PDF TEXT
STICK WELDING

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SWF Welding

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Stick Welding

Introduction

Congratulations on your decision to learn a new skill. This self paced online welding course is designed to get you from “zero to hero” in a hurry. Welding is one of the most sought-after trades in the world and for those people who don’t weld, they wish they knew how. This is your opportunity to learn a new skill.

Who this course for?

This online stick welding course is designed for a diverse range of learners, including beginners who are just starting their welding journey, hobbyists eager to expand their skills for personal projects, and students seeking to enhance their technical knowledge or prepare for a career in welding. Whether you're looking to learn the basics of stick welding from or refine your techniques and to tackle more advanced projects, this course offers clear, step-by-step instruction to suit your needs. It’s also ideal for those wanting to upgrade their current welding abilities, improve their understanding of equipment and materials, or gain the confidence to weld in a variety of settings.

This course is for you if:

- You don't have the time for night or weekend classes, but you've always wanted to learn welding.
- You've been thinking about welding, and you want to level up your skills and tackle metal Fabrication.
- You want expert instruction without the need for expensive travel and firm class schedules.

Stick welding is a great starting point for beginners because of its simplicity, versatility, and affordability. It lays the groundwork for understanding key welding principles, while also being forgiving enough to allow beginners to practice and improve quickly. Learning stick welding (Shielded Metal Arc Welding, or SMAW) first is often considered a solid choice for beginners due to several key advantages. ***Here are a few:***

Minimal Equipment

Stick welding requires fewer tools compared to other welding methods like TIG or MIG. All you need is a welding machine, electrodes, a ground clamp, and protective gear.

Works on a Variety of Materials

Stick welding can be used on many different metals (steel, stainless steel, cast iron, etc.) and thicknesses. It's ideal for general-purpose welding and repair work, making it a versatile skill for a wide range of applications.

Indoor and Outdoor Capability

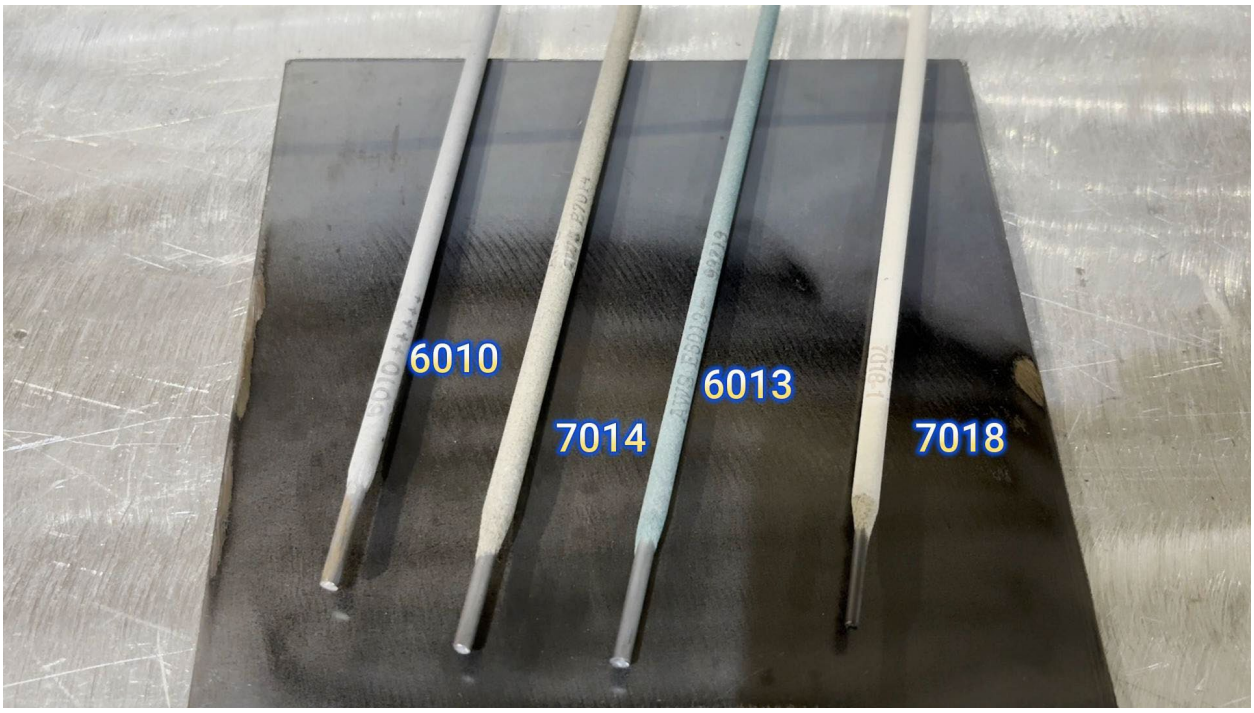
Unlike some other welding methods that require a clean, controlled environment, stick welding is more forgiving in outdoor and less-than-ideal conditions. It’s often used in construction, repair, and maintenance work in places like construction sites and farms.

Minimal Surface Preparation

Stick welding is more forgiving of surface contaminants (such as rust, dirt, and oil) compared to methods like TIG and MIG welding, which require cleaner surfaces. This makes it easier for beginners to focus on technique without worrying too much about the material's surface.

Electrode Flux Coating

The flux coating on stick electrodes helps to protect the weld from contamination by producing a shielding gas during the weld. This means there's less risk of issues like oxidation or contamination, especially in outdoor or challenging environments.



Good Penetration

Stick welding produces strong welds with excellent penetration, especially useful for thicker materials. This makes it an ideal choice for structural work, repairs, and heavy-duty applications.

All-Position Welding

Stick welding is often used for welding in all positions (flat, horizontal, vertical, and overhead), which helps students develop a well-rounded skill set early on. This versatility is valuable when moving on to more advanced welding techniques.

Affordable Equipment

Stick welding machines tend to be less expensive than MIG or TIG machines, especially for beginners. The cost of equipment is a big consideration for those just getting started in welding, and stick welding provides an accessible entry point into the field.

Fast Learning Curve

Because of its relatively simple nature and the immediate feedback from the welding process, beginners can start producing functional welds quickly. This leads to a sense of accomplishment and motivation to continue learning. Stick welding allows you to see the results of your work in real time. It's easy to inspect the bead, check for defects, and adjust as needed.

Course Structure

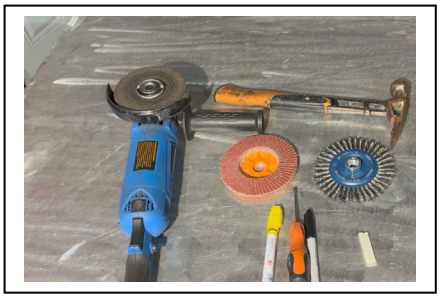
In this Course you will:

- Gain an understanding of Stick Welding principles.
- Learn about Stick welding tools and equipment and how to choose the right welder.
- Explore the various electrodes.
- Understand different joints, weld types and positions associated with stick welding.
- Troubleshooting and apply corrective actions.
- Identify weld Faults and apply corrective action.
- Learn Fillet Welds on Lap Tee and Corner joints.
- Learn Groove welds.
- Learn Fabrication and fabrication principles.

Module 1: Introduction to Stick Welding

- Overview of stick welding (SMAW)
- Safety practices and personal protective equipment (PPE)
- Welding equipment and power sources

Module 2: Setting Up for Welding



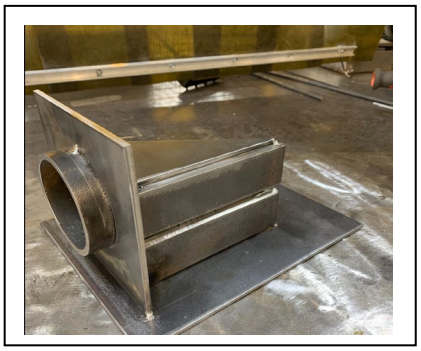
- Hand tools
- Electrodes (stick rods)
- Joint, weld types and positions

Module 3: Basic Welding Techniques and Troubleshooting

- Striking an arc
- Stringer beads
- Weaving
- Bead padding
- Weld faults
- Puddle recognition

Module 4: Intermediate Welds and Problem Solving

- Flat tee Joint (1F)
- Flat corner Joint (1F)
- Horizontal tee joint (2F)
- Lap joint (2F)



Module 5: Advanced Weld Techniques and Fabrication

- Flat Groove Welds (1G)
- Skills Fabrication project (1F,2F,3F 1G, 2G positions)

Stick Welding Overview

Stick welding, also known as Shielded Metal Arc Welding (SMAW) or Arc Welding, is a widely used welding process that has been around for many years. Stick Welding is a great choice due to its simplicity, versatility, and portability. It is one of the oldest and most widely used welding process. Stick welding involves creating an electric arc between a metal flux coated consumable electrode and the workpiece. The arc, between the electrode and the workpiece, provides the

intense heat required to melt the base metal and flux coated electrode. This heat causes the electrode and the workpiece to melt and fuse together, forming a high strength deposit.

