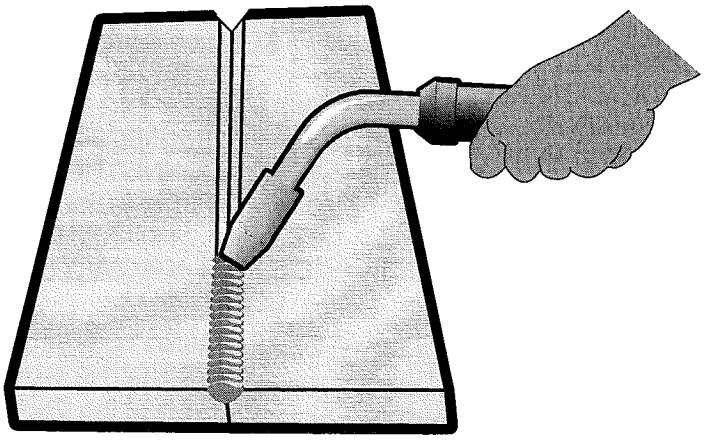
SEARS
CRAFTSMAN®

MIG Wire Feed Welder

WELDING INSTRUCTION GUIDE



- **INTRODUCTION**
- **SAFETY**
- **PREPARE TO WELD**
- **KNOW YOUR WELDER**
- **ESPAÑOL**

CAUTION:
Read and follow all Safety Rules
and Operating Instructions before
First Use of this Product.

Sears, Roebuck and Co., Hoffman Estates, IL 60179 USA

811-600-000 (June 1998)

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INTRODUCTION

This Welding Instruction Guide provides basic information about wire feed welding. It is to be used together with the User's Guide to provide all of the information needed to safely and effectively use your wire feed welder. The information in this book applies to almost all wire feed welders and gives the methods and techniques needed to make satisfactory welds and do it safely.

Where information is shown that does not necessarily apply to all models or brands of welders, it will be marked as either *optional on some welder models,* or *does not apply to all models.*

SAFETY SUMMARY

Every craftsman respects the tools with which they work. They know that the tools represent years of constantly improved designs and developments. The true craftsman also knows that tools are dangerous if misused or abused.

Reading this operator's manual before using the welder will enable you to do a better, safer job. Learn the welder's applications and limitations as well as the specific potential hazards peculiar to welding.

SAFETY INFORMATION

The following safety information is provided as guidelines to help you operate your new welder under the safest possible conditions. Any equipment that uses electrical power can be potentially dangerous to use when safety or safe handling instructions are not known or not followed. The following safety information is provided to give the user the information necessary for safe use and operation.

When a procedure step is preceded by a **WARNING**, it is an indication that the step contains a procedure that might be injurious to a person if proper safety precautions are not heeded.

When a procedure step is preceded by a **CAUTION**, it is an indication that the step contains a procedure that might damage the equipment being used.

A **NOTE** may be used before or after a procedure step to highlight or explain something in that step.

READ ALL SAFETY INSTRUCTIONS CAREFULLY before attempting to install, operate, or service this welder. Failure to comply with these instructions could result In personal injury and/or property damage.

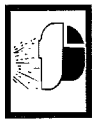
RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE.

NOTE:

- The following safety alert symbols identify important safety messages in this manual.
- When you see one of the symbols shown here, be alert to the possibility of personal injury and carefully read the message that follows.

This symbol indicates that the possibility of electric shock hazard exists during the operation of the step(s) that follow.

This symbol indicates that the possibility of fire hazard exists during the operation of the step(s) that follow.



This symbol indicates that the helmet must be worn during the step(s) that follow to protect against eye damage and burns due to flash hazard.

This symbol indicates that the possibility of toxic gas hazard exists during operation of the step(s) that follow.

This symbol indicates that the possibility of being burned by hot slag exists during operation of the step(s) that follow.

This symbol indicates that the eye protection should be worn to protect against flying debris in the following step(s).

- Published standards on safety are available. They are listed in ADDITIONAL SAFETY INFORMATION at the end of this SAFETY SUMMARY.

The National Electrical Code, Occupational Safety and Health Act regulations, local industrial codes and local inspection requirements also provide a basis for equipment installation, use, and service.

SHOCK HAZARDS

WARNING

Electric shock can kill! To reduce the risk of death or serious injury from shock, read, understand, and follow the following safety instructions. In addition, make certain that anyone else who uses this welding equipment, or who is a bystander in the welding area understands and follows these safety instructions as well.

- **IMPORTANT!** TO REDUCE THE RISK OF DEATH, INJURY, OR PROPERTY DAMAGE, DO NOT ATTEMPT OPERATION of this welding equipment until you have read and understand the following safety summary.
- Do not, in any manner, come into physical contact with any part of the welding current circuit. The welding current circuit includes:
  a. the work piece or any conductive material in contact with it,
  b. the workpiece clamp,
  c. the electrode or welding wire,
  d. any metal parts on the electrode holder, or wire feed gun.
- Do not weld in a damp area or come in contact with a moist or wet surface.
- Do not attempt to weld if any part of clothing or body is wet.
- Do not allow the welding equipment to come in contact with water or moisture.
- Do not drag welding cables, wire feed gun, or welder power cord through or allow them to come into contact with water or moisture.
- Do not touch welder, attempt to turn welder on or off if any part of the body or clothing is moist or if you are in physical contact with water or moisture.
- Do not attempt to plug the welder into the power source if any part of body or clothing is moist, or if you are in physical contact with water or moisture.
- Do not connect welder workpiece clamp to or weld on electrical conduit.
- Do not alter power cord or power cord plug in any way.
- Do not attempt to plug the welder into the power source if the ground prong on power cord plug is bent over, broken off, or missing.
- Do not allow the welder to be connected to the power source or attempt to weld if the welder, welding cables, welding site, or welder power cord are exposed to any form of atmospheric precipitation, or salt water spray.
- Do not carry coiled welding cables around shoulders, or any other part of the body, when they are plugged into the welder.
- Do not modify any wiring, ground connections, switches, or fuses in this welding equipment.
- Wear welding gloves to help insulate hands from welding circuit.
- Keep all liquid containers far enough away from the welder and work area so that if spilled, the liquid can not possibly come in contact with any part of the welder or electrical welding circuit.
- Replace any cracked or damaged parts that are insulated or act as insulators such as welding cables, power cord, or electrode holder **IMMEDIATELY**.

FLASH HAZARDS

WARNING

ARC RAYS CAN INJURE EYES AND BURN SKIN! To reduce risk of injury from arc rays, read, understand, and follow the following safety instructions. In addition, make certain that anyone else who uses this welding equipment, or is a bystander in the welding area, understands and follows these safety instructions as well.

