V. Safety

As in any welding process, GTAW safety precautions are very important. All information relating to the safe operation of the welding equipment and the welding process must be fully understood before attempting to begin work. A careless welder who does not observe simple rules can cause a dangerous situation for everyone in the area. The process of arc welding creates several hazards which must be guarded against. Useful safety information can be found in the owner's manual that comes with each piece of welding equipment.

Gas Tungsten Arc Welding (TIG) is an electrical welding process. Therefore, electrical energy is required from a welding machine. If the welding machine has the characteristics of a transformer or a motor-generator design, electrical energy is required as primary power to operate it. The welding machine must be installed according to the manufacturer's recommendation and in accordance with the National Electrical Code and local code requirements.

Electrical Shock

Welders must be concerned about the possibility of electrical shock. It should be remembered that electricity will always take the path of least resistance. If there is a proper secondary circuit, the current will follow that path. However, if there are poor connections, bare spots on cables, or wet conditions, the possibility of electrical shock does exist.

A welder should never weld while standing in water. If wet working conditions exist, certain measures should be taken. Such measures include standing on a dry board or a dry rubber mat when welding. Likewise, the welding equipment should not be placed in water. In addition, gloves and shoes must be kept dry. Even a person's perspiration can lower the body's resistance to electrical shock.

Fumes

As with most welding processes, the heat or the arc and molten pool generate fume. Since TIG does not typically use flux or produce slag, it is highly recommended that the material being welded is clean. Few fumes are produced compared to other arc welding processes like SMAW or FCAW. However, the base metals may contain coatings or elements such as lead, zinc, copper, nickel, etc. that may produce hazardous fumes. Ozone can also be produced as the ultraviolet light emitted by the arc hits the oxygen in the surrounding area, producing a very distinctive, pungent odor.

The welder should keep their head and helmet out of the fumes rising off the workpiece. Proper ventilation should be supplied, especially in a confined space. Since this is a gas shielded process, care must be taken not to extract too much air from the arc area, which would disturb the process.

Arc Rays

Several possible hazards exist due to the electric arc which include infrared and ultraviolet rays. The light and rays can produce a burn similar to sunburn. The arc rays, however, are more severe than sunburn since the welder is so close to the source. Any exposed skin can be quickly burned by these rays.

Clothing

Clothing made from a dark-colored, tightly woven material is best suited for welding. Flammability of clothing material must also be considered since sparks could ignite the fabric. Oxygen, for instance, supports combustion and should never be used for blowing off equipment or used on any person or personal clothing.

Shirt collars and shirt cuffs should be buttoned, and open front pockets are not advisable as they may catch sparks. Pant cuffs are not recommended, as they will also catch sparks. Matches or lighters should never be stored in pockets.

Since welding sparks can burn through clothing, for many applications leather capes, sleeves and aprons are recommended. To protect the feet, high-top leather shoes or boots are necessary. Canvas shoes are definitely not suitable. Clothing and shoes must be kept free of oil and grease or other flammable materials. Gauntlet type leather gloves should be worn to protect the hands and wrists. See Figure 5.1 and 5.2.

Figure 5.1 Properly dressed welder.

Figure 5.2 Boots, leathers, gloves.

It is essential to know that some Gas Tungsten Arc Welding results in relatively high levels of visible light and infrared radiant energy. This can add to the disintegration of cotton clothing due to ultraviolet radiation. Thus, recommended clothing should be worn at all times.

Eye Protection

The welding arc should never be observed with unprotected eyes. A short exposure to the arc, which sometimes occurs accidentally, may cause an eye condition known as "flash burn". Usually this is not a permanent injury, but may be painful for a short time after exposure. The feeling can be described as having sand in one's eyes. Sometimes it is possible for a period of 4 to 8 hours to pass before a painful sensation in the eyes develops. Mild cases of flash burn can possibly be treated by a doctor. Continued exposure to flash burn could cause permanent eye damage.

Persons passing by an area where welding is being done could possibly get a mild flash burn from a stray arc glare. It is recommended that not only welders, but all people in the welding area, wear approved tinted safety glasses. Most industrial locations require the use of safety glasses, but they are absolutely necessary in the welding area. See Figure 5.3.

Figure 5.3 Safety glasses.