Like any welding method, stick welding has its own set of advantages and disadvantages. Here are some of them: Stick welding is a versatile and cost-effective welding process, but it does come with some challenges in terms of achieving high-quality welds and productivity. The choice of welding method depends on factors such as the material, joint configuration, and the skill level of the welder.

Advantages and Disadvantages of stick welding

Advantages	Disadvantages
Versatility Stick welding is versatile and can be used in various positions (flat, horizontal, vertical, overhead) and on a wide range of materials, including steel, stainless steel, cast iron, and some non-ferrous metals.	***Steeper Learning Curve*** Stick welding can be challenging, especially for beginners. The process may produce more spatter and slag, requiring more post-weld cleanup. Mastering stick welding requires skill and practice.
Portability Stick welding equipment is relatively portable and doesn't require a complex setup. This makes it suitable for fieldwork and outdoor welding where other types of welding processes might be impractical.	***Deposition Rate*** Stick welding is generally slower compared to some other processes welding processes. Lower productivity due to is low deposition rate (amount of weld that can be deposited). This can result in lower productivity, especially for large projects.
Cost-Effective Stick welding machines are generally more affordable than some other types of welding machines. The consumables (electrodes) are also cost-effective compared to wire-fed processes like MIG welding.	***Post Weld Cleanup*** Stick welding requires cleanup after the fact. Because the electrodes have a flux coating, the flux coating breaks down in the heat of the arc leaving a left-over slag that must be removed, especially between multiple passes.
No Shielding Gas Required Stick welding doesn't require an external	***Productivity*** Stick welding can be less productive than

shielding gas, making it convenient for use in environments with wind or drafts.	other welding processes due to the down time cleaning and changing electrodes
Simple Equipment Stick welding equipment is relatively simple, consisting mainly of a power source and welding electrodes. This simplicity can reduce the likelihood of equipment failure and ease maintenance.	
Penetration Stick welding is known for its ability to provide deep penetration into the base metal, making it suitable for welding thick materials.	

Terms and definitions

These definitions provide a basic understanding of the terms commonly used in stick welding. Knowing these terms is essential for achieving successful and effective stick welds.

Stick Welding: Also known as Shielded Metal Arc Welding (SMAW), it is a manual arc welding process in which a consumable electrode coated with flux is used to create the weld. The weld area is protected from atmospheric contamination by the flux coating on the electrode.

Welding Power Source: A piece of equipment that converts electrical energy from an external power supply into the necessary welding parameters, such as current and voltage.

Electrode Holder (Stinger): The electrode holder is a clamp-like device that holds the welding electrode and connects it to the welding power source via a cable. It allows the welder to control the position and movement of the electrode during welding.

Work Clamp (Ground): The ground clamp is another clamp connected to the welding power source via a cable. It's attached to the workpiece to complete the electrical circuit and provide a return path for the welding current.

Welding Electrodes: Stick welding electrodes are consumable metal rods coated with a flux material. The flux coating serves multiple purposes, including protecting the molten weld pool from atmospheric contamination, stabilizing the arc, and facilitating slag removal. Electrodes

come in various types and sizes, each suitable for specific welding applications and base materials.

Welding Cables: These cables connect the welding power source to the electrode holder and ground clamp. They conduct the welding current from the power source to the workpiece through the electrode and back to the power source through the ground clamp.

Electrode: The welding rod or electrode is a consumable metal rod with a flux coating. It conducts the welding current to the workpiece and provides the filler material for the weld. Electrodes come in various types and are selected based on the material being welded.

Flux: A material that covers the electrode and melts during welding to protect the weld pool from atmospheric contamination. The flux also forms a slag that covers the weld bead, helping to cool and shape it.

Arc Length: The distance between the tip of the welding electrode and the surface of the workpiece. Maintaining the correct arc length is crucial for achieving a stable and controlled welding process.

Slag: The protective layer of melted flux that covers the weld bead after solidification. Slag is removed after welding to reveal the completed weld.

Weld Bead: The deposit of molten metal created by the welding process. It forms the actual weld joint.

Weaving: A technique in which the welding electrode is moved back and forth across the joint during welding. Weaving helps distribute heat and filler material, creating a wider and stronger weld.

Stringer beads: A welding technique where the welder runs a single pass along the joint in a straight line. This creates a narrow bead of weld metal that follows the path of the welding electrode or filler rod.

Arc Flash: Refers to the intense burst of light and radiation produced when the electric arc is struck during the welding process. This flash emits harmful ultraviolet (UV) and infrared (IR) radiation, as well as visible light, all of which can severely damage the eyes if proper protection is not used.

Polarity: In stick welding, polarity refers to the direction of current flow. There are two types: DCEN (Direct Current Electrode Negative) and DCEP (Direct Current Electrode Positive). The choice of polarity depends on the type of electrode used and the desired welding characteristics.

Welding Current: The electrical current flowing through the welding circuit during the welding process. The selection of the appropriate welding current is important for achieving the desired penetration and bead characteristics.

Root Pass The first weld bead applied in a multi-pass welding process. It is often followed by additional passes to complete the weld joint.

***Fill Pass*:** Sometimes associated with groove welds, refers to the process of adding filler material to the joint after the root pass has been completed. This would be the second set of welds after the root pass. The fill pass, on the other hand, builds up the weld metal to fill the remaining space between the joint's edges. This pass helps to add strength, volume to the weld.

Cap Pass: A cap pass is the final layer of the weld; it is applied to the top of a multi-pass weld. This pass reinforces the weld joint strength and appearance. The cap pass is applied after the root and fill passes have been completed, and it is typically done to improve the appearance of the weld and cover any imperfections.

SNEAK PEAK

Requirements

Welding Machine: Can be AC or DC. DC is preferred for better arc stability resulting in a cleaner looking weld bead.

Accessories: Electrode holder and Work clamp (also known as ground clamp)

Electrodes: Available in various types and sizes, selection is determined by type of material being welded and purpose. E6013, E7018 3/32”-1/8”

Protective Gear: Personal Protective Equipment includes welding helmet, gloves safety boots and appropriate clothing.

Suggested Tools: Wire brush, chipping hammer, welding clamp, pliers and optional angle grinder with disks.

Stick Welding Equipment

Stick welding typically uses direct current (DC) for the welding process. The two main types of Direct currents are Direct Current Electrode Positive (DCEP) and Direct Current Electrode Negative (DCEN). Other than some Flux Core applications and optional stick welding rods, DCEP, the positive terminal of the power source is connected to the electrode holder (stinger), while the negative terminal is connected to the work (ground) clamp. This polarity provides deeper penetration and provides a smoother arc for Stick welding.

