What Is Arc Welding? 110

Class Outline

Lesson: 1/18

Objectives

- Define welding.
- Explain characteristics that set welding apart from other joining processes.
- Identify common base metals used for welding.
- Explain the importance of heat control in welding.
- Define fusion welding.
- Define arc welding.
- Describe the properties of electricity.
- Identify the variables used to measure electricity.
- Describe the path of electricity in welding.
- Describe the arc welding process.
- Identify the major types of electrodes.
- Explain the importance of shielding.
- Identify common arc welding processes.
- Identify the equipment needed for arc welding.
- Describe the advantages of welding.
- Explain the importance of arc welding safety.

Figure 1. Arc welding is frequently used to join metals.

Figure 2. Arc welding is widely used in racing.

Lesson: 2/18

What Is Welding?

Welding is an incredibly valuable process that helps create all the numerous items you use every day. Consider your typical morning drive to work. You drive over a bridge, past buildings as airplanes fly overhead. None of these items, including your car, could exist without welding. Figures 1 through 3 show you a sample of many things constructed by welding. Chances are that most objects around you, including the chair you are sitting in, exist because they were welded during production.

Welding is a **joining** process that permanently joins together two separate components with heat, pressure, or a combination of those elements to make one new part. Welding is often an art form that requires a certain degree of skill. There are as many as 50 different types of welding that use different sources of energy. Generally, welding is a process used to join metals. However, certain plastics can also be welded.

This class will describe the basic process of arc welding as it applies to metals. You will also learn about the components used during arc welding and the advantages of this unique process.

Figure 1. The metals used to build this bridge were welded together.

Figure 2. Airplane parts often require specialized methods of welding.

Figure 3. A welded aluminum car frame.

Lesson: 3/18

Types of Joining Processes

Most parts made by manufacturing companies require some type of **joining** process to bring components together. Joining processes fit into these major categories:

- **Welding** permanently joins two materials together using heat, pressure, or a combination of the two to form one new part. Figure 1 shows a welded metal part.
- **Adhesive bonding** joins two materials together using a nonmetallic material. Adhesives come in several forms such as gels, liquids, pastes, solids, or drops. This process can join two dissimilar materials together. Figure 2 shows common adhesive pastes.
- **Mechanical fastening** bonds two materials together with a clamping force. Screws, clamps, and nails are fasteners. This method allows for disassembly. Figure 3 shows a fastener application.

Welding differs from these other joining processes. First, the **joint** created by welding is very strong. A welded joint is also permanent. You cannot easily "undo" two parts welded together. Welding is also often a fast and cost-efficient process. It is one of the most economical ways to join two metals permanently.

Figure 1. A welded part.

Figure 2. Common adhesives.

Figure 3. A mechanical fastening application.

TOOLINGU
confidence to compete

Lesson: 4/18

Types of Metals

Almost all materials that are welded are **metals**. Metals are classified as **ferrous metals** or **nonferrous metals**. Ferrous metals contain iron; nonferrous metals do not. Effective welding often requires that two metals are similar. However, certain welding processes are used to weld metals that differ from each other.

Many different metals form good welds. However, the most commonly welded metal is **low-carbon steel**, or mild steel. This ferrous metal can be welded using almost any method. Manufacturers use low-carbon steel to make a wide range of products, including cars, buildings, and washing machines. **Stainless steel** is another example of a ferrous metal that can be welded using various methods. As the name implies, stainless steel does not tarnish easily, and it is smooth and hard. Figure 1 shows a welder working with stainless steel.

Welders also work with nonferrous metals. These metals include **copper** and **aluminum**, as shown in Figure 2. You can see the difference in low-carbon steel, stainless steel, and aluminum in Figure 3. Welding two ferrous and nonferrous materials together can be successful, but only with limited welding methods.

Figure 1. Welding stainless steel.

Figure 2. Welding an aluminum tugboat.

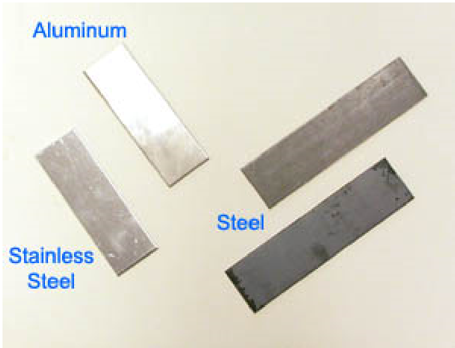

Figure 3. You can see the difference in appearance among steel, stainless steel, and aluminum.