The welder should wear a welding helmet equipped with the proper shade lens for the work being done. Welding lenses are not simply colored glass, but are special lenses which screen out almost 100% of the infrared and ultraviolet rays. Lenses are manufactured in various shades designated by a shade number, and the higher the shade number, the darker the lens. The choice of a shade may vary depending upon a person's sensitivity of eyesight and the welding variables. Generally speaking, the current used determines the shade lens needed. The higher the current, the darker the shade lens. The welding helmet can be equipped with an electronic lens which automatically lightens and darkens as required, as shown in Figure 5.4. Some electronic lens have adjustment for the darkness level. Safety rules can be found in the AWS approved ANSI Z49.1 booklet, *Safety In Welding And Cutting*. Another source of information is the booklet, *Recommended Practices For Gas Tungsten Arc Welding* (AWS C5.5). Refer to table 8 in Section XI for proper lens selection.

Figure 5.4 Welding helmet.

The Welding Environment

The area surrounding the welder can be called the welding environment. The Gas Tungsten Arc Welding process can create light, heat, smoke, sparks and fumes which influence that environment. In addition to the protective clothing the welder wears, other precautions must be taken.

The light given off from welding may bother other workers in the area. Permanent booths or portable partitions can be used to contain the light rays in one area. The heat and sparks given off are capable of setting flammable materials on fire. Welding should not be done in areas containing flammable gases, vapors, liquids or dusty locations where explosions are a possibility.

Many injuries have resulted from welding on containers that have held materials easily capable of catching fire or exploding. These are often referred to as combustibles. This problem not only refers to containers such as petroleum tanks, but also to tanks which have a volatile (explosive) nature when heated by a welding arc. Acceptable methods of cleaning such containers before welding are outlined in AWS A6.0, *Safe Practices For Welding And Cutting Containers That Have Held Combustibles*. Unless these procedures are read and carried out, no attempt should be made to weld on these containers.

Metals that have plating, coatings, paint or other materials near the arc area may give off smoke and fumes during welding. Health hazards, especially to the lungs, may exist from these fumes. Exhaust hoods or booths can remove fumes from a particular area. When welding in confined spaces such as inside tanks, in compartments of a ship or inside other containers, toxic (poisonous) fumes may gather. Also, the oxygen we breathe can be replaced by shielding gases used for welding or purging in an enclosed room. This condition can cause death due to the lack of oxygen. Care must be taken to provide enough clean air for breathing. Some type of system should be present to bring clean air to an area where fumes are being exhausted. In some instances, it may even be necessary to provide welders with air masks or self-contained breathing equipment.

Safe Handling of Cylinders

Regardless of the content, pressurized cylinders must at all times be handled with great care. Shielding gases such as carbon dioxide, argon and helium are nonflammable and nonexplosive. A broken off valve, however, will release extremely high pressures, which could cause the cylinder to be hurled about at dangerously high speeds. Another way of thinking about this pressure is to compare a cylinder to a balloon. If a balloon is blown up and then released, the jet force of air escaping causes the balloon to fly about quite rapidly and erratic. The same would be true if a cylinder valve would break off. The weight of the cylinder and the extremely high pressure could easily cause a very damaging and possibly fatal accident.

Cylinders should be securely fastened at all times (Figure 5.5). Chains are usually used to secure a cylinder to a wall or cylinder cart. When moving or storing a cylinder, a threaded protector cap must be fastened to the top of the cylinder. This protects the valve system should it be bumped or the cylinder dropped (Figure 5.6). It is accepted procedure to roll a cylinder in the upright position when moving the cylinder. Figure 5.7 shows this. In some shops cylinder carts are used to move cylinders about. Whatever the method, common sense must be used to ensure a safe working area.

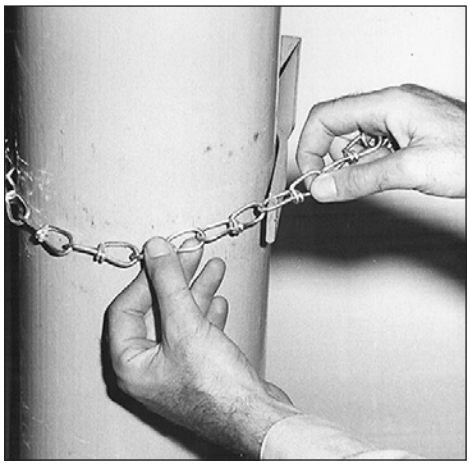

Figure 5.5 Securing cylinder to cart.

It is also very important to keep excess heat of any kind away from cylinders. Never weld on any cylinder. When a cylinder is exposed to too much heat, the pressure inside the cylinder will increase. To prevent the excess pressure from causing the cylinder to explode, the cylinder valve is equipped with a safety nut and bursting disc as shown in Figure 5.8.