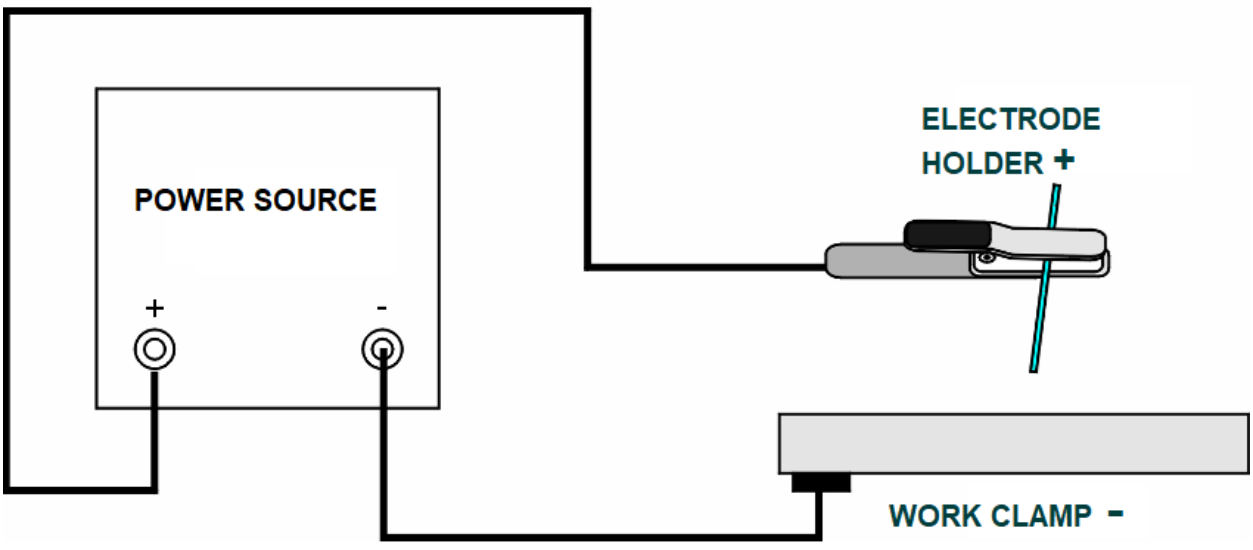


Figure 1 DCEP or Reverse Polarity

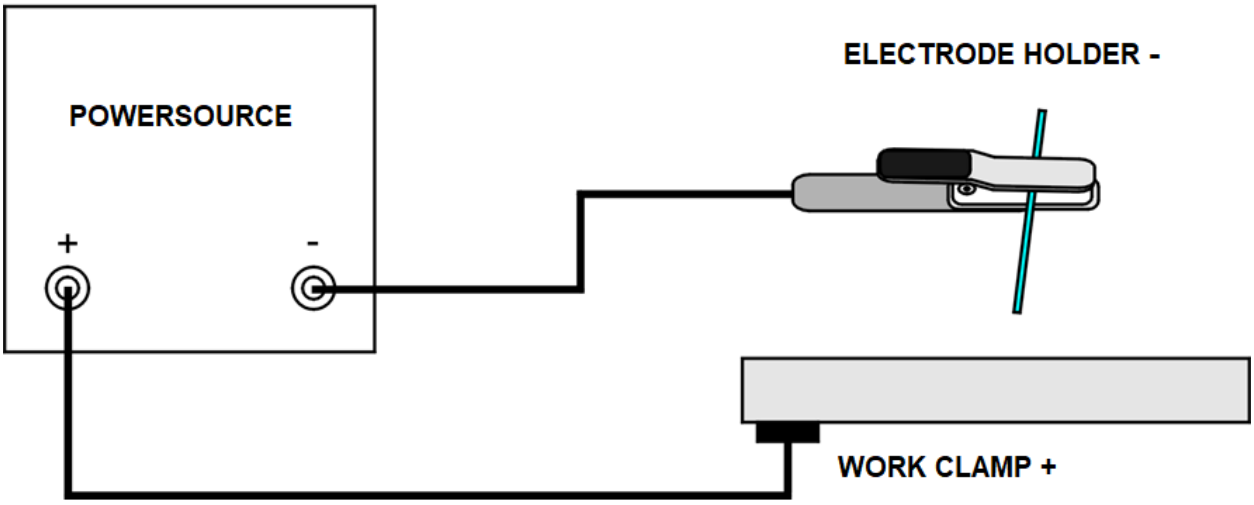


Figure 2 DCEN or Straight Polarity

Welding Machines (Power Sources)

CC and CV

Welding power sources can be either constant current or constant voltage or both. A constant current also known as a CC power source, is most used for stick welding. It provides a steady constant flow of current or amperage output, the operators arc length (distance from the tip of electrode to the workpiece) controls welding voltage.

Inverter Power Source

Inverter-based power sources are becoming the most popular because they can be used as a multi process machine. These power sources use advanced electronic circuitry to convert incoming alternating current (AC) power to a stable DC output. They are known for their compact size, energy efficiency and intuitive technology.

Transformer Power Source

Transformer-based power sources are traditional and widely used welding. These power sources rely on transformers to convert the input power to the required welding voltage and

current. Transformer-based power sources tend to be larger and heavier compared to inverter-based power sources.

Generator Power Source

A generator power source is a device that converts mechanical energy into electrical energy. It provides electrical power when other sources are not available. Generators are used in locations without access to the electrical grid, such as construction sites and remote areas. They are rated based on the amount of power they can produce and typically measured in watts (W) or kilowatts (kW). It's crucial to choose a generator power source with a power rating that meets your needs.

Choosing an appropriate power source (welder) for your needs

If you are a beginner or hobbyist welder, before acquiring a specific welder it is important to determine which welding process(es) you wish to learn. If you are looking to weld more than one process you might consider purchasing an inverter style welder to avoid purchasing multiple

power sources down the road. An inverter allows you to perform multiple welding processes in one machine.

The choice of power source depends on factors such as the welding application, desired welding performance, portability, and budget. It's important to consider the specific needs and requirements of your welding setup and consult with welding equipment suppliers or professionals to determine the most suitable power source for your application. ***We can help!!!!***

Welding Process

Determine which welding process suits your needs and skill level. If you are looking to weld more than one process (Stick, Tig, Mig) to avoid purchasing multiple power sources down the road, you will want to purchase an inverter type welder. Each process has its advantages and is suitable for different types of welding projects.

Power Supply

Consider the power supply available in your workspace. Welding machines typically require either 120V or 240V power input. Ensure that you have the appropriate power outlet and sufficient power capacity for the welder you choose.

Metal Types and Thickness

Consider the types of metals you intend to weld and their thicknesses. Different welders have different capabilities and are better suited for specific materials and thicknesses. Ensure that the welder you choose can handle the metals you plan to work with.

Duty Cycle

The duty cycle refers to the amount of time a welder can operate within a 10-minute period before needing to cool down. For example: if a welder has a 20% duty cycle, this means it will run for 2 minutes straight at full output and will need to rest for 8 minutes. Hobbyist welders generally have lower duty cycles compared to industrial-grade machines. Consider the duty cycle of the welder to ensure it can meet your needs without overheating.

Ease of Use

As a hobbyist, you may prefer a welder that is user-friendly and easy to operate. Look for welders with intuitive controls, clear displays, and features like adjustable wire feed speed and voltage. It's beneficial to choose a welder that you can quickly learn to operate effectively.

Portability:

If you plan to move your welder frequently or work in different locations, consider the portability of the machine. Some welders are compact and lightweight, making them easier to transport.

Budget

Set a budget for your welding equipment. Welders come in a wide price range, so consider the features and quality you require within your budget. It's essential to balance affordability with the necessary features for your welding projects.

Safety Features

Check for essential safety features, such as thermal overload protection, voltage reduction devices, and proper grounding provisions. Safety should always be a priority when working with welding equipment.

Warranty and Support

Look for welders from reputable manufacturers that offer warranties and reliable customer support. A good warranty can provide peace of mind and assistance if any issues arise with the machine.

By considering these factors, you can select a welder that suits your needs, skill level, budget, and the type of welding projects you plan to undertake for years to come.

It is advisable to reach out to us if you have any questions regarding a specific power source choice. We would be happy to put together a list of welders to consider.

Sneak Peak

Preparing for Welding

Safety First: Always wear protective gear to shield yourself from UV rays, sparks, and heat. Ensure proper ventilation in the work area to avoid inhaling fumes.

Surface Preparation: Clean the metal surfaces to remove rust, paint, or contaminants. Use a grinder or wire brush for best results.

Setting Up Equipment: Electrode Selection: Choose the correct electrode type and size for the material and thickness.

Machine Settings: Adjust the amperage according to the electrode and material thickness.

