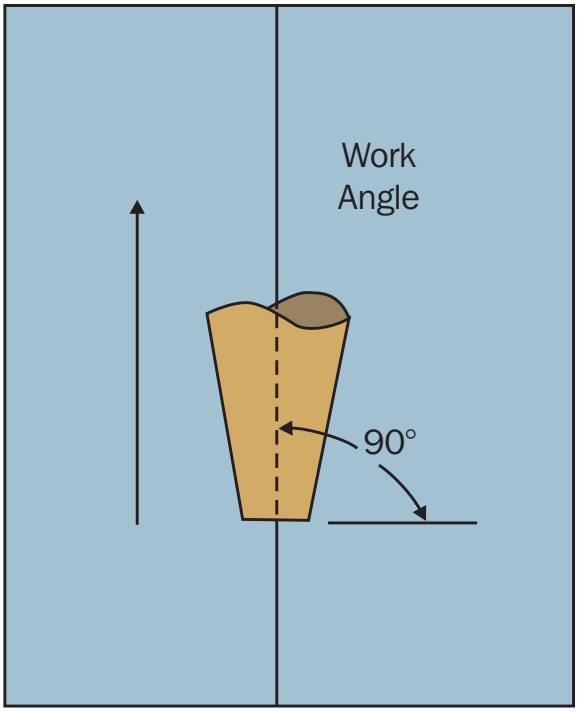


4 **Molten drop separates from electrode, and the arc is reignited.**

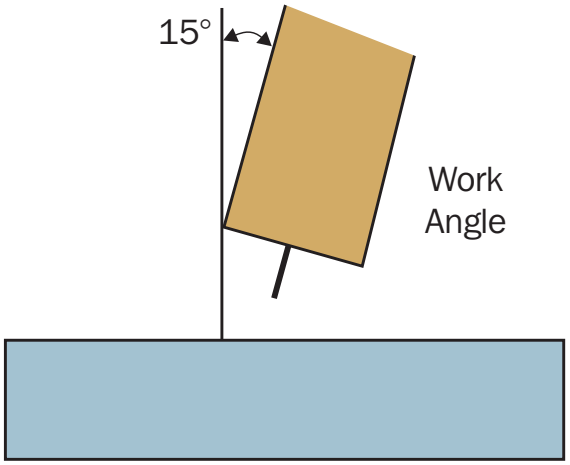
SPRAY TRANSFER



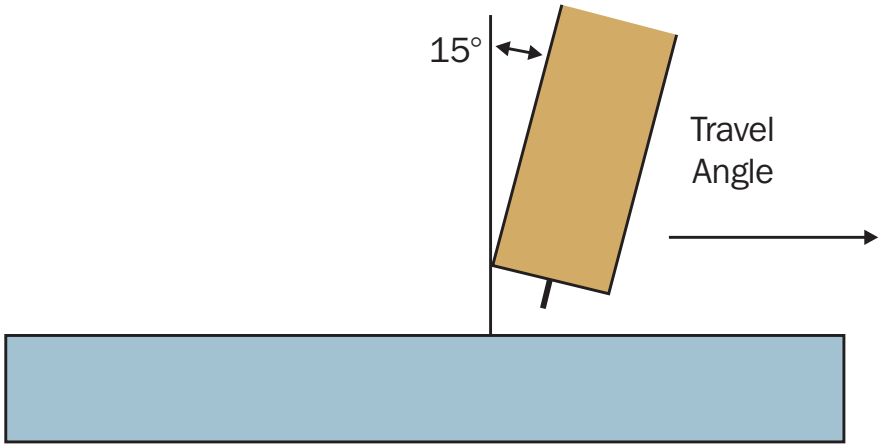
GUN ANGLE



Top View—90° work angle

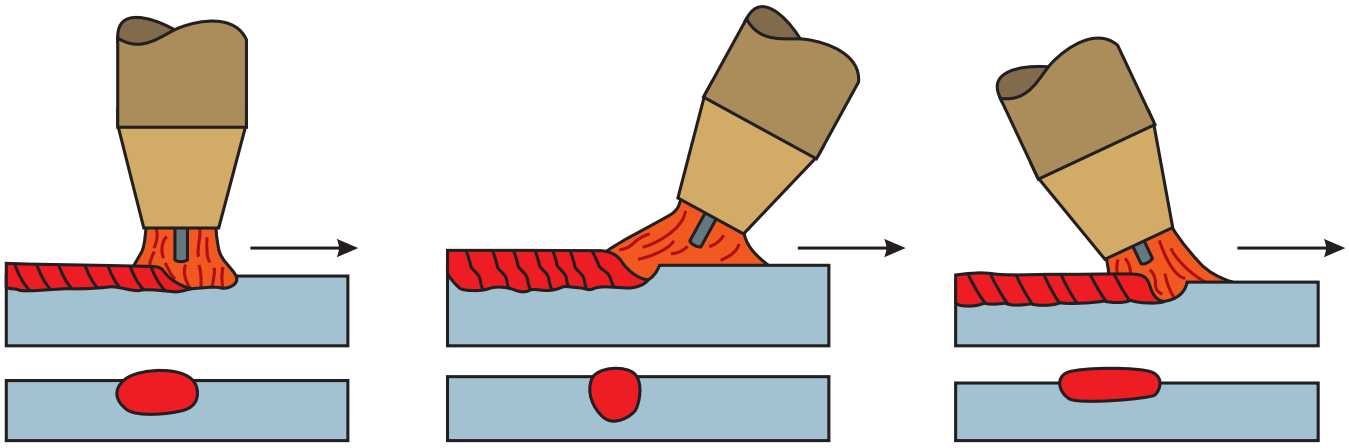


End View—15° work angle



Side View—15° travel angle

GUN POSITIONS—PERPENDICULAR, BACKHAND, AND FOREHAND



Perpendicular—medium band width and penetration.

Backhand—narrow bead width and deep penetration.

Forehand—wide bead width and low penetration.

LS–A

Name _____

MIG Welding Exercises

Purpose

The purpose of this activity is to perform MIG welding exercises.

Objective

Demonstrate MIG welding techniques.

Materials

- MIG welding equipment
- welding safety equipment
- steel
- copies of lab sheet

Procedure

Complete the following lab exercises in the order shown. A lab sheet should accompany each exercise. Before moving to the next exercise, gain instructor approval and directions.

#1 Bead
#2 Butt weld
#3 Lap weld
#4 Tee (fillet) weld

1. Lab exercise no. and type of weld: _____
2. Welding position: _____
3. Type and size of rod used: _____
4. Type and thickness of base metal: _____
5. Current setting: _____ Wire speed setting: _____
   Flow meter setting: _____

6. SCORECARD:

a. General appearance (e.g., smooth or uniform ripples)	5	4	3	2	1	0
b. Width (uniform)	5	4	3	2	1	0
c. Height (uniform)	5	4	3	2	1	0
d. Penetration	5	4	3	2	1	0
e. Starting	5	4	3	2	1	0
f. Stopping	5	4	3	2	1	0
g. Safety procedures followed	5	4	3	2	1	0
h. Other	5	4	3	2	1	0

i. TOTAL POINTS EARNED _____

7. Comments:

8. Grading scale:

36 to 40	A– to A+
32 to 35	B– to B+
28 to 31	C– to C+
24 to 27	D– to D+
1 to 23	F
0	0