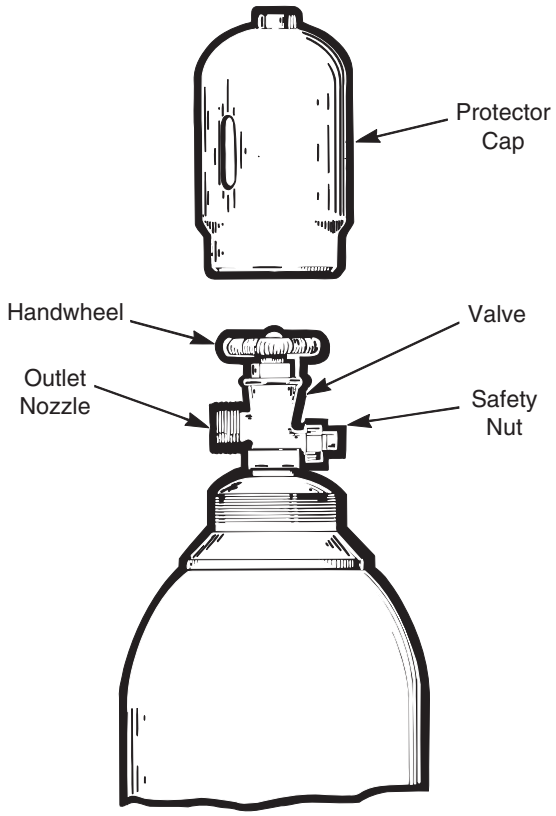

Figure 5.6 Shielding gas cylinder.

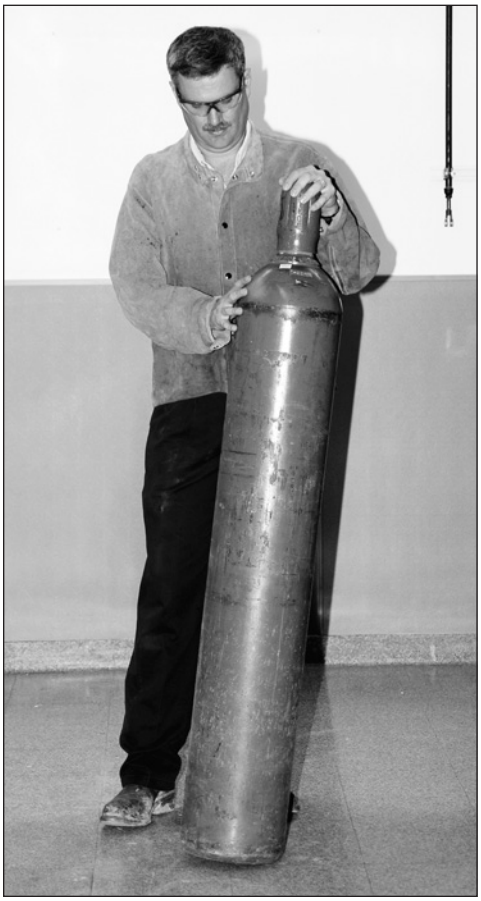

Figure 5.7 Rolling a cylinder.

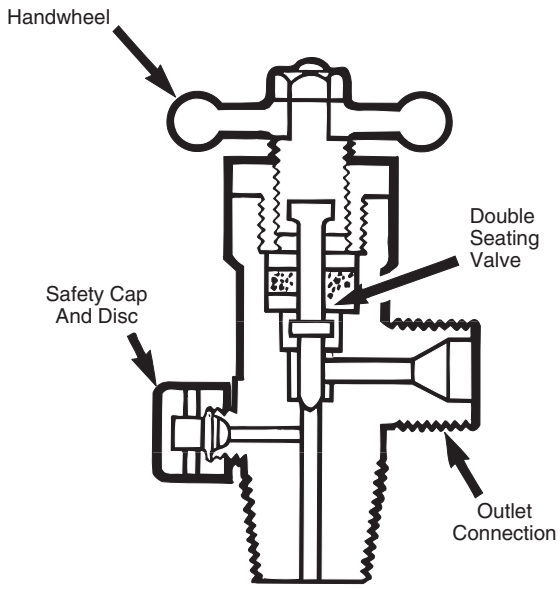

Figure 5.8 Cross section of cylinder valve.

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