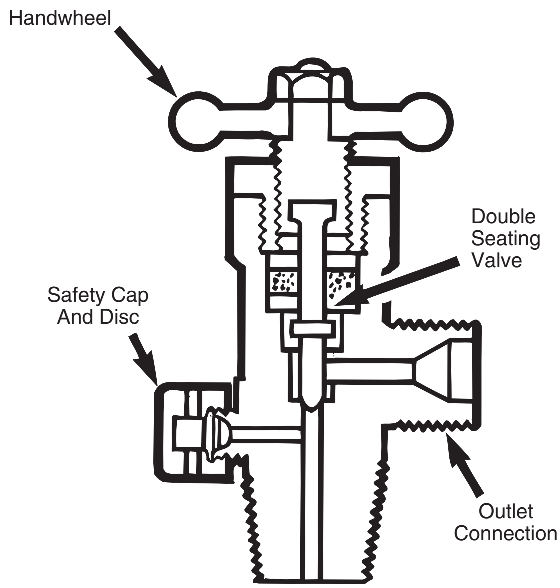

Figure 5.8 Cross section of cylinder valve.

Cylinders should not be stored or used in a horizontal position. This is because some cylinders contain a liquid which would leak out or be forced out if the cylinder was laid in a flat position.

Welding torches and other cables should not be hung on or near cylinders. A torch near a cylinder could cause an arc against the cylinder wall or valve assembly, possibly resulting in a weakened cylinder or even a rupture.

It is very important to be absolutely sure of yourself before attempting to use any welding equipment. ***Always think about what you are doing, and if you are not sure of the next step to take in any procedure, be sure to talk it over first with your welding supervisor. Remember, safety is an important factor not only for you, but for everyone around you!***

It can be said that common sense is the most important tool a welder can bring to the welding area. Common sense tells us we must respect the basic safety steps which must be taken to avoid both personal injury and injury to a fellow worker. Horseplay or practical jokes have no place in the working area!

VI. Preparation for Welding

Certain basic preparations should be made prior to establishing an arc. Preparations include base metal preparation, set up of the machine and its controls. (Basic preparation of commonly welded base metals will be covered later in this section.)

Figure 6.1 illustrates the front panel of a typical AC/DC machine designed for GTAW welding. Keep in mind that not all power sources will have all the features or controls of this machine. And the controls and switches mentioned in the following paragraphs may be found in locations on the power source other than the front panel. The various controls each have a specific function and the operator changes or varies them as the application changes. Power sources have symbols that represent these various controls; table 10 in Section XI covers these symbols.

Preparing the Power Source

Power Switch

This switch controls the primary line power to the transformer. When the switch is in the "on" position, voltage is applied to the control circuit. Operation of the fan with the power switch is dependent upon if the power source is equipped with Fan-On-Demand™ or not. In some cases, a pilot light will indicate the power source is in the "on" mode. In other cases the LED meters will indicate that the power is on. ***Before activating the "On" switch make certain the electrode is not in contact with the work lead or any portion of the work circuit!***

SMAW/GTAW Mode Switch

This switch should be set for the particular process being used. It will disable various functions that are not required when running one process or the other. For example, the gas solenoid valves will not be active in the SMAW mode as they are not required for this process.

Amperage Control Panel/Remote Switch

When a remote control device is being used, the switch must be in the "remote" position. When amperage control is to be at the front panel of the machine, the switch must be in the "panel" position.

Output Control Panel/Remote Switch

When a remote output control device is being used, the switch must be in the "remote" position. When using SMAW and not using a remote output control device, the switch must be in the "on" position. The "on" position means the output terminal of the machine will have voltage applied as soon as the power switch is turned on.

Arc Force/Balance Control

On this particular power source, when the high-frequency switch is enabled for GTAW welding, the arc force (Dig) circuitry drops out, and this control becomes the balance arc control. This will set the amount of time spent in the electrode negative (maximum penetration equals more DCEN) and electrode positive (maximum cleaning equals more DCEP) portions of the AC cycle. For additional information, refer to section II on GTAW fundamentals on the balance control. In the SMAW or Stick electrode welding mode, the arc force control will affect the arc action from a soft mushy type arc (minimum arc control) to a driving-digging, forceful type arc (maximum arc control). The arc force control is also referred to as "dig", and when used with the SMAW process it increases the short circuit amperage. When set at 0, short circuit amperage is the same as normal weld amperage.