Welding Safety

Safety should always be your top priority when welding. By following these guidelines and using common sense, you can greatly reduce the risk of accidents and injuries in the workshop. If you have any questions or concerns, don't hesitate to reach out. Now, let's gear up and get ready to weld safely!

The first line of defense against welding hazards is Personal Protective Equipment. Various hazards associated with the welding process, such as intense heat, UV radiation, sparks, electrical shock, and fumes can be harmful if not taken seriously. You want to avoid all synthetic materials when working with any hot work. This means avoiding materials such as polyester, fleece and micro fleece. **Cotton leather or wool** is your best choice.

Here's our list of PPE

Welding Helmet	A welding helmet is a protective headgear worn by welders to shield their eyes, face, and neck from the intense light, heat, sparks, and radiation produced during welding. Welding helmet with a suitable lens shade to protect the eyes from arc radiation must be worn.
Safety Glasses	Protective eyewear designed to shield the eyes from flying debris, dust, and other hazards present in a welding or fabrication environment. They are often worn in conjunction with a welding helmet.
Welding Gloves	Heat-resistant, durable gloves made from materials like leather, Kevlar, or aluminized fabric. They protect the welder's hands from sparks, heat, molten metal, and sharp objects while providing dexterity and comfort during welding tasks.
Long-Sleeved Clothing	Non synthetic long-sleeved clothing prevents burns and protects your skin from UV radiation. Worn in conjunction with other safety clothing.
Welding Jacket or Apron:	A welding jacket or apron is made from fire-resistant materials such as leather or heavy-duty cotton. It protects the welder's torso, arms, and legs from sparks, heat, molten metal, and UV radiation. The jacket typically includes long sleeves, while an apron covers the front of the body and waist area.
Safety Boots	Protective footwear designed to safeguard the welder's feet from falling objects, sharp debris, molten metal, and electrical hazards. They are

	typically made of leather or steel-toed materials for added protection and are slip-resistant to reduce the risk of falls.
Ear Protection (if needed)	Shields your ears from the loud noise and hot sparks produced by welding. Prolonged exposure to loud sounds from welding, cutting, or grinding can lead to hearing damage, so ear protection is essential.
Respirator	A respirator is a device that filters out harmful airborne particles, gases, and fumes to protect the welder's lungs. Welding produces toxic fumes from materials like metals, flux, and coatings, and a respirator is used to ensure that the welder does not inhale these hazardous substances. Respirator or welding mask with a proper filter to protect against fumes and gases generated during welding should be worn when needed

Workstation

Ventilation

Ensure proper ventilation to disperse welding fumes and gases. If indoors, consider using a fume extractor or welding hood. Proper ventilation is critical in welding operations to protect yourself from harmful fumes and gases produced during the welding process. Minimize exposure to welding fumes by positioning yourself upwind or using respiratory protection if necessary. Keep your head out of the plume, this means keeping your head out of the smoke.

1. Fume extractors or exhaust systems are designed to capture and remove welding fumes at the source, close to the welding arc.

2. Installing exhaust fans in the welding area can help maintain airflow and prevent fume accumulation. These fans should be strategically placed to push contaminated air out of the room.

3. Open Windows and Doors: If working in an enclosed space, make sure to open windows and doors to allow fresh air to circulate and carry fumes outside. However, this method alone may not be sufficient in high-volume welding areas.

Clean Workspace

Maintaining a clean workspace while welding is essential for both safety and efficiency. A cluttered or dirty environment can increase the risk of accidents, compromise the quality of your welds, and create exposure to hazardous materials.

1. Remove any flammable materials, clutter, or tripping hazards from your work area.

2. Before starting any welding work, make sure the area is free from flammable materials, including paper, wood, and oily rags.

3. Before beginning your welding project, ensure that the surfaces to be welded are clean and free from contaminants. Rust, oil, grease, and paint can cause weld defects, such as porosity or weak bonds.

4. Keep your welding tools and accessories organized and within reach. Use toolboxes, shelves, or carts to store items like welding electrodes, clamps, gloves, and other equipment.

Fire Extinguisher

Keeping a fire extinguisher close to the welding work area is an essential safety practice. Welding involves high heat, sparks, and molten metal, which pose a significant fire risk. A fire extinguisher is a critical safety tool that can quickly address any fire that may arise from welding operations.

Electrical Safety

Electrical safety is a critical consideration when welding, as welding equipment operates at high voltage and current. Improper handling of electrical components or equipment can result in electrical shocks, burns, and even fatalities. Here are key safety practices for preventing electrical hazards when welding:

Inspect Cables: Before starting any welding work, inspect welding cables, wires, and connections for any signs of damage, wear, or exposed wires. Frayed or damaged cables can create electrical hazards and increase the risk of electrical shock.

Test Equipment: Make sure that all welding machines, electrodes, and ground clamps are in proper working order. Check that the equipment is properly grounded and that no exposed parts are in contact with conductive materials.

Verify Power Sources: Ensure that power sources are appropriately rated for the welding machine you're using, and make sure connections are securely fastened to prevent loose connections that could lead to electrical arcing or sparks.

Arc Flash: Avoid looking directly at the welding arc to protect your eyes from damage. Utilize the helmet's auto-darkening feature. Wearing clear safety glasses always can greatly reduce the chances of arc flash. Having the extra layer of protection between the light and your eyes causes the light to travel through multiple filters. If arc flash occurs, seek medical attention.

Grounding: Proper grounding of the welding machine is essential to prevent electric shock. Always ensure that the machine is grounded according to the manufacturer's guidelines. Ensure proper grounding of both the welding machine and workpiece to prevent electrical shock.

Electrical Shock: Avoid welding in damp or wet environments. Wet surfaces can increase the risk of electrical shock. Never weld while standing in water or on wet ground. If welding in damp areas cannot be avoided, wear rubber soled boots and rubber gloves under your welding gloves to protect yourself from electrical shock.

Extension Cords: When using extension cords with welding machines, make sure they are rated for the correct voltage and current. Use industrial-grade, heavy-duty extension cords that can handle the power requirements of your welding equipment. Regularly inspect extension cords for signs of wear, fraying, or exposed wires. Avoid using an extension cord that is damaged or shows signs of wear.

Sneak Peak

Welding Technique

Strike an Arc- Touch the electrode to the workpiece and quickly lift it to create an arc. A smooth, steady motion helps maintain the arc.

Maintaining the Arc- Hold the electrode at a consistent angle (typically 15-30 degrees from vertical). Keep the arc length (distance between the electrode and the workpiece) as short as possible to ensure stability.

Travel Speed- Move the electrode steadily along the weld joint. Maintain a consistent speed to ensure even penetration and bead appearance.

Hand Tools for Stick Welding

Chipping Hammer and Wire Brush: After welding, leftover slag from the flux coating needs to be removed from the weld bead and surrounding area. A chipping hammer is used to chip away the slag, it has a pick and chiselled end for taping gently. While a wire brush is used to clean the weld and prepare it for inspection or further processing welders will sometimes use an angle grinder with a wire wheel.

Pliers: Welding pliers are commonly used for gripping hot metal, removing spatter, and holding small pieces of hot work during welding. These are best used for handling small metal pieces during the welding process.

Chalk or Soapstone: Used for marking guidelines and reference points on the workpiece.

Angle Grinder: For cutting parts and cleaning material pre and post welding. It is important to understand how to use an angle grinder safely. Always refer to manufacturers' recommendation.

C-Clamps or Welding Clamps: Used to secure workpieces in position during welding, preventing movement or misalignment. These tools are designed to provide steady pressure to hold workpieces while maintaining their position. Some models have insulated handles or pads to protect from heat.

Tape Measure: Used to measure the dimensions of workpieces, distances, or weld joint specifications.

Combination Square: The combination square is an indispensable tool for welders, it helps ensure accurate angles and squareness during layout and welding preparation. Combination squares feature a 90, 45 deg angle, level, and a marking tool.

Welding Magnetics: Assist in holding metal pieces at precise angles and alignments for tack welding. Be sure to only use the magnet for tacking and fitting, the magnets can disrupt the welding arc.

Electrodes

Mild steel electrodes consist of a **core wire** made from mild steel and an **outer flux coating** that plays a critical role in the welding process.