Lesson: 5/18

Heat Control

Metal can transform from one form to the next. Depending on the temperature, a metal exists in three forms: solid, liquid, or gas. Figure 1 illustrates these different forms. A solid has a definite shape and **volume**. Volume is the amount of space that an object occupies. A liquid also has definite volume, but not shape. A gas has no definite shape or volume, and it expands to take up extra space. When something transforms from a solid to a liquid, it melts. When it changes from a liquid to a gas, it is called **vaporization**.

Most welding processes add heat to metals so they can reach their **melting points** and transform from solids to liquid. Once the metals become liquid, or **molten**, they mix together and freeze, or harden, to form one solid part. If the temperature is not hot enough, welding is impossible because the base metals do not reach their melting points. If the heat input is too high, the metals vaporize into the air. This rule of physics requires that the welder must carefully control heat input when performing a weld.

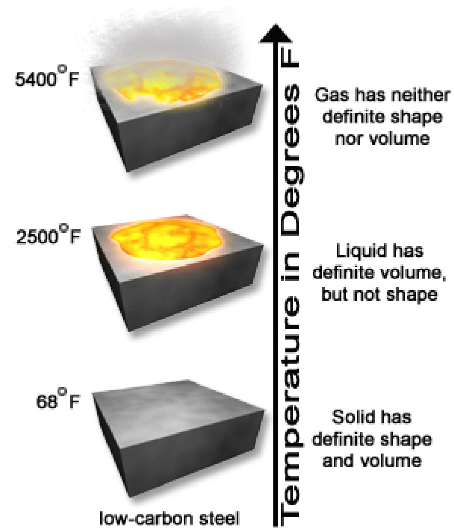

Figure 1. The transformation of metal: the exact melting point and boiling point depends on which metal you are using.

Lesson: 6/18

Fusion Welding

Most welding processes involve **fusion welding**. During fusion welding, heat melts the two **base metals**. Often a third, called a **filler metal**, is also melted into the joint to create a weld. Figure 1 illustrates the basic fusion weld process. Welds that do not use a filler metal are called **autogenous welds**. However, on the job, most welders refer to fusion welding as a process that does not use a filler metal.

To make a fusion weld, you need an energy source to melt the metals. This source of energy can either come from electricity or chemicals. **Arc welding**, shown in Figure 2, uses an electric **arc** to melt the base metals. Arc welding may also use a filler metal to create a weld. **Oxyfuel welding** uses oxyfuel gas to create a flame that melts the base metals. Oxyfuel gas contains a mixture of oxygen and another gas like acetylene.

While oxyfuel welding can be used to join metals, most welders use arc welding as the most common joining method. Effective arc welding requires a solid understanding of electricity and the welding process.

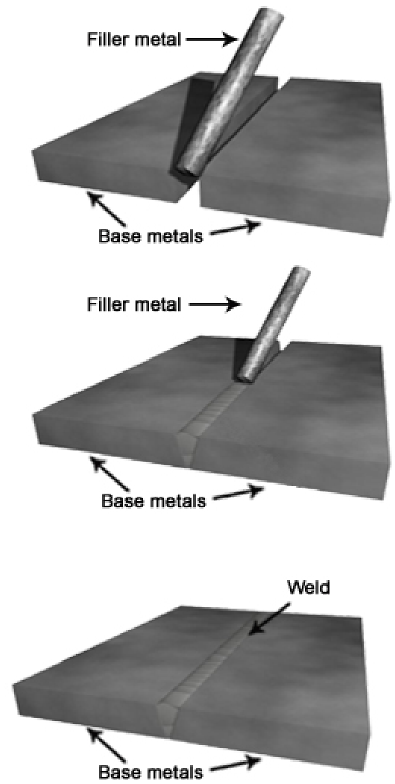

Figure 1. A fusion weld often melts the base metals and a filler metal to create one new part.

Figure 2. This welder is using arc welding to join parts without a filler metal.

Lesson: 7/18

What Is Arc Welding?

Arc welding, which is shown in Figure 1, describes a group of many different welding processes that use heat generated from electricity to melt the filler metal and base metals to form a weld. Electricity flows through an **electrode** to the **workpiece**. An electrode is a device used to conduct electrical current. The space where the electricity jumps from the electrode to the workpiece is referred to as an electric **arc**. The large amount of electricity generated from the electric arc is hot enough to melt the base metals and filler.