Preflow and Postflow

Preflow control is not always a standard feature on all GTAW power sources. It is made up of a timer control and an on/off function switch. When "on", the arc will not start until the preflow timer has timed out assuring the arc will start in an inert atmosphere. This reduces the possibility of air contaminating the start of the weld. When "off" the preflow timer is out of the circuit and the arc is able to start as soon as the remote output control is activated. Postflow is a standard feature on all GTAW power sources and consists of only a timer control. It is used to allow the electrode, weld pool and filler rod to be protected from the air while they cool down from welding temperatures. Once they have cooled, they will no longer oxidize. The postflow timer should time out and conserve shielding gas. It is usually set to allow one second of postflow time for each 10 amperes of welding current being used. The tungsten should cool bright and shiny. Any bluing or blackening indicates a lack of postflow.

Start Mode

The high-frequency switch has four (4) selections: start, off, lift, and continuous.

When it is desired to use high frequency only to start the arc, the "start" position is selected. The high frequency remains on only until an arc is established and then it is automatically removed from the circuit. This allows for starting the arc without touching the electrode to the work. This setting should be used when welding materials that might contaminate the electrode.

The "off" position is used when high frequency is not desired, such as when scratch starts are suitable, or when the machine is used for Stick electrode welding.

"Lift" arc is selected when high frequency is undesirable and yet tungsten inclusions must be eliminated.

The "continuous" position is selected when welding with alternating current on aluminum or magnesium. This provides continuous high frequency for arc stabilization and starting.

Primary Overload Circuit Breaker

The circuit breaker provides protection against overloading the main components of the welding machine. The circuit breaker must be "on" before the primary contactor of the machine can be energized.

Figure 6.1 Front panel of a typical AC/DC machine designed for GTAW welding.

Weld Current Control or Amperage Control

This control sets the output current of the machine when no remote current device is being used. With a remote device attached, the control provides a percentage of total output. For example, if the control is set at 50%, the remote device at full output will deliver 50% of the machines available current.

Remote Amperage Control Receptacle

This receptacle is provided for connecting a remote hand control or a remote foot control. This allows the operator to have amperage control while welding at a work station which may be a considerable distance from the power source. With the foot control, the operator can vary the amperage as he progresses along a joint. This is particularly helpful when starting on a cold workpiece. Amperage may be increased to establish a weld pool quickly, and as the material heats up, the operator can decrease the amperage. When coming to the end of a joint, the amperage can be further decreased to taper off and "crater out".

AC/DC Selector and Polarity Switch

This three-position switch permits the operator to select direct current electrode positive, direct current electrode negative, or alternating current.

High-Frequency Intensity Control

This control allows the operator to choose the proper intensity for the high-frequency output. As this control is increased, the current in the high-frequency circuit is increased. It should be set for the required intensity to start the arc. It is recommended that this control be kept at a minimum setting that will provide satisfactory weld starts. The higher the setting the greater the amount of radiation which will cause interference with communication equipment.

Spark Gap Assembly

The spark gap points are normally set at the factory for optimum performance. A feeler gauge can be used to check the spacing or make adjustments on some machines.

Preparing the Weld Joint

Many GTAW problems, or supposed problems, are a direct result of using improper methods to prepare the joint. Chief among these is the improper use of grinding wheels to prepare joints. Soft materials such as aluminum become impregnated with microsized abrasive particles which, unless subsequently removed, will result in excessive porosity. Grinding wheels should be cleaned and dedicated exclusively to the material being welded. The ideal joint preparation is obtained with cutting tools such as a lathe for round or cylindrical joints, or a milling machine for longitudinal preparations.