Core Wire

The core wire is typically made from mild steel, which is composed of primarily iron (Fe) with a small percentage of carbon (C). It is not until the flux coating is melted down in the arc that you get a high strength deposit.

Flux Coating:

The flux coating on mild steel electrodes is made from a mixture of minerals, binders, and chemicals, and it serves several important functions:

- Shielding the weld pool from atmospheric contamination (oxygen, nitrogen, moisture) by creating a gas shield during the welding process.
- Stabilizing the arc to ensure smooth and consistent welding.
- Improving weld bead appearance and preventing defects such as spatter and porosity by controlling the solidification of the weld.

- Deoxidizing the weld pool to prevent oxidation and ensure proper fusion between the base metal and the weld.
- Slag Formation: The flux coating forms a layer of slag over the weld bead, which helps protect the newly deposited metal as it cools and solidifies.

Mild Steel Electrodes

Mild steel electrodes are available in different types based on their coating, current type compatibility (AC or DC), and intended use. The following are common classifications:

E6010 Electrode:

Characteristics: These electrodes have a deep penetration characteristic and are primarily used for root pass welding in pipe welding or structural applications. E6010 electrodes work best with DC (direct current) but can also be used with AC (alternating current). The flux coating creates a stable arc with deep penetration and is particularly effective in conditions where the workpiece may be dirty or rusty.

Use: Ideal for pipe welding, field repairs, and projects requiring deep penetration into thicker materials.

E6011 Electrode:

Characteristics: Similar to the E6010, but with improved flexibility and ease of use. These electrodes can work well with both AC and DC current and provide good arc stability and penetration. The E6011 is often used in outdoor welding applications due to its resistance to contamination (moisture, rust).

Use: Commonly used in situations where there is contamination on the base metal, such as welding over rust or paint, and in general fabrication.

E6013 Electrode:

Characteristics: The E6013 is a versatile electrode that is used in both flat and horizontal welding positions. It provides smooth and easy-to-handle arcs, making it ideal

for amateurs and beginners. The flux coating creates a soft arc with moderate penetration and produces a clean weld with minimal spatter and good bead appearance.

Use: Ideal for light to medium welding tasks, such as general steel fabrication, home projects, and repair work.

E7018 Electrode:

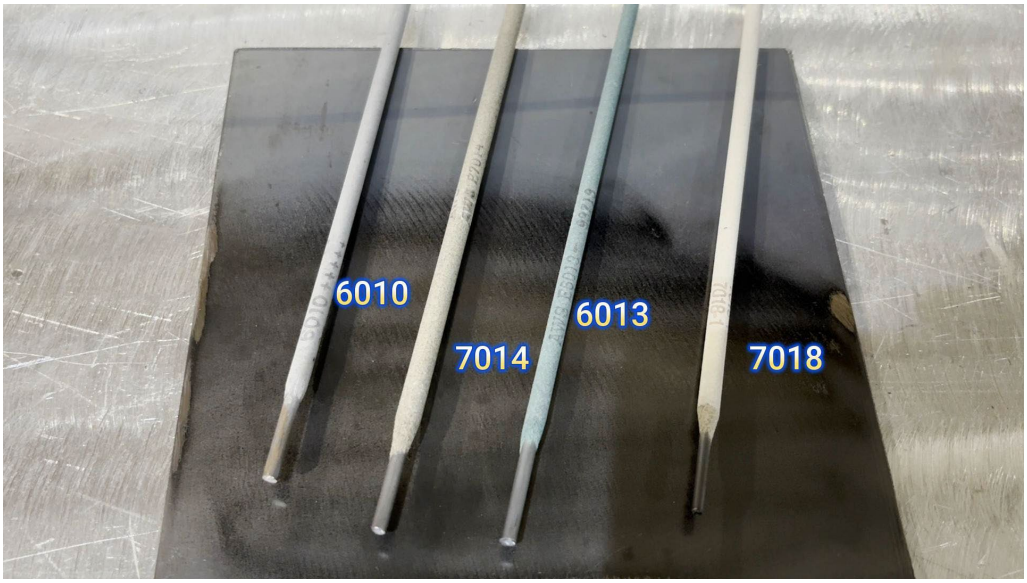
Characteristics: These electrodes have a low-hydrogen coating, which helps produce welds with excellent strength and toughness. The E7018 electrode provides a stable arc, low spatter, and excellent weld bead appearance. It is designed for high-strength welds and is highly resistant to cracking.

Use: Widely used for structural welding, pressure vessel manufacturing, and applications requiring high-strength joints (e.g., bridges, buildings, heavy machinery).

E7024 Electrode:

Characteristics: Known for its fast fill and high deposition rates, the E7024 electrode is designed for flat and horizontal welding positions. It has a thicker coating and produces a high-quality weld bead with good penetration and a smooth finish.

Use: Primarily used in flat positions, it is suitable for high-speed welding on large, thick sections of mild steel where strong, clean welds are needed.



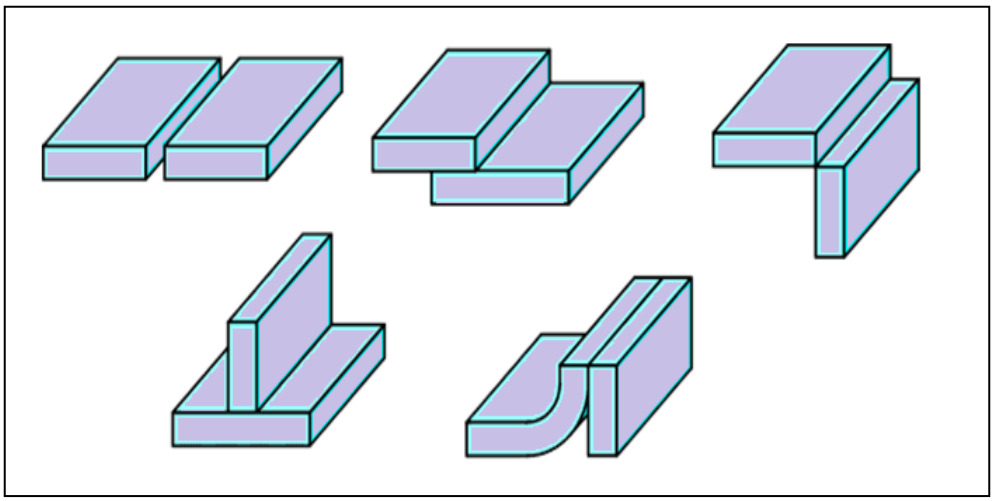
Characteristics of Mild Steel Electrodes

Characteristics	
Arc Stability	The quality of the arc formed between the electrode and the workpiece can greatly affect the weld's quality. Mild steel electrodes are designed to provide a stable arc, which is critical for producing consistent welds.
Weld Bead Appearance	The type of electrode used directly impacts the weld bead's appearance. For example, E6013 electrodes are known for their smooth, aesthetically pleasing weld beads while E7018 electrodes provide strong, crack-resistant welds with good visual results.
Penetration	Different mild steel electrodes offer varying levels of penetration. Electrodes like E6010 have deeper penetration, making them suitable for welding thicker materials, while E6013 electrodes offer more superficial penetration and are better for thinner materials.
Ease of Use	Some electrodes are easier to use than others, making them ideal for beginners. E6013 electrodes, for instance, are known for their easy handling, minimal spatter, and clean weld appearance, making them a good choice for those new to welding.
Current Type	Mild steel electrodes can be used with either DC (direct current) or AC (alternating current). Some electrodes are designed for specific current types, while others are more versatile and can be used with both. The choice of current type affects the weld characteristics,

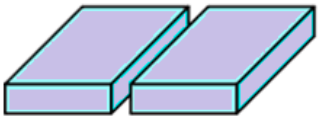
	including penetration, heat distribution, and arc stability.
Selecting the Right Mild Steel Electrode	When choosing a mild steel electrode, consider the material thickness you are welding. Choose an electrode with adequate penetration for the material thickness you are working with. For thicker materials, electrodes like E6010 or E7018 are ideal, while E6013 works well for thinner materials.
Position of Welding	Some electrodes, such as E7024, are best for flat or horizontal positions, while others like E6010 and E7018 are more versatile and can be used in a wider range of positions, including vertical and overhead.
Welding Environment:	Consider the environment in which you're welding. If you're working outdoors or in less-than-ideal conditions, electrodes with better resistance to moisture and contamination, like E6011, may be the best choice.
Weld Strength	For higher-strength applications, electrodes like E7018 are often required because they produce high-strength, crack-resistant welds.
Ease of Use	If you're a beginner, you might prefer E6013 electrodes due to its easier striking ability and smooth finish.