- Do not look at an electric arc without proper protection. A welding arc is extremely bright and intense and, with inadequate or no eye protection, the retina can be burned, leaving a permanent dark spot in the field of vision. A shield or helmet with a number 10 shade filter lens (minimum) must be used.
- Do not strike a welding arc until all bystanders and you (the welder) have welding shields and/or helmets in place.
- Do not wear a cracked or broken helmet and replace any cracked or broken filter lenses **IMMEDIATELY**.
- Do not allow the uninsulated portion of the wire feed gun to touch the workpiece clamp or grounded work to prevent an arc flash from being created on contact.
- Provide bystanders with shields or helmets fitted with a #10 shade filter lens.
- Wear protective clothing. The intense light of the welding arc can burn the skin in much the same way as the sun, even through light-weight clothing. Wear dark clothing of heavy material. The shirt worn should be long sleeved and the collar kept buttoned to protect chest and neck.
- Protect against **REFLECTED ARC RAYS**. Arc rays can be reflected off shiny surfaces such as a glossy painted surface, aluminum, stainless steel, and glass. It is possible for your eyes to be injured by reflected arc rays even when wearing a protective helmet or shield. If welding with a reflective surface behind you, arc rays can bounce off the surface, then off the filter lens on the inside of your helmet or shield, then into your eyes. If a reflective background exists in your welding area, either remove it or cover it with something non-flammable and non-reflective. Reflected arc rays can also cause skin burn in addition to eye injury.

FIRE HAZARDS

WARNING

FIRE OR EXPLOSION CAN CAUSE DEATH, INJURY, AND PROPERTY DAMAGE!

To reduce risk of death, injury, or property damage from fire or explosion, read, understand, and follow the following safety instructions. In addition, make certain that anyone else that uses this welding equipment, or is a bystander in the welding area, understands and follows these safety instructions as well. **REMEMBER!** Arc welding by nature produces sparks, hot spatter, molten metal drops, hot slag, and hot metal parts that can start fires, burn skin, and damage eyes.

- Do not wear gloves or other clothing that contain oil, grease, or other flammable substances.
- Do not wear flammable hair preparations.
- Do not weld in an area until it is checked and cleared of combustible and/or flammable materials. **BE AWARE** that sparks and slag can fly 35 feet and can pass through small cracks and openings. If work and combustibles cannot be separated by a minimum of 35 feet, protect against ignition with suitable, snug-fitting, fire resistant, covers or shields.
- Do not weld on walls until checking for and removing combustibles touching the other side of the walls.

- Do not weld, cut, or perform other such work on used barrels, drums, tanks, or other containers that had contained a flammable or toxic substance. The techniques for removing flammable substances and vapors, to make a used container safe for welding or cutting, are quite complex and require special education and training.
- Do not strike an arc on a compressed gas or air cylinder or other pressure vessel. Doing so will create a brittle area that can result in a violent rupture immediately or at a later time as a result of rough handling.
- Do not weld or cut in an area where the air may contain flammable dust (such as grain dust), gas, or liquid vapors (such as gasoline).
- Do not handle hot metal, such as the workpiece or electrode stubs, with bare hands.
- Wear leather gloves, heavy long sleeve shirt, cuffless trousers, high-topped shoes, helmet, and cap. As necessary, use additional protective clothing such as leather jacket or sleeves, fire resistant leggings, or apron. Hot sparks or metal can lodge in rolled up sleeves, trouser cuffs, or pockets. Sleeves and collars should be kept buttoned and pockets eliminated from the shirt front.
- Have fire extinguishing equipment handy for immediate use! A portable chemical fire extinguisher, type ABC, is recommended.
- Wear ear plugs when welding overhead to prevent spatter or slag from falling into ear.
- Make sure welding area has a good, solid, safe floor, preferably concrete or masonry, not tiled, carpeted, or made of any other flammable material.
- Protect flammable walls, ceilings, and floors with heat resistant covers or shields.
- Check welding area to make sure it is free of sparks, glowing metal or slag, and flames before leaving the welding area.

FUME HAZARDS

WARNING

FUMES, GASSES, AND VAPORS CAN CAUSE DISCOMFORT, ILLNESS, AND DEATH!

To reduce risk of discomfort, illness, or death, read, understand, and follow the following safety instructions. In addition, make certain that anyone else that uses this welding equipment or is a bystander in the welding area, understands and follows these safety instructions as well.

- Do not weld in an area until it is checked for adequate ventilation as described in ANSI standard #Z49.1. If ventilation is not adequate to exchange all fumes and gasses generated during the welding process with fresh air, do not weld unless you (the welder) and all bystanders are wearing air-supplied respirators.
- Do not heat metals coated with, or that contain, materials that produce toxic fumes (such as galvanized steel), unless the coating is removed. Make certain the area is well ventilated, and the operator and all bystanders are wearing air-supplied respirators.
- Do not weld, cut, or heat lead, zinc, cadmium, mercury, beryllium, or similar metals without seeking professional advice and inspection of the ventilation of the welding area. These metals produce **EXTREMELY TOXIC** fumes which can cause discomfort, illness, and death.
- Do not weld or cut in areas that are near chlorinated solvents. Vapors from chlorinated hydrocarbons, such as trichloroethylene and perchloroethylene, can be decomposed by the heat of an electric arc or its ultraviolet radiation. These actions can cause **PHOSGENE**, a **HIGHLY TOXIC** gas to form, along with other lung and

eye-irritating gasses. Do not weld or cut where these solvent vapors can be drawn into the work area or where the ultraviolet radiation can penetrate to areas containing even very small amounts of these vapors.

- Do not weld in a confined area unless it is being ventilated or the operator (and anyone else in the area) is wearing an air-supplied respirator.
- Stop welding if you develop momentary eye, nose, or throat irritation as this indicates inadequate ventilation. Stop work and take necessary steps to improve ventilation in the welding area. Do not resume welding if physical discomfort persists.

COMPRESSED GASSES AND EQUIPMENT HAZARDS

WARNING

IMPROPER HANDLING AND MAINTENANCE OF COMPRESSED GAS CYLINDERS AND REGULATORS CAN RESULT IN SERIOUS INJURY OR DEATH!

To reduce risk of injury or death from compressed gasses and equipment hazards, read understand and follow the following safety instructions. In addition, make certain that anyone else who uses this welding equipment or a bystander in the welding area understands and follows these safety instructions as well.

- Do not use flammable gasses with MIG welders. Only inert or nonflammable gasses are suitable for MIG welding. Examples are Carbon Dioxide, Argon, Helium, etc. or mixtures of more than one of these gasses.
- Do not attempt to mix gasses or refill a cylinder yourself Do not expose cylinders to excessive heat, sparks, slag and flame, etc. Cylinders exposed to temperatures above 130°F will require water spray cooling.
- Do not expose cylinders to electricity of any kind.
- Do not use a cylinder or its contents for anything other than its intended use. Do not use as a support or roller.
- Do not locate cylinders in passageways or work areas where they may be struck.
- Do not use a wrench or hammer to open a cylinder valve that cannot be opened by hand. Notify your supplier.
- Do not modify or exchange gas cylinder fittings.
- Do not deface or alter name, number or other markings on a cylinder. Do not rely on cylinder color to identify the contents.
- Do not connect a regulator to a cylinder containing gas other than that for which the regulator was designed.
- Do not attempt to make regulator repairs. Send faulty regulators to manufacturer's designated repair center for repair.
- Do not attempt to lubricate a regulator.
- Always change cylinders carefully to prevent leaks and damage to their walls, valves, or safety devices.
- Always secure cylinders with a steel chain so that they cannot be knocked over.
- Always protect a cylinder, especially the valve, from bumps, falls, falling objects and weather. Remember that gasses in the cylinders are under pressure and damage to a regulator can cause the regulator or portion of the regulator to be explosively ejected from the cylinder.
- Always make certain the cylinder cap is securely in place on the cylinder, whenever the cylinder is moved.
- Always close the cylinder valve and immediately remove a faulty regulator from service, for repair, if any of the following conditions exist.
- Gas leaks externally.
- Delivery pressure continues to rise with down stream valve closed.
- The gauge pointer does not move off the stop pin when pressurized or fails to return to the stop pin after pressure is released.

ADDITIONAL SAFETY INFORMATION

For additional information concerning welding safety, refer to the following standards and comply with them as applicable.

- ANSI Standard Z49.1 — SAFETY IN WELDING AND CUTTING — obtainable from the American Welding Society, 2051 N.W. 7th St., Miami, FL 33125 Telephone (305) 443-9353
- ANSI Standard Z87.1 — SAFE PRACTICE FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION — obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.
- NFPA Standard 51B — CUTTING AND WELDING PROCESSES — obtainable from the National Fire Protection Association, 470 Atlantic Ave., Boston, MA 02210
- CGA Pamphlet P-I - SAFE HANDLING OF COMPRESSED GASSES IN CYLINDERS - obtainable from the Compressed Gas Association, 500, 5th Ave. New York, NY 10038
- OSHA Standard 29 CFR, Part 1910, Subpart Q, WELDING, CUTTING AND BRAZING — obtainable from your state OSHA office.
- CSA Standard W117.2 — Code for SAFETY IN WELDING AND CUTTING. — obtainable from Canadian Standards Association, 178 Rexdale Blvd. Etobicoke, Ontario M9W 1R3
- American Welding Society Standard A6.0 - WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES - obtainable from the American Welding Society, 2051 N.W. 7th St., Miami, FL 33125 Telephone (305) 443-9353

WIRE FEED WELDING VARIABLES

SELECT THE WIRE

It is very important to select a type of wire that is compatible with the metal to be welded (base metal). If the wire is incompatible with the base metal, the quality of important characteristics such as penetration and strength may be sacrificed.

Solid Steel Wire Selection

Optional on some welder models

The welding wires recommended for most of the mild and low carbon steel applications you will have are AWS classification numbers E70S-3 and E70S-6. These two wires are very similar, but the E70S-6 tends to work a little better on moderately dirty steel and on sheet metal where smooth weld beads are required. These differences are very subtle, so in most applications, either wire is acceptable.

Self-Shielding Flux-Core Steel Wire

Self-shielding, flux-core steel wire is used primarily for welding mild steel without the use of a shielding gas. It is especially good to use when welding needs to take place in a windy environment. However, it produces more spatter than solid wire gas-shielded welding and leaves a slag on top of the weld that needs to be chipped off. Our recommendation for self-shielding, flux-core steel wire is AWS classification number E71T-GS.

NOTE: WITH FLUX-CORE WIRE YOU WILL BURN THROUGH METALS THINNER THAN 18 GAUGE.

Aluminum Wire Selection

Optional on some welder models

Selecting the proper wire for welding aluminum is much more complicated than steel wire selection, primarily due to the large number of aluminum alloys available. Also the recommended wire alloy is not necessarily the same as the base metal to be welded.

Because of the large number of alloys in use, a major problem is identifying the alloy number of the base metal to be welded. The alloy number is usually a four digit number and most often can be determined by referring to the owner/operation manual, dealer, distributor, or manufacturer of the item to be welded. If the alloy number cannot be determined, wire selection becomes a matter of trial-and-error. The only other recommendation is to seek the advice of someone who may have had previous experience with the same or similar aluminum welding application.

After determining the alloy of the base metal, refer to the chart in Table 1 to find the recommended wire.

Table 1. Aluminum Wire Alloy Selection Chart

BASE METAL ALLOY	WIRE ALLOY	WELDING EASE & CRACK RESISTANCE	WELD STRENGTH	DUCTILITY	USE IN TEMPS OVER 150 DEGREES F	COLOR MATCH AFTER ANODIZING	LOW CORROSION WHEN IMMERSED IN WATER
7005 7021 7039 7046 7146	5356	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
6061 6070	4043 5356	GOOD GOOD	FAIR GOOD	GOOD GOOD	GOOD POOR	POOR GOOD	GOOD FAIR
6005 6063 6101 6151 6201 6351 6951	4043 5356	GOOD GOOD	FAIR GOOD	GOOD GOOD	GOOD POOR	POOR GOOD	GOOD FAIR
5052 5454 5652	5356 5554	GOOD FAIR	GOOD FAIR	GOOD GOOD	POOR GOOD	GOOD GOOD	GOOD GOOD
5086 5154 5254 5356	5356 5183 5556	GOOD GOOD GOOD	GOOD GOOD GOOD	GOOD GOOD GOOD	POOR POOR POOR	GOOD GOOD GOOD	GOOD GOOD GOOD
5005 5050	4043 5356	GOOD GOOD	GOOD GOOD	FAIR GOOD	GOOD GOOD	POOR GOOD	GOOD GOOD
3004	4043 5356	GOOD GOOD	GOOD GOOD	FAIR GOOD	GOOD GOOD	POOR POOR	GOOD GOOD
3003	1100 4043	GOOD GOOD	GOOD GOOD	GOOD GOOD	GOOD GOOD	GOOD POOR	GOOD GOOD
2219	2319	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
2014 2036	2319	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD
1100	4043	GOOD	GOOD	GOOD	GOOD	POOR	GOOD
1060 1070 1080 1350	4043 1100	GOOD GOOD	GOOD GOOD	GOOD GOOD	GOOD GOOD	POOR GOOD	GOOD GOOD

NOTE: This chart assumes that the base metal being welded is all the same alloy. However, it is possible to weld two different alloys together. If this is an application that you become interested in, contact your local welding supply distributor or the American Welding Society (AWS) for assistance in selecting the proper wire.

Stainless Steel Wire Selection
When welding stainless steel, the alloy of the welding wire must be the same as the alloy of the base metal. As with

Optional on some welder models

aluminum, the alloy number can most often be determined by consulting the owner/operator manual, service manual, dealer, distributor, or manufacturer of the item to be welded. Otherwise, seek the advice of someone who may have had previous experience with the same or similar welding application. Stainless steel wire is quite expensive. The trial-and-error method of alloy determination should be avoided whenever possible.

Silicon Bronze Wire Selection
The most popular application for silicon-bronze MIG welding is non-structural

Optional on some welder models

sheet metal welding, especially auto body work. A weld with silicon bronze wire is very similar to that produced by oxygen-acetylene brazing. It is fairly flat and easy to grind smooth. Our recommended wire for this application is AWS classification number ERCuSi-A.

SELECTING THE WIRE SPOOL SIZE

This welder will accept either four inch or eight inch spools. Wire on a four inch spool will usually cost more per pound than on an eight inch spool. However, welding wire oxidizes over time, so it is important to select a spool size that will be used up within the times recommended below.

1. **STEEL WIRE -** is usually coated with copper to prevent the wire from rusting and to enhance the transmission of welding current from the contact tip to the wire. It is recommended that copper-coated steel welding wire be bought in spool sizes that will be consumed in six months or less. In the early stages of aging, the copper coating will begin oxidizing. The more time that passes, the heavier the oxidization will get. To check the wire for copper oxidation, unspool about two feet of wire, pinch the wire between thumb and forefinger, then pull the thumb and forefinger down the length of wire. Look at the thumb and fore finger; there will be a line created by the copper oxidation. A fairly fresh spool will leave a light gray line, whereas a well oxidized spool will leave a darker line. Heavy copper oxidation will cause arc flutter and possibly wire drive slippage. If steel wire continues to oxidize, the steel wire under the copper coating will rust causing even worse arc flutter and drive problems.
2. **SELF-SHIELDING, FLUX-CORE, STEEL WIRE** – spools should be selected based on the same guidelines as for copper-coated steel wire.
3. **ALUMINUM WIRE -** has even more of a potential storage problem than steel. It tends to oxidize much faster and the oxidation is much heavier. The early stages of oxidation are virtually invisible, but as time passes, a white powder will develop that will cause extreme arc flutter, wire drive problems, contamination build-up in the liner, wire burn-back into the contact tip and a poor weld. Ideally, it would be best to use up a spool of aluminum wire within three months.
4. **STAINLESS STEEL WIRE -** oxidizes at a relatively slow rate and its oxidation is very light, so the care for handling and storing stainless steel wire is much less critical than for aluminum and steel wires. However, because stainless

steel wire is quite expensive, it is still a good practice to follow the storage recommendations.

5. **SILICON-BRONZE WIRE -** spools should be selected based on the same guidelines as for copper-coated steel wire.

The above recommended spool storage times are rules-of-thumb and can be impacted by many factors such as length of time in distribution prior to retail sale, warehouse conditions, time of year (i.e. humid months or dry months), and how the spool was packaged by the manufacturer.

Although these factors are out of your control, there are some things that you can do to slow down the oxidation process: store in a dry place when not in use, store in sealed plastic bag when not in use, and leave unopened in the manufacturer's package until ready to use.

NOTE: If a spool has developed heavy oxidation, the only solution to the problem is to discard the spool of wire.

- If you have an oxidized spool of wire, do not discard it until you have unspooled a few turns of wire to see if the wire further down on the spool is in usable condition, if not, - discard the spool.

SELECTING THE WIRE DIAMETER

Using a wire that is too small in diameter can cause excessive weld spatter and weld heat. A wire that is too large can cause wire *stubbing* (stubbing is caused when the molten metal bridge between the electrode and weld pool cannot be broken and the electrode *stubs* into the pool and the pool freezes) and, at low amperages, cause an uneven arc. In either case, the weld is ruined. Use Table 2 below to identify the recommended wire diameter to use for the metal being welded. The recommendations supplied in Table 2 are for typical applications only.

Table 2. Wire Diameter Amperage Ranges (Typical)

WIRE DIAMETER	AMP RANGE	METAL THICKNESS
0.024 inch	30-90	26-18 Gauge
0.030 inch	60-200	18 Gauge - 3/16 inch
0.035 inch	90-230	14 Gauge - 5/16 inch

SELECTING SHIELDING GAS

The shielding gas plays an extremely important role in the MIG welding process. As with most welding processes, it is critical that the molten weld puddle be shielded from the atmosphere. Inadequate shielding will result in porous, brittle welds.

Not only is shielding the weld important; selecting the proper gas to shield with is of equal importance. Generally, the shielding gas selected is dependent upon the type and thickness of metal being welded. Selecting the wrong gas for the metal to be welded can result in porosity, brittleness, and/or undesirable

Optional on some welder models

penetration of the weld.

Although there are many gasses and gas mixtures available for MIG welding, the following recommendations are based on the electrical output characteristics and metal thickness welding capabilities of this specific MIG welder.

Gas Selection For Steel Welding With Steel Wire

For either mild or low carbon (High Strength Structural) steel, in thicknesses that can be welded with this welder, our primary recommendation is a gas

mixture of 75% Argon and 25% Carbon Dioxide, though 100% Carbon Dioxide is also acceptable. DO NOT USE Argon gas concentrations higher than 75% on steel. The result will be extremely poor penetration, porosity, and brittleness of weld.

This gas mixture helps to prevent burn through and distortion on very thin steel yet provides good penetration on thicker steel. Its ability to minimize spatter results in clean, smooth weld appearances. In addition, it provides good puddle control when welding vertically or overhead. This gas mixture is available pre-mixed in a single cylinder from your local gas distributor.

Gas Selection For Aluminum Gas Welding
Our only recommendation for shielding an aluminum weld is pure Argon. Do not attempt to use the Argon/Carbon Dioxide (recommended for steel) when welding aluminum.

Gas Selection For Stainless Steel Welding
The best shielding gas for stainless steel welding is a mixture of 90% Helium, 7.5% Argon, and 2.5% Carbon Dioxide. However, the 75% Argon, 25% Carbon Dioxide mixture (recommended for steel) can also be used, but an increase in the area being heated by the arc will be experienced causing slightly greater distortion of the base metal. Also this mixture can cause a decrease in the ability of the stainless steel weld to resist corrosion. Either mixture can be obtained in a single cylinder from your local gas distributor.

NOTE: Potential shielding gas problems.

1. DEFECTIVE GAS - Just like any other product, a cylinder of gas can be defective. Moisture or other impurities in the gas can create dirty, porous, brittle welds with greatly reduced penetration. The only remedy is to replace the cylinder.
2. INSUFFICIENT SHIELDING GAS COVERAGE - This problem can be created by several causes. The symptoms are a dirty, porous, brittle, and/or non-penetrating weld. Refer to your WELDER USER'S GUIDE for corrective action.

Gas Selection For Steel Welding With Silicon Bronze Wire
Use only pure Argon when welding steel with Silicon-Bronze wire.

SELECT WELDING CURRENT POLARITY

Direct current (dc) reverse polarity is required when using gas-shielded steel welding wires. Direct current straight polarity is used with self-shielding flux cored wires. Depending on the configuration of your welder as it was manufactured, you may need to convert the polarity for the type of wire you will be using. (Note: some welders do not have the capability of changing the polarity.)

Direct current reverse polarity is sometimes referred to as DCEP (Direct Current Electrode Positive) and dc straight polarity is sometimes referred to as DCEN (Direct Current Electrode Negative).

PREPARING THE WORK AREA

An important factor in making a satisfactory weld is preparation. This includes studying the process and equipment and then practice welding before attempting to weld finished product. An organized, safe, convenient, comfortable, well-lighted work area should be available to the operator. The work area should specifically be free of all flammables with both a fire

extinguisher and bucket of sand available.

To properly prepare for welding, it is necessary to:

1. prepare an organized, well lighted work area (see Figure 1).
2. provide protection for the eyes and skin of the operator and by-bystanders,
3. and set up the work piece and make the workpiece clamp connection.

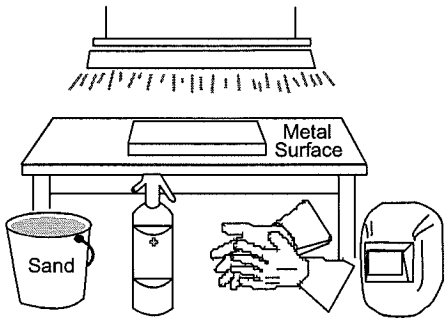


Figure 1. Work Surface Preparation

SETTING UP THE WORK PIECE

PREPARING THE JOINT

For effective welding, the surfaces to be joined must be free of dirt, rust, scale, oil or paint. Welding on metals not properly cleaned will cause a brittle and porous weld.

Aluminum welding requires more detailed preparation than steel welding.

1. A clean weld joint area is a must in obtaining a quality aluminum weld. Remove dirt and oxidation with a stainless steel bristled wire brush. Remove any oil or grease with a good chemical aluminum cleaner.
2. Aluminum is often anodized to prevent it from oxidizing. However, an anodized surface will NOT conduct electricity. Therefore, to weld anodized aluminum, you must sand or grind the anodized coating from the weld joint area and from the site where the workpiece clamp will be connected.

To determine if the aluminum you intend to weld is anodized, simply touch the two probes of an electrical continuity tester or ohmmeter to the aluminum in question. The probes should be an inch or two apart. If there is no indication of electrical continuity, the aluminum is anodized.

If the base metal pieces to be joined are thick or heavy, it may be necessary to bevel the edges, with a metal grinder, at the point of contact, as in Figure 2. The angle of the bevel should be approximately 60 degrees.

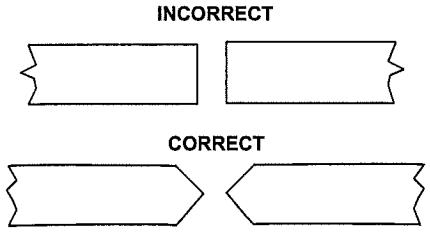


Figure 2. Workpiece Preparation

WARNING

ARC RAYS CAN INJURE EYES AND BURN SKIN! To help prevent eye injuries when grinding, always wear goggles. The grinder must also be inspected to verify that it is in good condition.

See the chart, TYPES OF WELD JOINTS, in Figure 3, for detailed instructions for preparing the weld joint.

During welding, the work pieces will become hot and will tend to expand. The expansion may cause the pieces to shift from the regular position. If possible, the work pieces should be clamped into the position they are to occupy when the welding is completed.

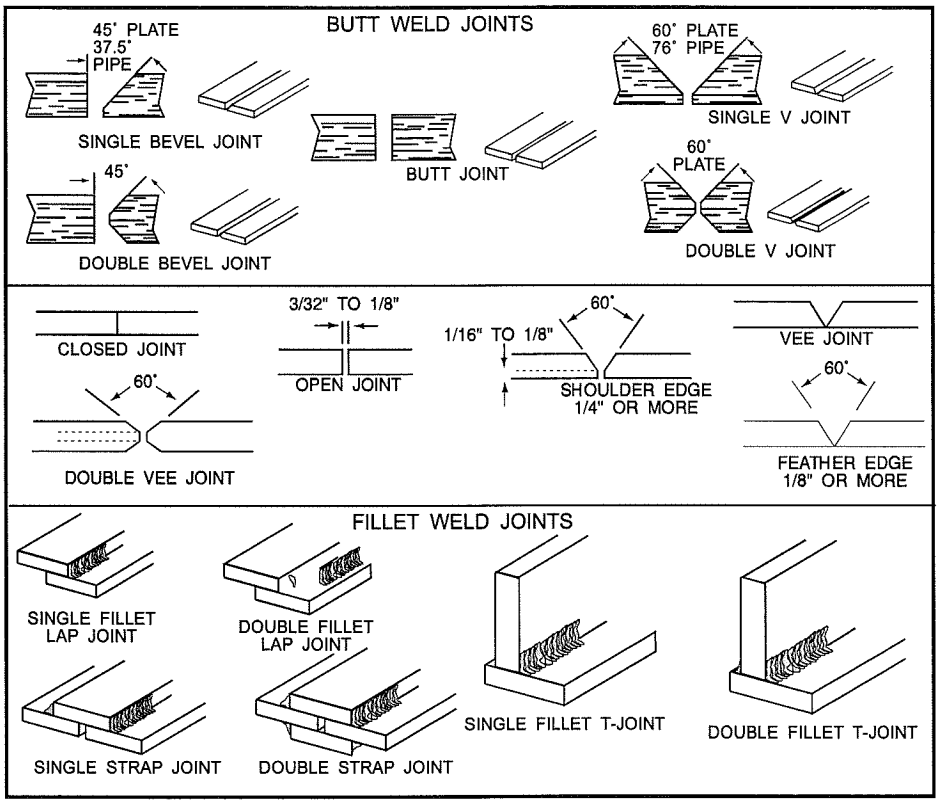


Figure 3. Types of Weld Joints

WORKPIECE CLAMP CONNECTION

It is best to connect the workpiece clamp directly to the work piece and as close to the weld as possible. If it is impractical to connect the workpiece clamp directly to the work piece, connect it to the metal that is securely attached to the work piece, but not electrically insulated from it. Also, make sure the attached metal piece is of about the same or greater thickness as the work piece.

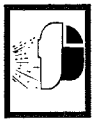
CAUTION

There is risk of electronic component damage if the workpiece clamp is being connected to an automobile or other equipment with on-board computer systems, solid state electronic controls, solid state sound systems, etc., DO NOT WELD until disconnecting the cable from the battery that is attached to chassis ground. Failure to do so may result in ELECTRONIC COMPONENT DAMAGE.

Tuning In the Wire Speed

Tuning the wire speed is one of the most important parts of MIG welder operation. Selecting the best wire speed setting is much the same as tuning in a station on the radio. It must be done before starting each welding job or whenever the heat setting, wire diameter, or wire type are changed. Tune the wire speed according to the following steps.

1. Set up and ground a scrap piece of the same type of metal that you will be welding. It should be equal to or greater than the thickness of the actual work piece and free of paint, oil, rust, etc.
2. Select a heat or voltage setting.
3. Hold the gun in one hand allowing the nozzle to rest on the edge of the work piece farthest away from you and at an angle similar to that which will be used when actually welding.



WARNING

ARC RAYS CAN INJURE EYES AND BURN SKIN! To reduce the risk of injury from arc rays, never strike a welding arc until you, and all bystanders in the welding area, have welding helmet or shield in place and are wearing the recommended protective clothing. DO NOT CONTINUE unless you have read, understand and intend to follow the entire SAFETY SUMMARY provided at the front of this manual.

4. With your free hand, turn the WIRE SPEED control to maximum and continue to hold onto the adjustment knob.
5. Lower your welding helmet and pull the trigger on the gun to start an arc.
6. Begin to drag the gun toward you while turning down the WIRE SPEED control at the same time.
7. LISTEN! As you decrease the wire speed, the sound that the arc makes will change from a sputtering sound to a smooth, high-pitched buzzing sound and then will begin sputtering again, if you decrease the wire speed too far.
8. Continue to decrease the wire speed until the arc noise passes the high-pitched buzzing (preferred sound) and begins to sputter again.
9. Turn the WIRE SPEED control back, in the opposite direction until you come back to the preferred sounding arc noise.

The WIRE SPEED is now tuned in. REMEMBER! Repeat this tune in procedure whenever you select a new heat setting, a different wire diameter, or a different type of wire.

NOTE: When tuning in the WIRE SPEED for self-shielding flux-core wire, you will find a very

wide preferred sounding range. The range could span as much as 60° on the WIRE SPEED control. It is important to know that the heat of the arc and penetration into the base metal increases as the wire speed increases within the preferred sounding range for a given heat setting. It is possible, therefore, to use the wire speed control to slightly increase or decrease heat and penetration by selecting higher or lower wire speed settings WITHIN the preferred sounding range for a given heat setting.

LEARNING TO WELD

Whether you have welded before or not, it is important that you become familiar with your new welder, its controls, and the results achieved at different settings. We strongly recommend that you practice with your new welder on scrap metal trying different heat settings, base metal thicknesses, and welding positions for each type and size of wire that you will be using. By doing this you will gain a feel for how changes in these welding variables affect the weld.

Of course, if you have not MIG welded before, you will need to develop welding skills and techniques as well.

The self-taught welder learns through a process of trial and error. The best way to teach yourself how to weld is with short periods of practice at regular intervals. All practice welds should be done on scrap metal that can be discarded. Do not attempt to make any repairs on valuable equipment until you have satisfied yourself that your practice welds are of good appearance and free of slag or gas inclusions. What you fail to learn through practice will be learned through mistakes and re-welds later on.

HOLDING THE GUN

The best way to hold the welding gun is the way that feels most comfortable to you. While practicing to use your new welder, experiment holding the gun in different positions until you find the one that seems to work best for you.

Position the Gun to the Work Piece

There are two angles of the gun nozzle in relation to the work piece that must be considered when welding.

1. Angle A (Figure 4) can be varied, but in most cases the optimum angle will be 60 degrees. The point at which the gun handle is parallel to the work piece. If angle A is increased, penetration will increase. If angle A is decreased, penetration will decrease also.

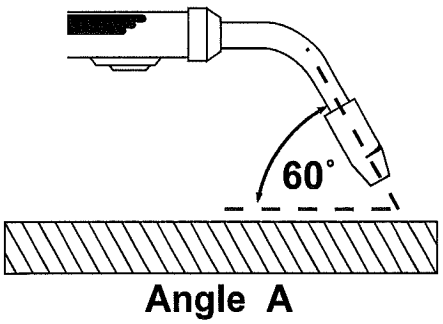


Figure 4. Gun Position, Angle A

2. Angle B (Figure 5) can be varied for two reasons: to improve the ability to see the arc in relation to the weld puddle and to direct the force of the arc.

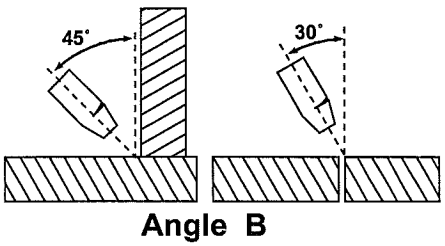


Figure 5. Gun Position, Angle B

The force of the welding arc follows a straight line out of the end of the nozzle. If angle B is changed, so will the direction of arc force and the point at which penetration will be concentrated.

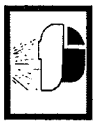
On a butt weld joint, the only reason to vary angle B from perpendicular (straight up) to the work piece would be to improve visibility of the weld puddle. In this case, angle B can be varied anywhere from zero to 45 degrees with 30 degrees working about the best.

On a fillet weld joint, the nozzle is generally positioned in such a manner so as to split the angle between the horizontal and vertical members of the weld joint. In most cases, a fillet weld will be 45 degrees.

Distance from the Work Piece

The end of the welding gun is designed with the contact tip recessed from the end of the nozzle and the nozzle electrically insulated from the rest of the gun. This permits the operator to actually rest the nozzle on the work piece and drag it along while welding. This can be very helpful to beginning welders to steady the gun, allowing the welder to concentrate on welding technique. If the nozzle is held off the work piece, the distance between the nozzle and the work piece should be kept constant and should not exceed 1/4 inch or the arc may begin sputtering, signaling a loss in welding performance.

LAYING A BEAD



WARNING

EXPOSURE TO A WELDING ARC IS EXTREMELY HARMFUL TO THE EYES AND SKIN! Prolonged exposure to the welding arc can cause blindness and burns. Never strike an arc or begin welding until you are adequately protected. Wear flameproof welding gloves, A heavy long sleeved shirt, cuffless trousers, high topped shoes and a welding helmet.

WARNING

ELECTRIC SHOCK CAN KILL! To prevent ELECTRIC SHOCK, do not perform any welding while standing, kneeling, or lying directly on the grounded work.

WELDING TECHNIQUES

MOVING THE GUN

Gun travel refers to the movement of the gun along the weld joint and is broken into two elements: Direction and Speed. A solid weld bead requires that the welding gun be moved steadily and at the right speed along the weld joint. Moving the gun too fast, too slow, or erratically will prevent proper fusion or create a lumpy, uneven bead.

1. **TRAVEL DIRECTION** is the direction the gun is moved along the weld joint in relation to the weld puddle. The gun is either PUSHED (see Figure 6) into the weld puddle or PULLED away from the weld puddle.

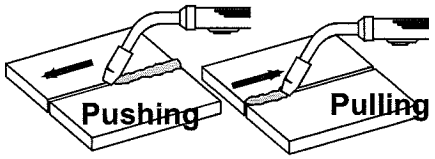


Figure 6. Gun Travel Direction

For most welding jobs you will pull the gun along the weld joint to take advantage of the greater weld puddle visibility. However, there are a few applications where pushing the gun may provide some advantages:

a. VERTICAL WELDING can be done by starting at the top of a weld joint and pulling the gun down toward the bottom. However, in the event that puddle control becomes difficult (such as the puddle wanting to run downward), starting a vertical weld at the bottom of a weld joint and pushing the gun up toward the top

will help to overcome this problem.

b. ALUMINUM WELDING can be done using either direction of gun travel, but pushing will leave a weld that is cleaner in appearance. Pulling the gun will leave a sooty weld since the finished weld is always being blasted by the arc and the impurities coming out of the weld puddle. This problem affects the weld appearance only and the weld can be cleaned up with a stainless steel bristled wire brush.

2. **TRAVEL SPEED** is the rate at which the gun is being pushed or pulled along the weld joint. For a fixed heat setting, the faster the travel speed, the lower the penetration and the lower and narrower the finished weld bead. Likewise, the slower the travel speed, the deeper the penetration and the higher and wider the finished weld bead.

TYPES OF WELD BEADS

The following paragraphs discuss the most commonly used welding beads.

Once you have the gun in position with the wire lined up on the weld joint, lower your helmet, pull the trigger and the arc will start. In a second or two you will notice a weld puddle form and the base of the bead beginning to build. It is now time to begin to move with the gun. If you are just learning to weld, simply move the gun in a straight line and at a steady speed along the weld joint. Try to achieve a weld with the desired penetration and a bead that is fairly flat and consistent in width.

As you become more familiar with your new welder and better at laying some simple weld beads, you can begin to try some different welding techniques to improve, and add versatility to your welding skills.

There are two basic types of weld beads, the stringer bead and the weave bead.

1. The STRINGER BEAD (Figure 7) is formed by traveling with the gun in a straight line while keeping the wire and nozzle centered over the weld joint. This is the easiest type of bead to make and is the type you have been using up to this point.

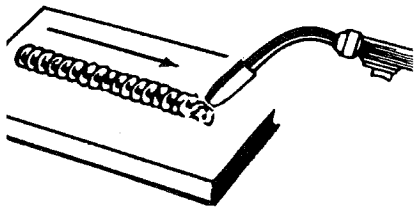


Figure 7. Stringer Weld Bead

2. The WEAVE BEAD (Figure 8) is used when you want to deposit metal over a wider space than would be possible with a stringer bead. It is made by weaving from side to side while moving the gun. It is best to hesitate momentarily at each side before weaving back the other way.

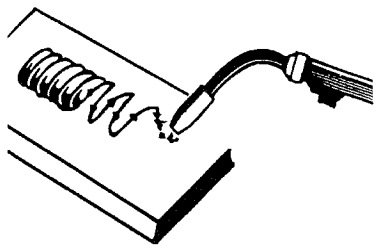


Figure 8. Weave Weld Bead

WELDING POSITIONS

There are four basic welding positions: flat, horizontal, vertical, and overhead.

1. The FLAT POSITION (Figure 9) is the easiest of the welding positions and is probably the one you have been using thus far. It is best if you can weld in the flat position if at all possible as good results are easier to achieve.

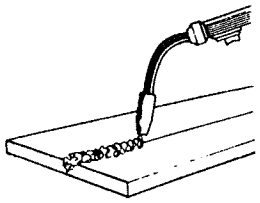


Figure 9. Flat Position Weld

2. The HORIZONTAL POSITION (Figure 10) is next in difficulty level. It is performed very much the same as the flat weld except that angle B (see POSITION OF THE GUN TO THE WORK PIECE, above) is such that the wire, and therefore the arc force, is directed more toward the metal above the weld joint. This is to help prevent the weld puddle from running downward while still allowing slow enough travel speed to achieve good penetration. A good starting point for angle B is about 30 degrees DOWN from being perpendicular to the work piece.

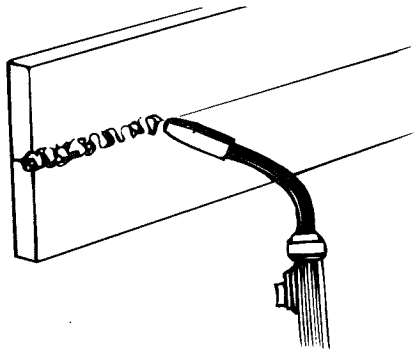


Figure 10. Horizontal Position Weld

3. The VERTICAL POSITION (Figure 11) is the next most difficult position. Pulling the gun from top to bottom may be easier for many people, but in some instances it can be difficult to prevent the puddle from running downward. Pushing the gun from bottom to top may provide better puddle control and allow slower rates of travel speed to achieve deeper penetration. When vertical welding, angle B (see POSITION OF GUN TO THE WORK PIECE, above) is usually always kept at zero, but angle A will generally range from 45 to 60 degrees to provide better puddle control.

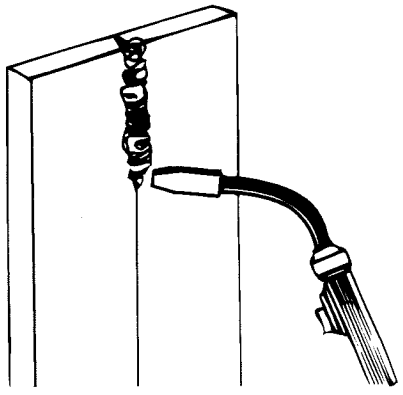


Figure 11. Vertical Position Weld

4. The OVERHEAD POSITION (Figure 12) is the most difficult welding position because gravity is pulling at the weld puddle trying to make it drip off the work piece. Angle A (see POSITION OF THE GUN TO THE WORK PIECE, above) should be maintained at 60 degrees, the same as in the flat position. Maintaining this angle will reduce the chances of molten metal falling into the nozzle should it drip from the weld puddle. Angle B should be held at zero degrees so that the wire is aiming directly into the weld joint. If you experience excessive dripping of the weld puddle, select a lower heat setting. Also, the weave bead tends to work better than the stringer bead when welding overhead.

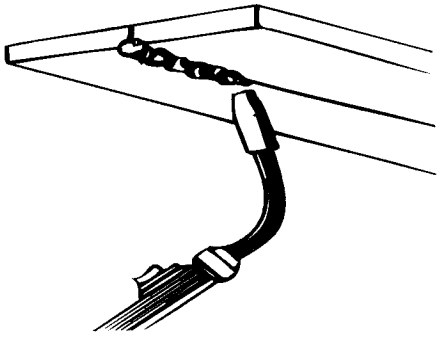


Figure 12. Overhead Position Weld

MULTIPLE PASS WELDING

1. Butt Weld Joints.
   In PREPARING THE WORK PIECE, we discussed the need for edge preparation on thicker materials by grinding a bevel on the edge of one or both pieces of the metal being joined. When this is done, a V is created, between the two pieces of metal, that will have to be welded closed. In most cases more than one pass or bead will need to be laid into the joint to close the V. Laying more than one bead into the same weld joint is known as a multiple-pass weld.

   The illustrations in Figure 13 show the sequence for laying multiple pass beads into a single V butt joint.

NOTE: WHEN USING SELF-SHIELDING FLUX-CORE WIRE it is very important to thoroughly chip and brush the slag off each completed weld bead before making another pass or the next pass will be of poor quality.

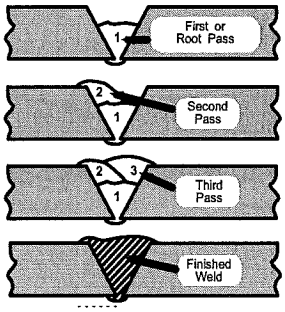


Figure 13. Triple Pass V Butt Joint

2. Fillet Weld Joints.
   Most fillet weld joints, on metals of moderate to heavy thickness, will require multiple pass welds to produce a strong joint. The illustrations in Figure 14 show the sequence of laying multiple pass beads into a T fillet joint and a lap fillet joint.

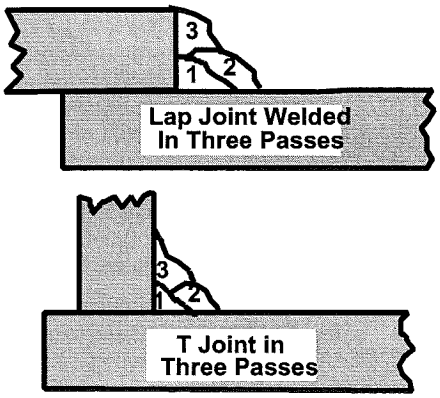


Figure 14. Triple Pass Lap and T Weld Joint

SPECIAL WELDING METHODS

SPOT WELDING

The purpose of a spot weld is to join pieces of metal together with a spot of weld instead of a continuous weld bead. There are three methods of spot welding: Burn-Through, Punch and Fill, and Lap (see Figure 15). Each has advantages and disadvantages depending on the specific application as well as personal preference.

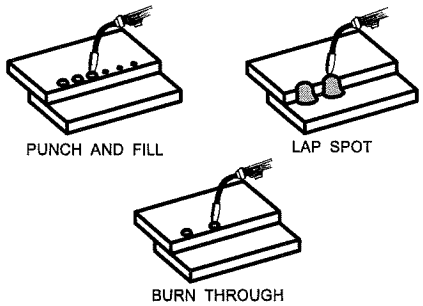


Figure 15. Spot Weld Methods

1. The BURN-THROUGH METHOD welds two overlapped pieces of metal together by burning through the top piece and into the bottom piece.

   With the burn-through method, larger wire diameters tend to work better than smaller diameters because they have greater current carrying capacities allowing the arc to burn through very quickly while leaving a minimal amount of filler metal build up. Wire diameters that tend to work best, with the burn-through method, are 0.030 inch diameter solid wire or 0.035 inch self-shielding flux-core wire.

   Do not use 0.024 inch diameter solid or 0.030 inch self-shielding flux-core wires when using the burn-through method unless the metal is VERY thin or excessive filler metal build-up and minimal penetration is acceptable.

   Always select the HIGH heat setting with the burn-through method and tune-in the wire speed prior to making a spot weld.

2. The PUNCH AND FILL METHOD produces a weld with the most finished appearance of the three spot weld methods. In this method, a hole is punched or drilled into the top piece of metal and the arc is directed through this hole to penetrate into the bottom piece. The puddle is allowed to fill up the hole leaving a spot weld that is smooth and flush with the surface of the top piece.
   Select the wire diameter, heat setting, and tune-in the wire speed as if you were welding the same thickness material with a continuous bead.

3. The LAP SPOT METHOD directs the welding arc to penetrate the bottom and top pieces, at the same time, right along each side of the lap joint seam.
   Select the wire diameter, heat setting, and tune-in the wire speed as if you were welding the same thickness material with a continuous head.

SPOT WELDING INSTRUCTIONS

1. Select the wire diameter and heat setting recommended above for the method of spot welding you intend to use.
2. Tune in the wire speed as if you were going to make a continuous weld.
3. Hold the nozzle piece completely perpendicular to and about 1/4 inch off the work niece.
4. Pull the trigger on the gun and release it when it appears that the desired penetration has been achieved.

5. Make practice spot welds on scrap metal, varying the length of time you hold the trigger, until a desired spot weld is made.
6. Make spot welds on the actual work piece at desired locations.

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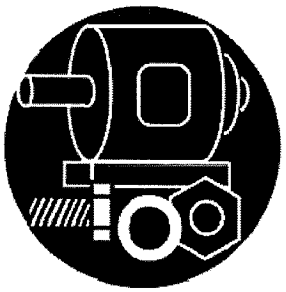

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