Cleaning

Cleanliness of both the weld joint area and the filler metal is an important consideration when welding with the Gas Tungsten Arc Welding process. Oil, grease, shop dirt, paint, marking crayon, and rust or corrosion deposits all must be removed from the joint edges and metal surfaces to a distance beyond the heat affected zone. Their presence during welding may lead to arc instability and contaminated welds. If a weld is made with any of these contaminants present, the result could be a weld bead with pores, cracks, or inclusions. Cleaning may be accomplished by mechanical means, by the use of vapor or liquid cleaners, or by a combination of these.

Fixturing

Fixturing may be required if the parts to be welded cannot be self supported during welding or if any distortion cannot be tolerated or corrected by straightening. Fixturing should be massive enough to support the weight of the weldment and to withstand stresses caused by thermal expansion and contraction. The decision to use fixturing for the fabrication of a weldment is governed by economics and quality requirements.

Preheating

Preheating is sometimes required, the necessity being dictated for the most part by the thickness of the material to be welded. Preheating is most often achieved with the use of an oxy-acetylene torch. However care must be taken when using this method that localized overheating doesn't occur, and the base metal is not contaminated with combustion by-products of the oxy-fuel process. Other methods of preheating include induction coils, heating blankets and heating furnaces.

Preparing Aluminum for Welding

The preparation of aluminum deserves more consideration than it is often times given. Aluminum is very susceptible to contaminants which can cause considerable problems when welding. First of all, aluminum has a surface oxide which must be removed. This oxide removal is mentioned in detail in the text devoted to Squarewave current. There have been various theories as to how the arc action actually provides the cleaning action. High speed photographs and films of the arc let us observe the oxide removal.

When the electrode is positive and the work is negative (reverse polarity or during one half of the AC cycle), the positively charged gas ions are attracted to the negative workpiece. These ions strike the surface with sufficient force to chip away at the brittle oxide much like a miniature sand-blasting operation. The electron flow from the work to the electrode lifts the loosened oxide leaving clean base metal to be welded.

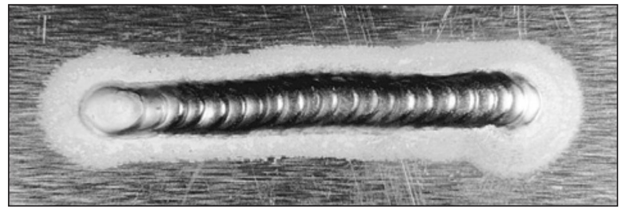

Figure 6.2 Aluminum TIG Weld. Note bright area where oxides have been removed through cleaning action of the arc.

This cleaning action should not be relied upon to do all the cleaning. Mechanical or chemical cleaning methods should be employed to remove heavy oxide, paint, grease, and oil, or any other materials that will hinder proper fusion. Mechanical cleaning may be done with abrasive wheels, wire brushes, or other methods. Special abrasive wheels are available for aluminum, and stainless steel wire brushes are recommended. The important point is that the abrasive wheels and wire brushes should be used only on the material being cleaned. If a wire brush for example were used on rusty steel, and then on aluminum, the brush could carry contaminants from one piece to another. The vigorous brushing can impregnate the contaminants carried in the brush into the aluminum. The same is true of the abrasive wheel and equipment used to cut and form aluminum.

There's another problem that sometimes occurs when only the side of the joint being welded is cleaned. Contamination from the backside or between butting edges can be drawn into the arc area. It is recommended that both sides of the joint be cleaned if it contains foreign material.

Another frequent source of contamination is the filler metal. Aluminum filler wire and rod oxidizes just like the base metal. If it is severe enough the rod must be cleaned prior to use. The operator sometimes transfers contaminants from dirty welding gloves onto the filler rod and consequently into the weld area. Stainless steel wool is a good material to use for cleaning filler wire and rod.

Welding Aluminum

The information contained in Figures 6.3a and 6.3b will serve as a guide to aluminum welding parameters.