Weld Joints

A **weld joint** refers to the point or area where two or more pieces of metal are joined together using a welding process. The weld joint acts as the strength of the final weld. Weld joints fall under one of 5 different types.



Butt, Corner, Tee, Edge, Lap



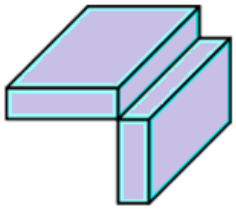
Butt Joint

- **Definition:** A butt joint is formed when two pieces of metal are placed end-to-end or aligned side-by-side. This weld joint is associated with groove welds and is a common type of joint in welding.

- **Applications:** Butt joints are typically used in welding sheet metal, plates, and pipes where the welded pieces need to align flush.

- **Welding Process:** This joint often requires edge preparation such as beveling or grooving to allow for adequate penetration of the weld.

- **Strength Considerations:** While the butt joint provides good strength when welded properly, the edge preparation is often essential for effective penetration.



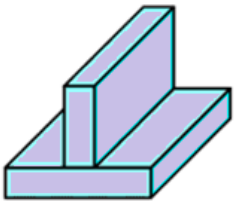
Corner Joint

- **Definition:** A corner joint is made when two pieces of metal are joined at a right angle, typically with one piece butting against the other at 90 degrees.

- **Applications:** This joint is commonly used in the construction of frames, boxes, and enclosures, as well as in sheet metal work.

- **Welding Process:** Corner joints can be welded in the outside corner or inside corner configurations, and the welder may need to perform edge preparation.

- **Strength Considerations:** The strength of corner joints depends on the proper alignment and weld size, particularly when the joint is welded from the inside.



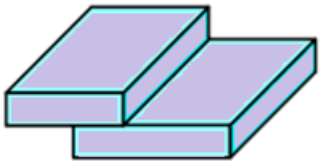
T-Joint

- **Definition:** A T-joint is formed when one piece of metal is placed perpendicular to another, resembling the shape of the letter "T." The top piece is typically welded to the vertical piece.

- **Applications:** This joint is frequently used in structural work, such as building frames, or in general fabrication.
- **Welding Process:** T-joints often require a fillet weld (a weld along the corner) to connect the two pieces and can be welded in different positions depending on the angle of the joint.
- **Strength Considerations:** Fillet welds in T-joints are commonly used because they provide a strong connection between the two pieces. The joint's strength is influenced by the size and quality of the fillet weld.

Edge Joint

- **Definition:** An edge joint is formed when two pieces of metal are placed edge-to-edge, with the edges touching each other.
- **Applications:** This joint is typically used in sheet metal work or for thin materials, such as in the construction of ducts, boxes, and certain types of panels.
- **Welding Process:** Edge joints are often welded using a fillet weld, though butt welds may also be applied depending on the thickness and configuration of the pieces being joined.
- **Strength Considerations:** The edge joint is not as strong as other joints as it does not offer as much surface area of welded material.

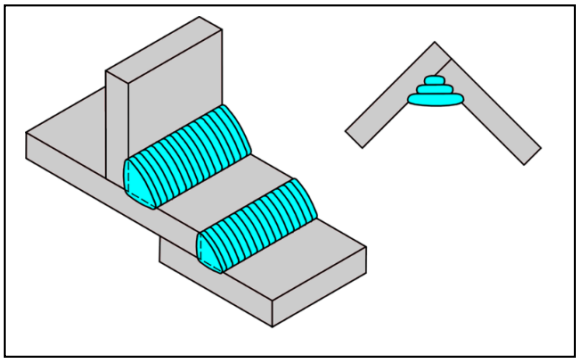


Lap Joint

- **Definition:** A lap joint occurs when two pieces of metal are overlapped, and a weld is applied along the edge of the overlap.
- **Applications:** Lap joints are widely used in situations where fillet welds are desired such as in sheet metal work or thin-walled materials such as the automotive industry.
- **Welding Process:** The lap joint can be welded with a fillet weld.
- **Strength Considerations:** While lap joints are generally strong, the overlap and the weld size should be carefully chosen to ensure that the joint can handle the forces it will encounter in use.

Weld Types

- Fillet Welds
- Groove Welds
- Plug/Slot Welds
- Surface Welds

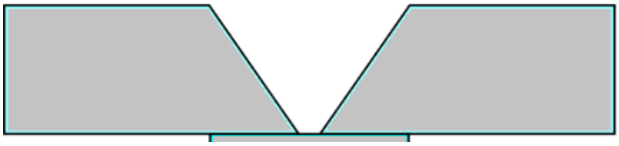


Fillet Welds

A fillet weld is a triangular-shaped weld used to join two pieces of metal that are placed at a right angle (90 degrees), like in T-joints or Lap joints. A fillet weld should be flat to slightly convex depending on its use and application. Fillet welds usually lends itself to structural and general fabrication.

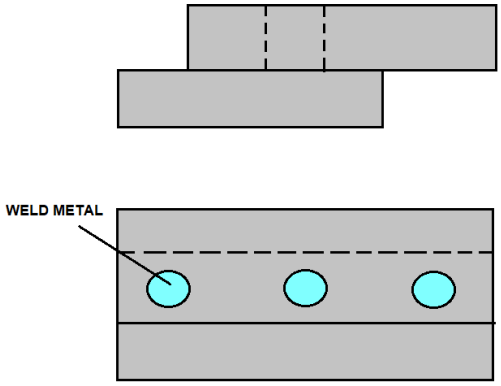
Groove Welds

Groove welds are commonly used for butt joints when deep penetration is needed, especially for thicker materials. It is a type of weld made between two pieces of metal where a groove is created at the joint. There are different types of groove welds depending on the groove preparation (e.g., V-groove, U-groove, J-groove). These welds are typically used when welding pipe joints and thicker plates.



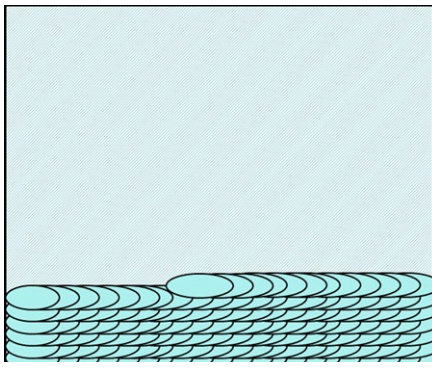
Plug/Slot

A plug weld involves welding a hole in one piece of metal to another piece of metal beneath it. The hole is filled with weld metal to join the two pieces. Plug welds are often used on overlapping pieces of material when no other weld should be visible or when a high-strength weld joint is required between two layers of material. The difference between a plug and a slot is the shape. Plug is round where a slot is oblong.