Figure 2 illustrates the basic arc welding process. The small area where the base metals and filler metal melts from the electric arc is called the **weld puddle**. The temperature of the arc varies based upon the welding process.

Arc welding is one of the most widely used processes. With most arc welding processes, a welder can bring the materials and equipment needed to perform a weld directly to the job site.

Figure 1. Arc welding uses electricity to generate heat and melt the metals.

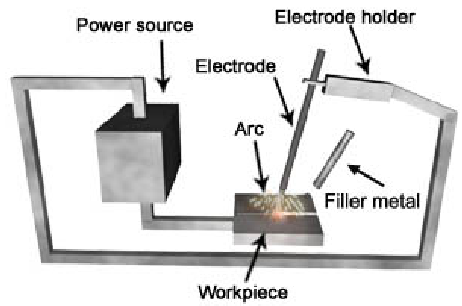

Figure 2. The setup for a basic arc welding application.

Lesson: 8/18

What Is Electricity?

All arc welding processes involve **electricity**. Electricity is energy that takes place through the flow of **electrons**. Electrons are negatively charged particles that orbit the center of an **atom**. The orbits of electrons appear as rings, similar to the way planets orbit the sun. If there is room, an atom might share or even trade electrons with a neighboring atom, as shown in Figure 1.

In some materials, called **conductors**, electrons flow freely from one atom to the next. Electricity is the flow of these electrons. Metals are particularly good conductors. However, in materials like rubber and plastic, there is not a lot of room to share electrons, so it is much more difficult for them to flow. This is what makes these materials good **insulators**. Insulated wire, like the example shown in Figure 2, uses an aluminum wire to conduct electricity. The outer covering of the wire serves as an **insulator** that prevents electricity from flowing outside the wire. During arc welding, air acts as an insulator. If you pull the electrode too far away from the workpiece, the air restricts the flow of electricity.

As electricity flows through materials, it converts into other forms of energy, such as heat, light, or motion. It is this conversion of electricity into heat that makes arc welding possible.

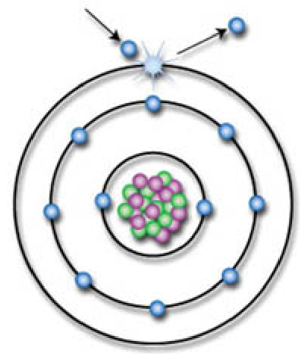

Figure 1. Electricity is the flow of electrons between atoms.

Figure 2. Insulated aluminum wire.

Lesson: 9/18

Voltage, Current, and Resistance
All electrical energy is understood using these fundamental values that measure its flow:

- **Current** is the flow of electricity.
- **Voltage** is the "pressure" that forces the electrons through the circuit.
- **Resistance** is the force that inhibits the flow of electricity.

A conductor has very little resistance and allows current to flow easily. An insulator creates significant resistance. Electricity always flows in the path of least resistance.

An effective way to understand the flow of electricity is by comparing it to water. Consider the typical garden hose illustrated in Figure 1. If you turn on the faucet, water begins to flow out the open end, much like electrical current. Water pressure, like voltage, is necessary to cause the water to flow. This pressure must overcome gravity, friction, and other forces that, like resistance, restrict the flow of water.

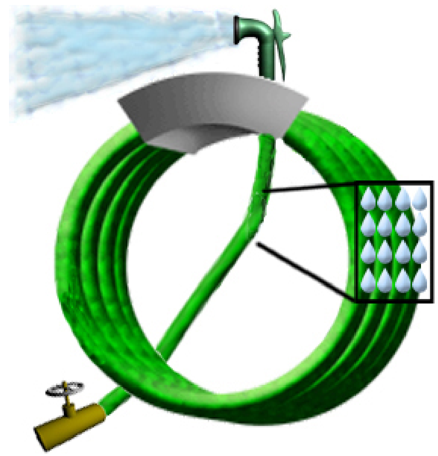

Figure 1. Increased voltage is much like an increase in water pressure. Increased current is like extra water droplets spraying out of the hose.