Aluminum is a very good conductor of heat. The heat is rapidly conducted away from the arc area and spread over the work-piece. On small weldments, the entire part may heat up to a

Aluminum…Manual Welding – Alternating Current – High Frequency Stabilized						
					Gas	
Metal Thickness	Joint Type	Tungsten Electrode Diameter	Filler Rod Diameter (If Required)	Amperage	Type	Flow-CFH
1/16"	Butt	1/16"	1/16"	60 – 85	Argon	15
	Lap	1/16"	1/16"	70 – 90	Argon	15
	Corner	1/16"	1/16"	60 – 85	Argon	15
	Fillet	1/16"	1/16"	75 – 100	Argon	15
1/8"	Butt	3/32" – 1/8"	3/32"	125 – 150	Argon	20
	Lap	3/32" – 1/8"	3/32"	130 – 160	Argon	20
	Corner	3/32" – 1/8"	3/32"	120 – 140	Argon	20
	Fillet	3/32" – 1/8"	3/32"	130 – 160	Argon	20
3/16"	Butt	1/8" – 5/32"	1/8"	180 – 225	Argon	20
	Lap	1/8" – 5/32"	1/8"	190 – 240	Argon	20
	Corner	1/8" – 5/32"	1/8"	180 – 225	Argon	20
	Fillet	1/8" – 5/32"	1/8"	190 – 240	Argon	20
1/4"	Butt	5/32" – 3/16"	3/16"	240 – 280	Argon	25
	Lap	5/32" – 3/16"	3/16"	250 – 320	Argon	25
	Corner	5/32" – 3/16"	3/16"	240 – 280	Argon	25
	Fillet	5/32" – 3/16"	3/16"	250 – 320	Argon	25

Figure 6.3a Aluminum weld parameters.

Aluminum with Advanced Squarewave…Manual Welding – Alternating Current – High Frequency Stabilized								
Metal Thickness	Joint Type	Tungsten Size	Filler Material Diameter	Electrode Positive Amperage	Electrode Negative Amperage	AC Frequency Setting (Hz)	Balance Setting	Shielding Gas
1/16"	Butt	1/16"	1/16"	20	50	110	75% EN	100% Argon
	Lap	1/16"	1/16"	20	50	110	70% EN	100% Argon
	Corner	1/16"	1/16"	20	50	110	70% EN	100% Argon
	Fillet	1/16"	1/16"	20	50	110	70% EN	100% Argon
1/8"	Butt	3/32"	3/32"	60	120	140	70% EN	100% Argon
	Lap	3/32"	3/32"	60	120	140	73% EN	100% Argon
	Corner	3/32"	3/32"	60	120	140	68% EN	100% Argon
	Fillet	3/32"	3/32"	60	125	175	78% EN	100% Argon
1/4"	Lap	3/32"	3/32"	110	230	250	73% EN	100% Argon
	Corner	3/32"	3/32"	110	220	140	70% EN	100% Argon
	Fillet	3/32"	3/32"	110	240	250	75% EN	100% Argon

Figure 6.3b Aluminum with Advanced Squarewave weld parameters.

point that requires reduction of amperage from the original setting. Remote foot amperage controls are advantageous in these situations. When welding out-of-position, the amperages shown in Figures 6.3a and 6.3b may be decreased by about 15%. A water-cooled torch is recommended for amperages over 150. The electrode stickout beyond the cup may vary from approximately 1/16" on butt joints to possibly 1/2" in joints where it is difficult to position the torch. The normal recommended arc length is approximately the same as the electrode diameter.

Preparing Stainless Steel for Welding

"Stainless steel" is a common term used when referring to chromium alloyed and chromium-nickel alloyed steel. There are magnetic and non-magnetic types of stainless steel. There are a large number of alloy types and each type possesses some specific properties as to corrosion resistance and strength. A check with the manufacturer is recommended when in doubt about the specific properties of an alloy.

When welding stainless steel, it should be thoroughly cleaned. Protective paper or plastic coatings are applied to many stainless sheets. Foreign material may cause porosity in welds and carburetion of the surface which will lessen the corrosion resisting properties. Any wire brushing should be done with stainless steel wire brushes to prevent iron pick up on the stainless surfaces. As with other welding procedures, clean and dry filler metal should be used and proper precautions taken to prevent contamination during welding.

Welding Stainless Steel

Figure 6.4 contains parameters which will serve as a guide for welding stainless steel.

Chromium-nickel stainless steels are considered readily weldable. Normally the welding does not adversely affect the strength or ductility of the deposit, parent metal, or fusion zone. The filler metal used should be compatible, of similar composition, to the base metal. The heat conductivity of chrome-nickel stainless steels are about 50% less than mild steel with a high rate of thermal expansion. This increases the tendency for distortion on thin sections.

Values shown in Figure 6.4 are for single pass welds on the thinner sections, multiple pass welds on heavier material, and for welding out-of-position. Job conditions will affect the actual amperage, flow rate, filler rod, and tungsten used. Some examples are:

- Joint design and fit-up
- Job specifications
- Use of backing (gas, rings, bars)
- Specific alloy
- Operator

Heat input can be critical. In many applications, it is desirable to keep the heat input as low as possible. In the weld and heat affected zone, a metallurgical change takes place known as carbide precipitation. If corrosion resistance is a big factor in the completed weld, it should be noted that some of the corrosion resistance properties are lost in the weld and adjacent areas that are heated above the temperature where carbide precipitation occurs (800 – 1400˚ F). Keeping heat input to a minimum is necessary in this situation. The longer the work is at the 800 – 1400˚ F temperature, the greater the precipitation. Rapid cooling through this range will help keep precipitation to a minimum. On some alloys of stainless steel, columbium or titanium are added to prevent carbide precipitation. It is important that the filler metal used is of the same general analysis as the material being welded.

Preparing Titanium for Welding

Titanium's light weight, excellent corrosion resistance, and high strength-to-weight ratio make this a desirable metal for applications in the chemical, aerospace, marine and medical fields. Its use in the petrochemical industry and in the manufacture of sports equipment is some more recent application areas. Many consider titanium as very hard to weld. Titanium alloys can be embrittled by not following proper welding techniques, but titanium is much more readily welded than typically believed.

Before welding titanium, it is essential that the weld area and the filler metal be cleaned. All mill scale, oil, grease, dirt, grinding dust and any other contamination must be removed. If the titanium is scale free, degreasing is all that is required. If oxide scale is present, it should be degreased prior to descaling. An area at least 1 inch (25mm) from where the weld is to be made should be cleaned. The joint edges should be brushed with a stainless steel wire brush and degreased with acetone just prior to welding. Any titanium part handled after cleaning should be done so in a so-called "white glove" procedure to eliminate recontamination of the weld area. The cleaned parts should be welded within a few hours or properly stored by wrapping in lint-free and oil-free materials.

If grinding or sanding is used to clean titanium or prepare a joint, be very cautious of the fine titanium dust particles. Titanium is flammable and the smaller the dust particles are, the more flammable it becomes.

Stainless Steel … Manual Welding … Direct Current – Electrode Negative

Metal Thickness	Joint Type	Tungsten Electrode Diameter	Filler Rod Diameter (If Required)	Amperage	Gas Type	Gas Flow-CFH
1/16"	Butt	1/16"	1/16"	40 – 60	Argon	15
	Lap	1/16"	1/16"	50 – 70	Argon	15
	Corner	1/16"	1/16"	40 – 60	Argon	15
	Fillet	1/16"	1/16"	50 – 70	Argon	15
1/8"	Butt	3/32"	3/32"	65 – 85	Argon	15
	Lap	3/32"	3/32"	90 – 110	Argon	15
	Corner	3/32"	3/32"	65 – 85	Argon	15
	Fillet	3/32"	3/32"	90 – 110	Argon	15
3/16"	Butt	3/32"	1/8"	100 – 125	Argon	20
	Lap	3/32"	1/8"	125 – 150	Argon	20
	Corner	3/32"	1/8"	100 – 125	Argon	20
	Fillet	3/32"	1/8"	125 – 150	Argon	20
1/4"	Butt	1/8"	5/32"	135 – 160	Argon	20
	Lap	1/8"	5/32"	160 – 180	Argon	20
	Corner	1/8"	5/32"	135 – 160	Argon	20
	Fillet	1/8"	5/32"	160 – 180	Argon	20

Figure 6.4 Stainless steel weld parameters.

Welding Titanium

Figure 6.5 contains parameters which will serve as a guide for welding titanium.

These welding parameters are useable on the three various types of titanium alloys. The three types of titanium alloys are:

1. Titanium (CP). Commercially pure (98 to 99.5% Ti), can be strengthened by small additions of oxygen, nitrogen, carbon and iron.
2. Alpha Alloy. Generally single-phase alloys which contain up to 7% aluminum and a small amount <0.3% of oxygen, nitrogen and carbon.
3. Alpha-Beta Alloys. They have a characteristic two-phase microstructure brought about by the addition of up to 6% aluminum and varying amounts of beta formers. Beta forming alloys are vanadium, chromium, and molybdenum.

Figure 6.6 shows some of the relative weldability of these various alloy groups. Also displayed are recommended filler metals. When welding titanium and its alloy, the filler metal should closely match the alloy content of the base metal being welded.

Titanium... Manual Welding – Direct Current Electrode Negative						
					Gas	
Metal Thickness	Joint Type	Tungsten Electrode Diameter	Filler Rod Diameter (If Required)	Amperage	Type	Flow-CFH*
1/16"	Butt	1/16" – 3/32"	1/16"	65 – 105	Argon	15
	Lap	1/16" – 3/32"	1/16"	100 – 165	Argon	15
	Corner	1/16" – 3/32"	1/16"	65 – 105	Argon	15
	Fillet	1/16" – 3/32"	1/16"	100 – 165	Argon	15
1/8"	Butt	3/32"	3/32"	95 – 135	Argon	15
	Lap	3/32"	3/32"	150 – 200	Argon	15
	Corner	3/32"	3/32"	95 – 135	Argon	15
	Fillet	3/32"	3/32"	150 – 200	Argon	15
3/16"	Butt	3/32" – 1/8"	3/32"	150 – 225	Argon	20
	Lap	3/32" – 1/8"	3/32"	150 – 250	Argon	20
	Corner	3/32" – 1/8"	3/32"	150 – 225	Argon	20
	Fillet	3/32" – 1/8"	3/32"	150 – 250	Argon	20
1/4"	Butt	1/8"	3/32" – 1/8"	175 – 275	Argon	20
	Lap	1/8"	3/32" – 1/8"	200 – 300	Argon	20
	Corner	1/8"	3/32" – 1/8"	175 – 275	Argon	20
	Fillet	1/8"	3/32" – 1/8"	200 – 300	Argon	20

*This is the torch (primary) shielding gas flow rate, a trailing (secondary) shield gas flow rate should be 2 to 4 times this rate. A trailing shielding gas is generally required for welding titanium.

Figure 6.5 Titanium weld parameters.

Weldability Rating			
Alloy		Rating	Filler Metal
Commercially Pure (CP)	Ti-0.15 O2	A	ERTi-1
	Ti-0.20 O2	A	ErTi-2
	Ti-0.35 O2	A	ERTi-4
Alpha Alloys	Ti-0.2 Pd	A	ERTi-7
	Ti-5 Al-2.5 Sn	B	ERTi-6
	Ti-5 Al-2.5 Sn ELI*	A	ERTi-6ELI
Alpha-Beta Alloys	Ti-6 Al-4V ELI	A	ERTi-5ELI
	Ti-7 Al-4Mo	C	ERTi-12
	Ti-8 Mn	D	Welding Not Recommended

Figure 6.6 Titanium welding ability.

*ELI = Extra-low interstitial impurities are specified. These interstitial impurities are carbon, hydrogen, oxygen and nitrogen and both the filler metal and base metal are low in these impurities.

Key

A = Excellent; useful as-welded, near 100% joint efficiency if base metal annealed condition.

B = Fair to good; useful as-welded, near 100% joint efficiency if base metal annealed condition.

C = Limited to special applications; cracking can occur under high restraint.

D = Welding not recommended; cracking under moderate restraint; use preheat (300 – 350˚ F) followed by post weld heat treatment.

Shielding of the titanium weld and surrounding metal (this includes the hot end of the filler rod) that reach temperatures of 1200˚ F (650˚ C) is required. When doing manual "open air" (not in a bubble or totally enclosed chamber) care must be taken to prevent atmospheric contamination of the titanium. Since titanium has a very low thermal conductivity, it will stay hot for a long time after the welding arc has moved along the joint. Thus a trailing gas is essential. This can be accomplished with a large gas lens on the torch or a trailing gas shoe that attaches to the TIG torch. This metal shoe (chamber) has a porous metal diffuser to allow the gas to blanket the titanium until it has cooled below its oxidation temperature. Figure 6.7 is an example of a trailing gas shield. The primary gas shielding is what is flowing through the torch and the secondary gas shielding is what is flowing through the trailing shield. If the back side of the joint is going to be exposed to oxidation temperatures >500˚ F, it must also be protected from the atmosphere by a backing gas shielding or in the case of pipe or tubing purging the inside of the pipe or tube.

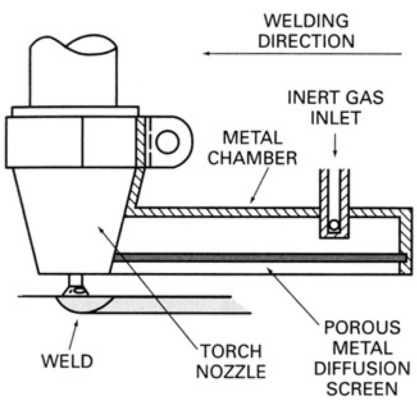

Figure 6.7 Torch trailing shield for TIG welding of titanium and other reactive metals.

Preparing Mild Steel for Welding

Mild steel should always be mechanically cleaned prior to welding. Rust, paint, oil and grease, or any surface contaminants should be removed. Hot-rolled products such as angle iron, plate, and pipe may contain a heavy mill scale. For best results, remove scale prior to welding. Black pipe usually contains a varnish type coating, which should be removed before welding.

Welding Mild Steel

Low carbon steels, commonly referred to as mild steels, are readily welded by the GTAW process. These groups of steels are available in many different alloys and types. The familiar structural shapes, plates, and hot rolled sheet metal are usually comprised of what is termed "semi-killed steel". This term means the steel has been partially deoxidized during manufacture. The steel, however, still contains some oxygen, and this oxygen can cause problems when welding. These problems will appear in the form of bubbles in the weld pool, and possibly in the finished weld bead. "Killed steel" has had more oxygen removed in its manufacture, and presents less of a problem when welding.

A filler wire containing sufficient silicon and manganese, added as deoxidizers, is necessary. Lower grade filler rods used for oxyacetylene welding of many hot rolled products are not suitable for making high-quality GTAW welds. Direct current electrode negative is recommended with high-frequency start. A 2% thoriated tungsten with point or taper on the electrode should be used.

Figure 6.8 contains parameters which will serve as a guide for welding mild steel.

Mild Steel … Manual Welding … Direct Current – Electrode Negative						
					Gas	
Metal Thickness	Joint Type	Tungsten Electrode Diameter	Filler Rod Diameter (If Required)	Amperage	Type	Flow-CFH
1/16"	Butt	1/16"	1/16"	60 – 70	Argon	15
	Lap	1/16"	1/16"	70 – 90	Argon	15
	Corner	1/16"	1/16"	60 – 70	Argon	15
	Fillet	1/16"	1/16"	70 – 90	Argon	15
1/8"	Butt	1/16" – 3/32"	3/32"	80 – 100	Argon	15
	Lap	1/16" – 3/32"	3/32"	90 – 115	Argon	15
	Corner	1/16" – 3/32"	3/32"	80 – 100	Argon	15
	Fillet	1/16" – 3/32"	3/32"	90 – 115	Argon	15
3/16"	Butt	3/32"	1/8"	115 – 135	Argon	20
	Lap	3/32"	1/8"	140 – 165	Argon	20
	Corner	3/32"	1/8"	115 – 135	Argon	20
	Fillet	3/32"	1/8"	140 – 170	Argon	20
1/4"	Butt	1/8"	5/32"	160 – 175	Argon	20
	Lap	1/8"	5/32"	170 – 200	Argon	20
	Corner	1/8"	5/32"	160 – 175	Argon	20
	Fillet	1/8"	5/32"	175 – 21 0	Argon	20

Figure 6.8 Mild steel weld parameters.