Surface Welds

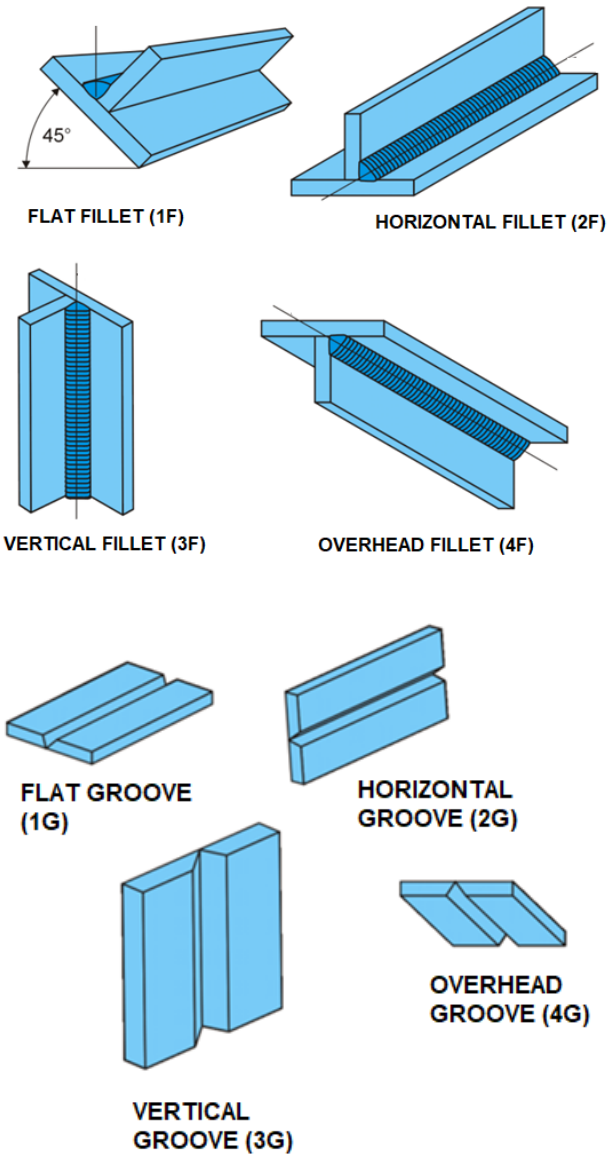
A surfacing weld is applied to the surface of a metal to either improve its properties (such as wear resistance or corrosion resistance) or to rebuild worn-out parts.
Surface welds are common in repair work or when reconditioning parts that have been eroded or worn down must be rebuilt. These include machine parts, shafts, press dies and excavating equipment. Build up can often be used in an application called hard facing and requires the use of specific alloy materials for the weld to achieve the desired surface properties.



Welding Positions

Welding positions refer to the orientation or alignment of the workpieces during the welding process relative to the person welding. The position in which welding is performed plays a crucial role in determining the ease of execution, and the overall quality of the weld. There are four primary welding positions commonly used in welding, each with its unique challenges and

techniques. Generally, welder will try their best to place a weld in the most comfortable position to achieve the highest quality. These positions are usually Flat and Horizontal.



Common Weld Faults

Weld faults, also known as welding defects**,** refer to undesirable irregularities that occur during the welding process, which affect the quality, strength, and appearance of the finished weld. These defects can arise due to improper technique, equipment malfunction, or material issues.

Identifying and addressing weld faults is critical in ensuring the integrity and safety of welded structures.

Appearance in welding refers to the visual characteristics of the welded joint, including uniformity, smoothness, and absence of defects. It's an important aspect of quality control in welding. Fillet weld should be free of defects and remain flat to slightly convex. A groove weld should be free of defects and remain slightly convex. By following these corrective actions, welders can improve the quality and integrity of their welds, minimizing defects.

Weld faults can result in weak, ineffective, or unsightly welds, leading to structural failures, Identifying the causes of weld faults is crucial in preventing defects and ensuring high-quality welds. Proper technique, adequate equipment, and careful attention to material preparation and welding parameters are essential in minimizing these common issues. By following these corrective actions, welders can improve the quality and integrity of their welds and minimizing defects.

Common Defects Causes and Conditions

Defect	Description	Cause	Corrective Action
Porosity	Refers to the presence of voids or gas pockets within a welded joint. Porosity weakens the weld and can	Contaminated or moist filler materials. Inadequate shielding gas or	Clean base metal to remove contaminants (oil, rust, moisture).

	lead to structural integrity issues.	improper gas flow. Weld pool contamination from oils, rust, or dirt.	Maintain proper electrode angles and arc length.
Undercut	Undercut occurs when the base metal along the edges of the weld joint is eroded away, leaving a groove. It weakens the weld and can lead to failure.	Excessive heat input or too high of a welding speed. Incorrect torch angle or improper welding technique.	Turn down amperage setting. Point in direction of undercut. Maintain proper and consistent arc length. Maintain correct rod angles
Overlap	Overlap happens when one weld bead does not properly fuse with the preceding weld bead, resulting in a layered appearance. It weakens the weld and reduces its load-bearing capacity.	Insufficient heat or travel speed. Incorrect welding technique or improper torch angle. Too much filler material.	Reduce heat input to prevent excessive weld bead build-up. Slow down travel speed to allow proper weld formation. Adjust electrode angle to ensure proper fusion with the base metal.
Lack of Penetration	Occurs when the weld metal does not properly fuse with the base material or the previous weld layer, resulting in a gap or discontinuity at the joint interface.	Low welding current. Incorrect technique or travel speed. Incorrect joint preparation.	Increase amperage. Slower travel speed. Ensure correct electrode t size for deeper.
Lack of fusion	Occurs when the weld metal does not properly fuse with the base material or the previous weld layer, resulting in a gap or discontinuity at the joint interface.	Low welding temperature. Incorrect technique or insufficient heat. Incorrect filler material or contaminated surfaces.	Increase heat input. Slower travel speed. Clean the base metal of contaminants. Maintain proper electrode size. Ensure correct rod

			angle and arc length.
Arc Strikes	Arc strikes are unintended contacts between the welding electrode and the workpiece outside of the intended weld zone. They can cause surface damage and weaken the weld.	Improper handling of the electrode. Inaccurate arc control. Improper grounding. Distraction and fatigue.	Use controlled starts and stops to prevent arc wandering. Ensure proper grounding of the workpiece. Use the correct welding parameters for the base material.
Slag Inclusion	Slag is the by product of the flux used in some welding processes. It forms a protective layer over the weld pool to prevent atmospheric contamination. After welding, the slag must be removed to inspect the weld.	Incomplete removal of slag from previous welding passes. Incorrect electrode handling or technique. Improper shielding gas or contamination of the weld area.	Clean weld area between passes to remove slag. Always stay at leading edge of puddle. Adjust heat settings to avoid slag entrapment.
Spatter	Spatter refers to small droplets of molten metal that are ejected from the weld pool during the welding process. While some spatter is inevitable, excessive spatter is considered a defect. Soft spatter can be removed easily and is not considered a defect.	High welding voltage or amperage. Incorrect torch angle or travel speed. Inadequate shielding gas or improper gas flow.	Lower amperage to reduce heat input. Maintain proper electrode angle and distance from the base material.
Convexity	Convexity in welding refers to a slight outward curvature of the welded surface. It's important to control convexity to ensure proper fusion and strength of the weld.	Too slow of travel speed Inadequate penetration in plate Oversized electrode for the weld joint can lead to an overly raised bead.	Speed up travel speed to avoid excessive deposition of filler metal. Control filler metal deposition to avoid overfilling the joint.

			Use the correct electrode size Maintain consistent rod angle.
Concavity	Concavity is the opposite of convexity, referring to a slight inward curvature of the welded surface. Excessive concavity can indicate incomplete fusion or penetration.	Excessive Heat Input can result in concave weld. Excessive travel speed Undersized electrode for the weld joint can lead to an overly raised bead.	Slower travel speed to allow proper fill. Ensure proper filler material and electrode size for joint dimensions. Maintain correct electrode angle and torch position. Adjust travel speed to avoid insufficient fill of the weld bead.

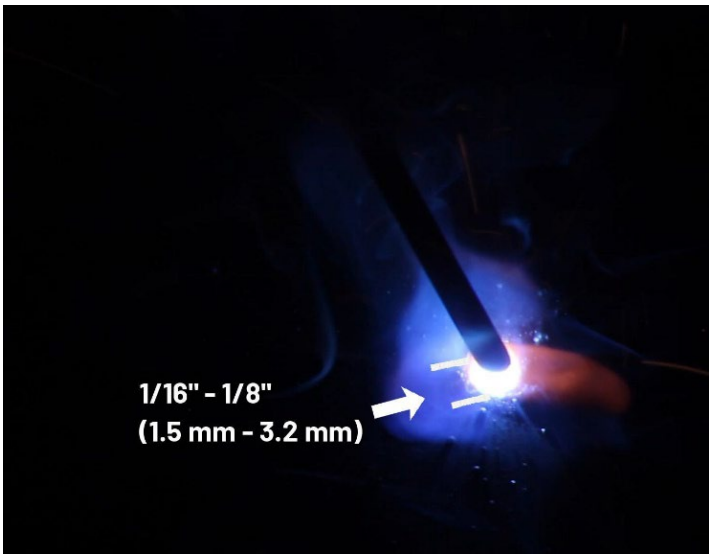
Welding Techniques and Parameters

Get Comfortable: Use as little muscle in your body possible. Getting comfortable when stick welding is crucial for both the quality of the weld and the welder's safety. Being in a comfortable position helps reduce fatigue, which can lead to shaky hands, improper bead placement, or inconsistent penetration.