TOOLINGU
confidence to compete

Lesson: 10/18

The Path of Electricity

As electricity flows, it follows a specific **path**. Arc welding power comes from the current, or flow of electricity, which is caused by the voltage, or electrical pressure, generated by the **welder**. The term "welder" refers both to the equipment that generates electrical current and the person who welds. The person who welds may also be called a **weldor**.

For arc welding to occur, a complete **circuit** must be formed between the welder and the workpiece. The welder is connected to the workpiece with a **work cable**. The electrode is connected to the welder with an **electrode cable**. The electrode is held next to the workpiece to create the electric arc. Figures 1 and 2 compare the path of electricity in arc welding and a common flashlight circuit.

Depending on the type of welding process, the electricity may flow in either direction. When welding with DCEN (Direct Current Electrode Negative) or straight polarity, current flows through the electrode, then through the base metal to the ground cable and back to the welding machine. When welding with DCEP (Direct Current Electrode Positive) or reverse polarity, the current flows in the opposite direction. AC, or alternating current, switches the direction of current flow hundreds of times per second when using a traditional 60 Hz power source. For most SMAW welding, DCEP or reverse polarity welding is the preferred method, but others may be used.

The **arc length**, or the distance the arc travels from the electrode tip to the workpiece, must be regulated. If the arc is too short, the electrode may stick to the workpiece. An arc that is too long results in a wide weld with **spatter**. Spatter refers to the metal particles projected from the weld puddle.

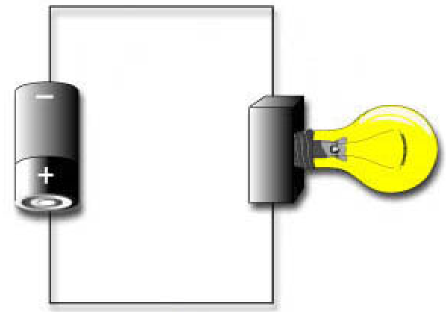

Figure 1. Like welding, a basic flashlight circuit requires a complete, closed path for electrical flow.

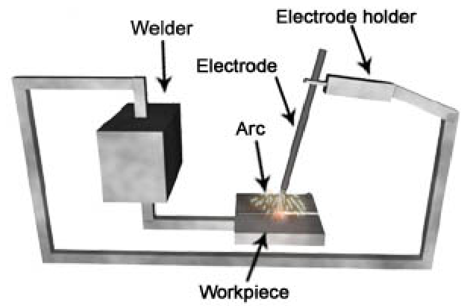

Figure 2. A basic arc welding circuit.

Lesson: 11/18

The Arc Welding Process

After the welder has observed welding safety, the next step is to strike the arc. Not all arc welding processes require the welder to strike the electrode manually. However, the most widely used arc welding process, shielded metal arc welding, requires the welder to strike the arc manually.

To strike the arc, the welder scratches or taps the workpiece with the electrode to initiate the arc within fractions of a second. Figures 1 and 2 compare two methods for striking an arc. **Scratching** is like striking a match; the electrode is dragged along the workpiece at an angle. **Tapping** requires the welder to move the electrode vertically down to the workpiece.

Once the arc is established, the welder must be able to see the weld puddle. This small area of molten metal forms as a result of the heat generated from the arc. The welder then guides the electrode along the joint to melt the metals and gradually form the weld. The welder must maintain control of the puddle and the arc length to ensure a good weld. The final weld is the **bead**, or the solid end product that fuses together the two pieces of metal.

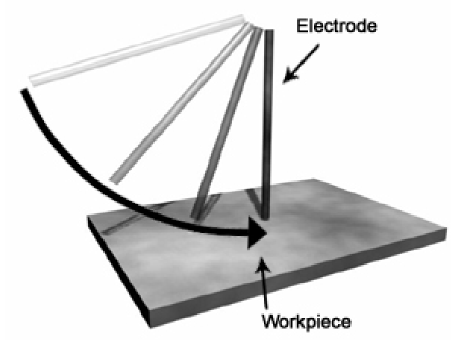

Figure 1. The scratching method.

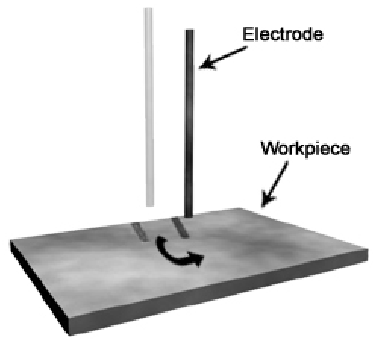

Figure 2. The tapping method.

TOOLINGU
confidence to compete

Lesson: 12/18

Electrodes

Arc welding uses either a **consumable electrode** or a **nonconsumable electrode**. A consumable electrode has two duties. It carries electricity to the arc and also serves as the **filler metal**. Along with the base metals, the consumable electrode melts during the welding process and becomes part of the finished weld.

Figures 1 and 2 compare electrode rods and wire. Consumable electrode rods, also referred to as "sticks," are approximately 9-18 inches long and from 5/64 to 1/4 inch in diameter. Since consumable rods melt away, the rods must be changed. With wire electrodes, you can work without many interruptions since the electrode feeds continuously into the weld puddle.

Figure 3 shows a nonconsumable electrode. These electrodes are usually made of **tungsten**, and they resist melting through the arc. Despite their name, however, nonconsumable electrodes eventually diminish through **vaporization**. Nonconsumable electrode wear is much like the process by which a knife's edge wears down and becomes dull after repeated use.

Figure 1. Consumable electrode rods.

Figure 2. Consumable wire electrodes.

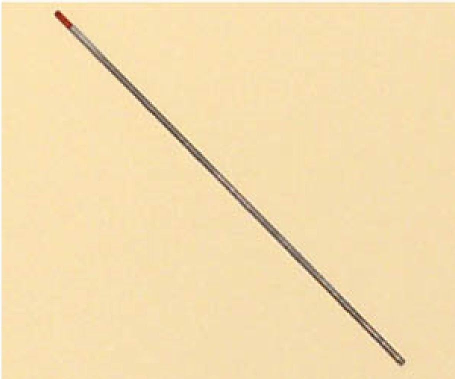

Figure 3. A tungsten electrode.

Lesson: 13/18

Arc Shielding
The high temperatures of the welding process cause the molten metals to chemically react with the gases in the atmosphere. Nitrogen, oxygen, and hydrogen in the air can damage the properties of the base metals and weld bead, which harms the welded joint.

Flux prevents this atmospheric damage. Flux is a powder material with a lower melting point than the base metals. As you can see in Figure 1, the electrode for shielded metal arc welding has a flux coating. As the flux burns in the arc, it creates a gaseous shield that protects the arc and the weld puddle.

The burning residue of the flux forms **slag**. Slag also protects the molten metal from atmospheric damage and helps with cooling. After the metal cools, slag can be removed by brushing, chipping, or scraping. Figure 2 shows a welder removing slag that has cooled.

Flux also serves another purpose during arc welding. It helps to stabilize the electric arc and aids in the reduction of spatter. Some processes use external **gas shielding** instead of flux to protect the weld from contaminants.

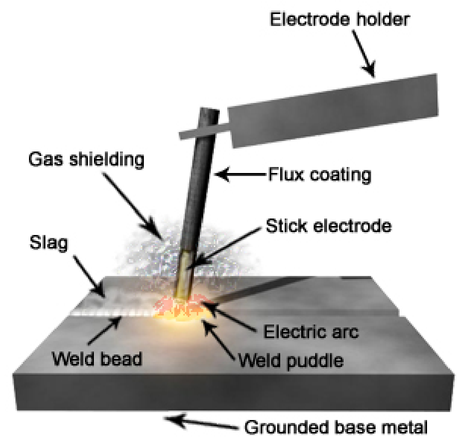

Figure 1. Flux creates a gaseous shield that protects the arc and weld puddle.

Figure 2. Chipping slag from the welded metal.

Lesson: 14/18

Types of Arc Welding Processes

There are many different types of arc welding processes established by the **American Welding Society** (AWS). However, the following are the four most common types:

- **Shielded metal arc welding** (SMAW) uses a flux-coated electrode. It is the most common welding method in the world. SMAW is a slow process, but it is mobile and inexpensive. Figure 1 shows outdoor SMAW welding.
- **Gas metal arc welding** (GMAW) uses a bare metal wire as the electrode. A welding gun feeds the wire automatically, and the arc is covered with an inert gas for shielding. There is no slag with GMAW and no loss of arc time because the welding gun feeds the wire continuously. Figure 2 shows a GMAW weld bead.
- **Flux-cored arc welding** (FCAW) uses a continuously fed electrode, much like GMAW. However, FCAW uses special wire tubing that contains the flux and consumable electrode. FCAW creates smooth and consistent weld joints. Figure 3 shows an FCAW gun.
- **Gas tungsten arc welding** (GTAW) uses a nonconsumable tungsten electrode and an inert gas for shielding. This process can be used on almost any metal; it can even join two dissimilar metals. However, GTAW is a slow process that requires the highest degree of operator skill, but produces quality welds. Figure 4 shows a GTAW weld bead.

Figure 1. A welder performing shielded metal arc welding on site.

Figure 2. A weld bead created by gas metal arc welding.

Figure 3. Flux-cored arc welding.

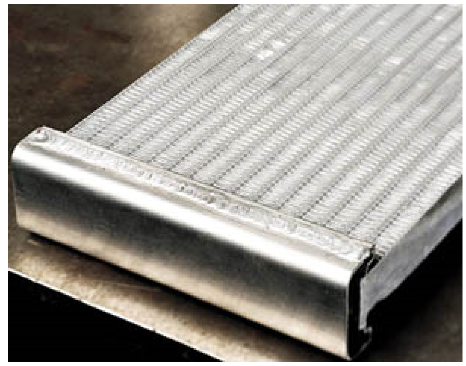

Figure 4. Gas tungsten arc welding creates precise weld beads.

Lesson: 15/18

Arc Welding Equipment

The equipment for performing an arc weld varies depending on the process. However, all welders need the basic materials. Figure 1 shows the basic materials needed to perform shielded metal arc welding. Most welding processes require a **welder**, which is the machine that generates the necessary current to strike the arc. All welding processes also require an electrode. The type of electrode you use depends on the weld process and the base metals. An **electrode cable** connects the welder to the electrode and conducts electricity.

Figure 2 shows the basic setup for an arc welding process. A **work clamp** is connected to the welder by a cable, or **work cable**. The work clamp and cable attach to the workpiece and conduct electricity. All processes also use some form of shielding to protect the molten metal from the atmosphere. Lastly, and perhaps most importantly, you must be sure to have the proper safety equipment for any welding process.

Figure 1. Basic equipment for a shielded metal arc welding application.

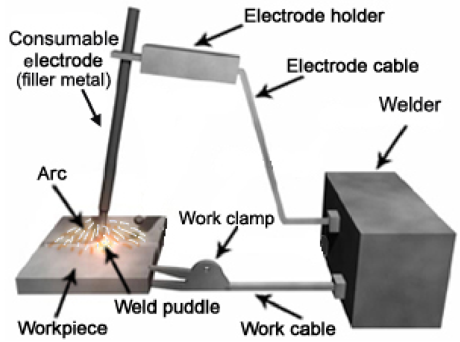

Figure 2. The components of a basic arc welding process.

Lesson: 16/18

Advantages of Welding

Arc welding processes offer significant advantages. The permanent joint formed by welding is often stronger than the base metals, and it is a fast and economical process. As you can see in Figure 1, welding makes large-scale construction easier since welders do not have to be inside the shop to perform a weld. Many welders are usually trained in a shop but do much of their work on site.

Just as any other process, welding comes with disadvantages. Many welding processes require skill and practice. Welding also is a dangerous process that requires you to be aware of your actions at all times and follow specific safety guidelines.

Career welders perform a vital service for the manufacturing industry. It is also common for welding to become a hobby as well. Whether it is working on racecars like in Figure 2, or welding a grill like in Figure 3, welding offers numerous possibilities beyond building bridges and pipelines.

Figure 1. Shielded metal arc welding performed on site.

Figure 2. Performing gas metal arc welding on a racecar.

Figure 3. Many welding hobbyists begin with welding a grill.

Lesson: 17/18

Arc Welding Safety
Before beginning the welding process, you must be aware of all safety precautions. Since welding processes can emit dangerous fumes, the work area must be well ventilated. The work area must also be free from any debris. A clean work area, like the one shown in Figure 1, is mandatory in welding.

In general, leave no skin exposed when welding. The arc's **UV rays** can burn skin and damage your vision. A protective helmet, shown in Figure 2, or a welding shield, must be worn for all welding processes. Welding gloves, usually made of leather, are essential. You can also wear a leather bib or apron. You must wear safety boots and clothing free from tatters. Figure 3 illustrates examples of protective welding clothing.

Sparks and spatter pose a risk of fire or explosion. Your clothing must be free from oil, grease, or anything flammable that might ignite. Some fabrics can melt from extreme temperatures. Wear dark-colored wool or cotton clothing. Welding processes can be very loud. To prevent hearing damage, you should wear ear protection, which also prevents sparks from landing in your ears.

The mass quantity of energy generated during a weld poses a risk of electric shock. All materials must be grounded; all surfaces must be free from water or moisture. Finally, welders must be aware of their actions at all times.

Figure 1. An example of a clean work area.

Figure 2. A welding helmet.

Figure 3. Examples of protective welding clothing.

Lesson: 18/18

Summary

Welding permanently joins together two separate components with heat, pressure, or a combination of the two to create one new part. Welding differs from other joining processes like adhesives or mechanical fastening because it is permanent, fast, and economical.

The type of metal most often welded is mild steel. The welder must control heat input during an arc weld. Fusion welding refers to welding processes that melt the base metals to create one new part. Many welding processes also use a third metal, called a filler metal, added to the weld joint.

The most common type of welding, arc welding, uses heat generated by electricity to melt the base metals. During arc welding, electricity converts into heat to melt the base metals. Electrical flow is measured in current, voltage, and resistance. Welding requires a closed circuit in which electricity can flow from the welder to the electrode, to the workpiece, and back to the equipment.

When manually striking the arc, a welder establishes the arc by striking or tapping. A process can use either a consumable or nonconsumable electrode. To prevent atmospheric damage, arc welding uses flux and protective gases to shield the weld.

There are many different types of arc welding processes. The equipment for an arc weld varies depending on the process. However, all processes require a welder, an electrode, and a work clamp. Lastly, because welding is a dangerous process, safety precautions must be observed at all times.

Figure 1. A joint formed by arc welding.

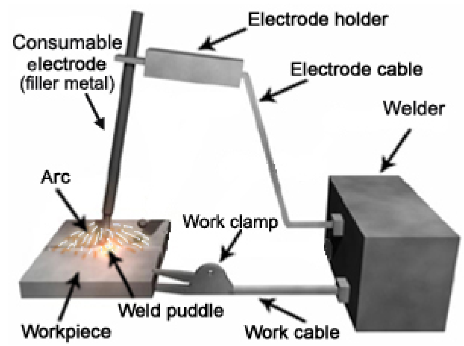

Figure 2. Basic arc welding.

Class Vocabulary

Adhesive Bonding A process that binds materials together using a non-metallic material. Paste, glue, and tape are examples of common adhesives.

Aluminum A non-ferrous, silvery-white metal that is soft and light. Aluminum is one of the most difficult metals to weld.

American Welding Society The non-profit society that regulates the industrial standards for welding.

Arc The area in which electricity jumps from the electrode to the workpiece. The heat generated by the arc melts the base metals.

Arc Length The distance that the electricity must travel from the tip of the electrode to the weld puddle.

Arc Welding A fusion welding process that uses electricity to generate the heat needed to melt the base metals.

Atom The smallest distinguishable unit of a material that maintains the same characteristics.

Autogenous Weld A welding process that does not require a filler metal. Sometimes the joint created by an autogenous weld cannot be detected.

Base Metal One of the two or more metals to be welded together to form a joint.

Bead The end product of a joint that has been welded.

Circuit A controlled path for electricity. During welding, the welder, work and electrode cables, electrode, and workpiece form a complete circuit.

Conductor A material that allows for the flow of electricity. For a successful arc weld, electrodes and base metals must be good conductors.

Consumable Electrode An electrode that conducts electricity to the arc but also melts into the weld as a filler metal.

Copper A reddish metal that is very ductile, thermally and electrically conductive, and corrosive resistant. Copper can be welded using limited methods.

Current The flow of electricity, measured in amperes or amps. Arc welding requires a continous flow of electricity to maintain the arc.

Electricity The energy created by the movement of electrons. Electrical energy can be converted into light, heat, or motion.

Electrode A device that conducts electricity. In welding, the electrode also can act as the filler metal.

Electrode Cable The path used in welding to conduct electricity from welder to the electrode. In welding, the cables are connected to the welder, the workpiece, and electrode, providing a closed electrical circuit.

Electrode Holder The insulated handle that clamps onto the electrode. The welder holds this during welding to control the arc.

Electron A negatively charged particle that orbits the nucleus of an atom. Electrons flow between atoms in electrical conductivity.

Ferrous Metal A metal that contains iron. Ferrous metals are the most common type of welded metal.

Filler Metal A type of metal sometimes added to the joint in fusion welding. Filler metal adds to the strength and mass of the welded joint.

Flux A non-metallic material used to protect the weld puddle and solid metal from atmospheric contamination.

Flux-Cored Arc Welding An arc welding process that uses a continuously fed consumable electrode that contains flux at its core. It is also referred to as FCAW.

also referred to as FCAW.

Fusion Welding A welding process that melts the base metals at the joint. Upon cooling, the welded joint is often stronger than the base metals.

Gas Metal Arc Welding An arc welding process in which the bare wire electrode and inert shielding gas are fed to the weld through a welding gun. It is also referred to as GMAW or MIG welding.

Gas Shielding A layer of inert gas that protects the weld puddle and arc from atmospheric contamination.

Gas Tungsten Arc Welding A very precise arc welding process that uses a nonconsumable tungsten electrode. It is also referred to as GTAW or TIG welding.

Insulator A material that inhibits the flow of electricity.

Joining A process that brings materials together using either fasteners, adhesives, welding, or similar methods.

Joint The meeting point of the two materials that are joined together. Welding creates a permanent joint.

Low-Carbon Steel A steel that has a carbon range between 0.05 and 0.30 percent. Also referred to as mild steel, low-carbon steel is the most commonly welded metal.

Mechanical Fastening A process that joins two materials using a clamping force. Examples of mechanical fasteners include screws, bolts, and nails.

Melting Point The temperature at which a solid becomes a liquid. Welding requires metals to reach their melting points.

Metal A hard, strong material that conducts electricity and heat, is shiny when polished, and can be bent and formed into shapes.

Molten In a liquid state. Molten metals flow as a liquid.

Nonconsumable Electrode An electrode that conducts electricity to the arc and does not become part of the finished weld.

Nonferrous Metal A metal that does not contain iron. Non-ferrous metals are more difficult to weld than ferrous metals.

Oxyfuel Welding A fusion welding process that uses a flame produced by gas containing oxygen and a gas fuel. Oxyfuel welding is also referred to as OFW.

Path A conductor that directs electricity in a circuit. The path in welding and other applications is often copper wire.

Resistance The opposition to current flow. Electricity flows in the path of least resistance.

Scratching A method of striking the arc in which the welder guides the electrode across the workpiece at an angle. The scratching method closely resembles striking a match.

Shielded Metal Arc Welding An arc welding process that uses a flux-coated rod. It is also referred to in the shop as SMAW or stick welding.

Slag Cooled flux that forms on top of the bead. Slag protects cooling metal and is then chipped off.

Spatter Liquid metal droplets expelled from the welding process. Spatter can leave undesirable dots of metal on a workpiece surface.

Stainless Steel A steel that resists tarnishing. Stainless steel can be welded using many methods.

Tapping A method of striking the arc in which the welder moves the electrode downward to the base metal in a vertical direction.

Tungsten A gray metal that is very strong at elevated temperatures. Tungsten is used to make nonconsumable electrodes.

UV Rays Harmful rays emitted by the arc during welding. UV rays can damage a welder's vision and burn skin.

Vaporization The process by which a liquid becomes a gas. Vaporization of a metal can ruin a weld.

Voltage The electrical force or pressure that causes current to flow in a circuit. Voltage is measured in volts

Volume The amount of space that an object occupies. Solids and liquids have definite volume.

Weld Puddle The small area of molten metal that forms during welding. The cooled weld puddle forms the permanent joint. A weld puddle is also called a weld pool, molten pool, or molten puddle.

Welder Either the person who performs a weld or the power source that provides the electricity needed to perform an arc weld. Printed materials may use both meanings of the term.

Welding A joining process that uses heat, pressure, and/or chemicals to fuse two materials together permanently.

Weldor A term sometimes used to refer to the person who welds.

Work Cable The path used in welding to conduct electricity from welder to the workpiece. In welding, the cables are connected to the welder, the workpiece, and electrode, providing a closed electrical circuit.

Work Clamp The object that, along with the electrode, comes in direct contact with the workpiece during welding. The work clamp is connected to the work cable.

Workpiece A part that is being worked on. The workpiece may be subject to cutting, welding, forming or other operations.