Stance: Maintain a stable and comfortable stance while welding to prevent fatigue and ensure accuracy. The body should be relaxed, use as little muscles in your body as possible. Getting comfortable might be the single most important part of welding. If we are not comfortable it is difficult to do our best.

Positioning: Position yourself in such a way that you have a clear view of the weld puddle and can maintain a steady hand.

Arc length is the distance between the tip of the welding electrode and the workpiece. It's crucial to maintain a consistent arc length for quality welds.



Travel speed refers to the rate at which the welding torch or electrode travels along the joint during welding. Proper travel speed ensures adequate heat input and fusion.

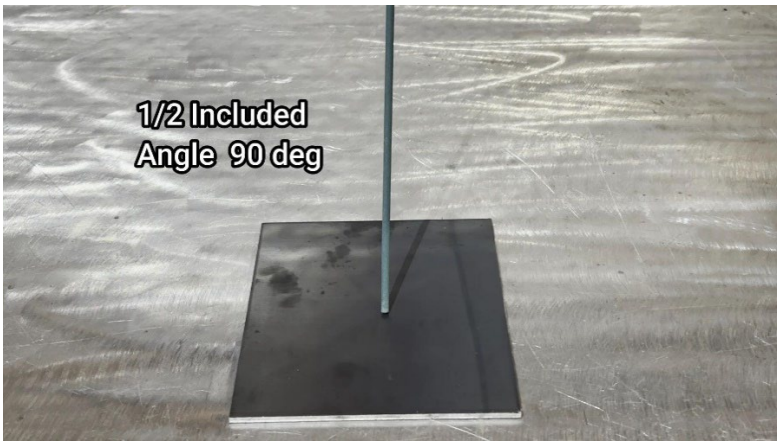
Common Variables for Stick Welding

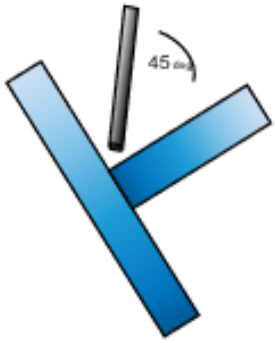
Parameters	Effect	Recommended Settings
Amperage	Controls heat input, penetration, and bead size.	Adjust based on electrode size and material thickness.
Voltage	Arc length controls voltage with stick welding.	Use appropriate arc length for electrode type/size
Travel Speed	Impacts weld penetration, bead size, and heat input.	Adjust for consistent bead formation.
Electrode Size/Type	Determines filler material and bead characteristics.	Choose based on base material and application.
Arc Length	Affects heat concentration and weld bead formation.	Half to one time dia. of electrode
Welding Position	Impacts puddle control and ease of welding.	Adjust parameters for vertical, overhead, or other positions.

Angles

Work Angle

The work angle refers to the angle between the electrode and the workpiece. This angle is crucial for achieving the correct bead shape and penetration. Rule of thumb is to hold a work angle of ½ included angle. This means if our weld joint is 90 deg our work angle should come in at 45 deg +- 5 deg. Welding a flat plat is 180 deg, this mean our work angle is 90 deg +- 5 deg See image below.



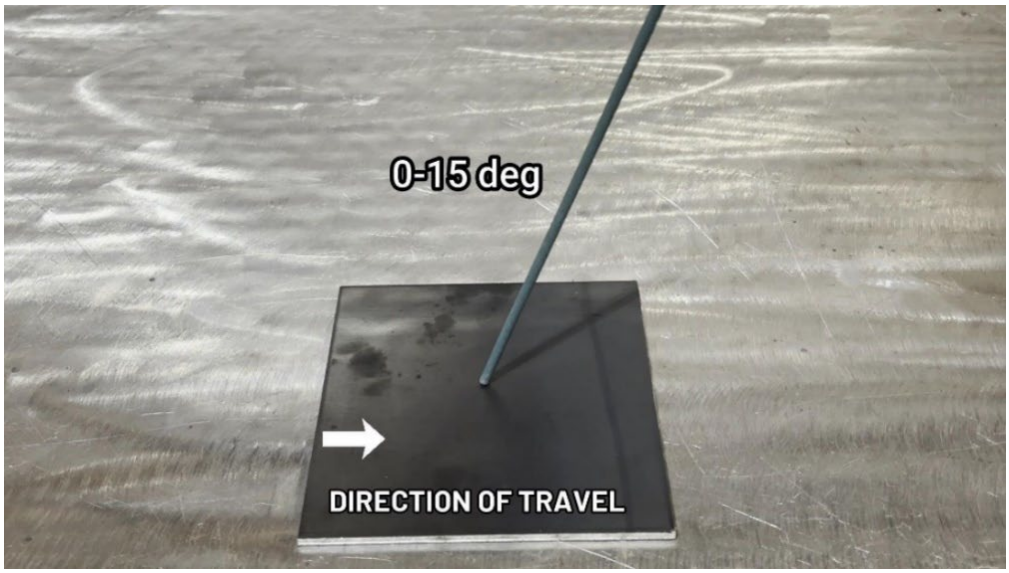


Travel Angle

Also known as your inclination is your angle relative to the direction of travel. A good travel angle (inclination) should be between 0-15 deg for most positions. The correct travel angle ensures a smooth, consistent weld bead and good heat distribution. When dragging the puddle, the steeper the angle the narrower and more crowned up your weld bead will be. Less travel angle will produce a wider flatter looking bead.

Dragging (Pulling or Backhand Technique) The electrode is angled back toward the completed weld, dragging away from the puddle. This technique provides deeper penetration and is best used for welding processes which produce slag. Ideal for positions such as Flat, Horizontal and Overhead.

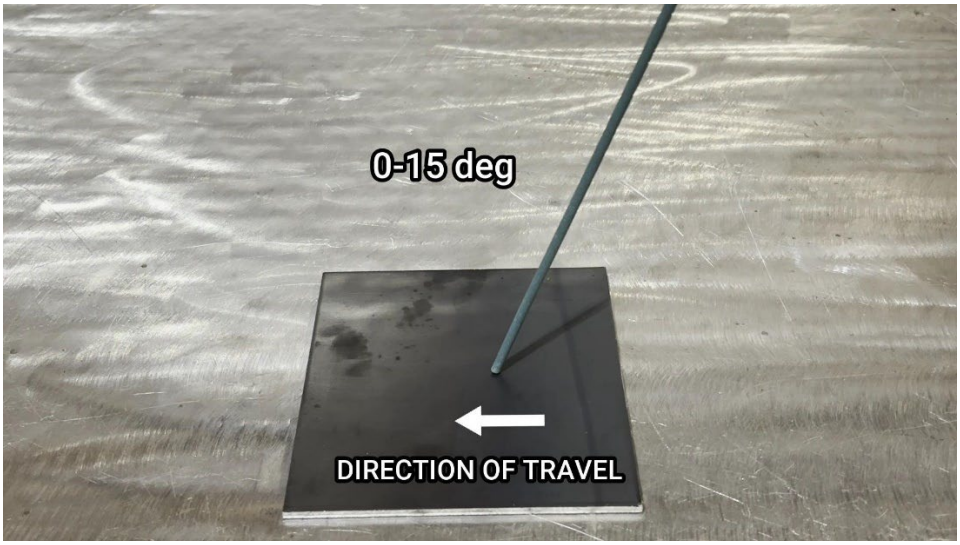
Dragging (Pulling or Backhand Technique)



Pushing (Forehand Technique)

The electrode is angled forward, in the direction of travel. This technique moves the puddle forward in the direction of travel. This technique produces a wider flatter weld bead with slightly less penetration.

Pushing (Forehand Technique)



If every other setting and parameter is consistent and your beads are not flat enough, try bringing this angle closer to zero.

Notes: