Instruction Manual

Gas Welding, Cutting, Brazing, & Heating Torches

IMPORTANT

For your own safety, read these instructions. Failure to do so could lead to serious injury.

SAVE THESE INSTRUCTIONS!

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FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN SERIOUS PERSONAL INJURY.

Repair
Have only qualified repairmen service, test and clean the equipment.

Extra Copies
Extra copies of these instructions are available. Call your distributor or contact the factory of Harris Products Group..

CAUTION

Use RMA-CGA grade "T" hose for Alternate Fuel Gases to prevent Hose failure.

Introduction

These instructions are intended for experienced operators and those working under the close supervision of skilled welders. Operation and maintenance of welding and cutting equipment should conform to the provisions of American National Standard Z49.1, "Safety in Welding and Cutting". American Welding Society Manual C4.2-78 "Operator's Manual for Oxy-Fuel Gas Cutting" deserves careful study.

Reference Publications

AWS C-4.2-78 "Operator Manual for Oxy-Fuel Gas Cutting" - American Welding Society, 550 N.W. LeJeune Rd., Miami, Fl 33126

ANSI Z49.1 - "Safety in Welding and Cutting" - American National Standards Institute, 1430 Broadway, New York, NY 10018

Compressed Gas Association (CGA), 1235 Jefferson Davis Highway, Arlington, VA 22202

· **Safety Bulletin SB.8** - "Use of Oxy-Fuel Gas Welding and Cutting Apparatus."

· **Pamphlet E-1** - "Standard Connections for Regulator Outlets"

· **CGA Standard V-1** - "Compressed Cylinder Valve Inlet and Outlet Connections"

IMPORTANT SAFEGUARDS

Read all Instructions

Warning:

When using welding and cutting torches, basic safety precautions should always be followed to reduce the risk of fire and personal injury, including the following:

1. Wear protective attire. Always wear welding goggles to protect eyes from sparks and light rays. Use gloves, and protective clothing. Watch for sparks in cuffs. Do not wear oily gloves. Do not carry lighters, matches or other flammable objects in pockets when welding or cutting.

2. Handle Cylinders with care. Chain or otherwise secure cylinders to a permanent fixture. Take care when moving. To transport cylinders (except when in cylinder carts), remove regulators and replace with valve cap. Never use any cylinder in other than an upright position.

3. Use "Good Housekeeping" in work area. Keep sparks and flame away from combustibles. Prepare your work area before welding or cutting.

4. Do not oil or grease equipment. The equipment does not require lubrication. Oil or grease is easily ignited and burns violently in the presence of oxygen.

5. "Crack" oxygen cylinder valve before installing regulator. Open valve slightly and then close. This will clear valve of dust or dirt which may be carried to regulator and cause damage or accident. Do not discharge flow of gas at any person or flammable material.

6. Be sure all connections are tight. Don't force connections. Never test for leaks with a flame. Use a soapy water solution and check for bubbles.

7. Purge oxygen and fuel gas passages separately before lighting torch. This will aid in preventing improper mixing of gases.

8. Use recommended pressure settings. Improper pressures are wasteful. Extreme pressure build up in regulators is a warning they need repair.

9. Never use oxygen or fuel gas to blow off work, equipment or clothing. Pure oxygen supports combustion and a spark can ignite oxygen-saturated clothing.

10. Purge system after use. When shutting down, close cylinder valves, then bleed system by emptying both hoses independently. First, open torch oxygen "OX" needle valve, drain line until pressure is zero, then close oxygen needle valve. Repeat process with torch fuel "GAS" needle valve.

11. Do not work with damaged or leaking equipment. Use soapy water when checking for leaks. Do not use frayed or damaged hose. Never use torch as a hammer to knock slag from work.

12. Handle equipment with care. Its continued good service and your safety depend upon it.

13. Keep work area well ventilated. Flammable materials burn violently in an oxygen atmosphere. Flames and glowing materials (tobacco smoking) must be avoided when using oxygen. See American National Standard Z49.1, paragraph 8.1.2.

14. When working with acetylene. Never use at pressures over 15 PSIG (Pounds per Square Inch Gauge).

15. Do Not Force connectors and threads. The differences are intentional for the various Gases.

16. Never light a torch with matches or a lighter. Always use a striker

17. Always be aware of others around you when using a torch.

18. Be careful not to let welding hoses come into contact with torch flame sparks from cutting or hot metal.

NOTE: SAVE THESE INSTRUCTIONS

Set-Up Instructions

Attaching Regulators, Hoses and Torch

(WRENCH NOT INCLUDED)

1. Secure gas cylinders, if used, in upright position.

Note: Check contents of the cylinders before startup to assure an adequate supply for the intended operating cycle.

2. Open cylinder valve (Fig. 1) slightly to blow out dirt, the close. DO NOT discharge flow of gas at any person or flammable material.

3. Attach regulators (Fig. 2 and 3) using standard CGA inletconnection and tighten firmly.

4. Attach hoses to regulators (Fig. 4) and tighten.

Note: The fuel gas (red) hose connections are left hand threads and the oxygen (green) hose connections are right hand threads.

5. Attach fuel gas hose to torch valve (Fig. 5) marked “Gas” (left hand thread).

Figure 1. Opening Oxygen Cylinder Valve

Figure 2. Attaching Oxygen Regulator

Figure 3. Attaching Fuel Gas Regulator

Figure 4. Attaching Hose to Regulator

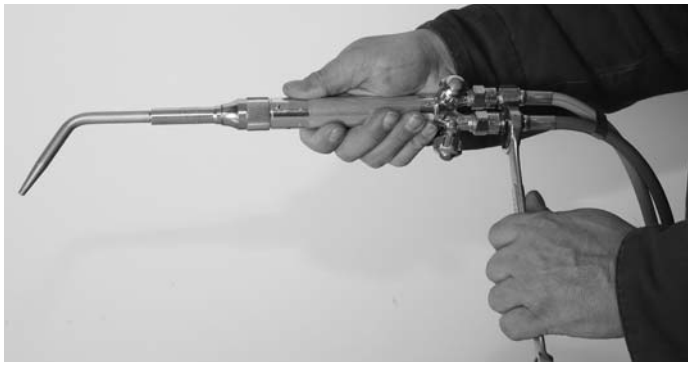


Figure 5. Attaching Hose to Torch

6. Attach oxygen hose to torch valve marked “OX” (righthand thread).

7. Install correct size tip (Figs. 6 and 7) for metal thickness to be welded or cut. make sure the tip seat is free of nicks or burrs. Welding tips should be hand-tightened only. Cutting tips should be wrench tightened.

8. Close both valves on torch (Fig. 6) (clockwise) before opening cylinders.

Figure 6. Installing Welding Tip

Figure 7. Installing Cutting Tip

Adjusting Pressure

To identify equal pressure or universal pressure torches, set 25 ± 5 PSI on oxygen supply, disconnect fuel gas hose and check valve with mixer or cutting attachment on torch. Open all gas valves and check fuel gas inlet. If pressure is found, equipment is equal pressure type. If suction is noted, equipment is universal pressure type. Reconnect check valve and hose and purge thoroughly before lighting.

Note: 1. For Equal Pressure Torches (sometimes called "medium pressure"). This equipment requires fuel gas pressures above 1 PSIG. Positive pressure is used to mix fuel gas with oxygen.

2. For Universal Pressure Torches (sometimes called "low pressure"). This equipment operates with less than 1 PSIG fuel gas pressure. Oxygen, at pressure, creates suction that pulls the fuel gas into the mixer.

1. Be sure both regulator adjusting keys (Fig. 8) are free, by turning counter-clockwise until loose.

2. Slowly open fuel gas cylinder valve (Fig. 9) not over one (1) turn and set regulator key for required operating pressure. Keep handle or valve wrench on cylinder valve to allow rapid shutdown.

Figure 8. Regulator Adjusting Key

Figure 9. Opening Fuel Gas Cylinder Valve

3. To prevent a sudden increase in pressure, slowly open fully the oxygen cylinder valve (Fig. 10). and set regulator to required operating pressure.

Note: The oxygen cylinder valve should always be wide open when operating.

4. Test connections and regulators for leaks by brushing with a soapy water solution while observing for presence of any bubbles. If bubbles are observed, tighten fittings and wipe off soap solution. Refer to Regulator Test in the Maintenance instructions.

Figure 10. Opening Oxygen valve

Operating Instructions

Lighting Torch for Acetylene and Mapp® Fuel Gas

1. Purge system. Refer to Maintenance Instructions.

2. Open torch fuel "GAS" valve (Fig. 11) approximately one half turn and ignite fuel gas.

3. Keep opening torch fuel "GAS" valve (Fig. 12) until flame stops excessive smoking and leaves the end of tip about 1/8", then reduce slightly to bring flame back to tip.

4. Open torch oxygen "OX" valve (Fig. 12) until a bright inner cone appears on the flame.

Note: The point at which feathery edges of flame disappear and a sharp inner cone is visible is called the "Neutral Flame." ® Airco, Inc.

Lighting Torch for Other Fuel Gases (Propane, Propylene & Natural Gas)

1. Purge System. Refer to Maintenance Instructions.

2. Open torch fuel "GAS" valve approximately one quarter turn and ignite fuel gas. Close valve slightly if flame blows off tip.

3. Crack oxygen "OX" valve and open until feathery, secondary cone disappears.

4. Alternately open each valve to bring flame intensity up to the desired point.

Note: A neutral flame has a shortened, sharply defined inner cone, blue in color. Intensity of the color depends on fuel gas used, but all gases will show lighter blue as oxygen is added past the neutral point.

Figure 11. Igniting Fuel Gas

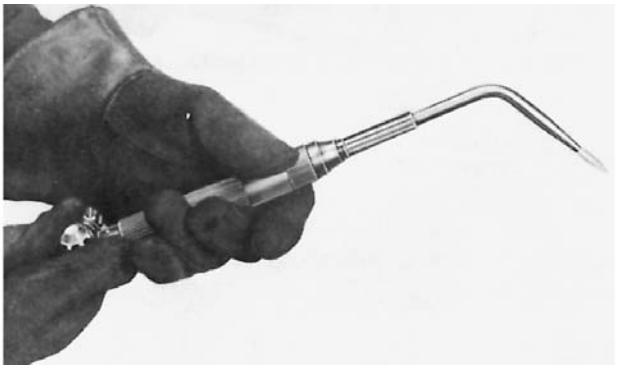


Figure 12. Adjusting flame

Shutting Down Equipment

1. First close torch oxygen "OX" valve, then close torch fuel "GAS" valve (Fig. 12). This sequence will prevent flame from popping out at shut down.

2. Close supply valves for both gases (FIgs. 9 and 10).

3. Bleed off all oxygen at torch "OX" valve, (Fig. 12) then close the valve.

4. Bleed off all fuel gas at torch "GAS" valve, (Fig. 12) then close the valve.

5. All pressure gauges should read 0 PSI. Turn both pressure regulator adjusting keys (Fig. 8) counterclockwise until loose.

Gas Welding and Steel Flame Cutting

Basic Gas Welding Procedures

Gas Welding. Gas welding is a method of joining similar metals by heating the adjacent surfaces to the melting point with an oxy-acetylene flame, and allowing the two parts to fuse together, with a filler metal being required on materials 3/16" thick or more. The resulting weld is as strong as the parent metal.

Clean all metal. All metal should be cleaned before welding. Oil, grease, rust, scale, or other impurities will affect the weld quality, or tensile strength. Metal 3/16" or more thick should be bevelled before welding, and when bevelled sides are joined, a filler rod of the same material is necessary.

Welding Tip Chart. There are a variety of tip sizes available to handle welding or brazing different thickness of material. For complete information regarding material thickness and pressure settings refer to the current product catalog or visit our website at *www.harrisproductsgroup.com*. If too large a tip is used and the flame softened, the tip heats up unnecessarily and is often accompanied by a popping noise which splatters the weld puddle. Too hot a flame burns the steel, and too small a flame will not heat the metal to the proper temperature.

Proper Flame. A neutral flame (Fig. 13) is used for almost all gas welding. The oxy-acetylene flame consumes all oxygen in the air around the welding area, which leaves an uncontaminated weld area and a weld of maximum strength. An oxidizing flame is rarely used, but a carburizing flame is occasionally helpful when flame hardening or brazing.

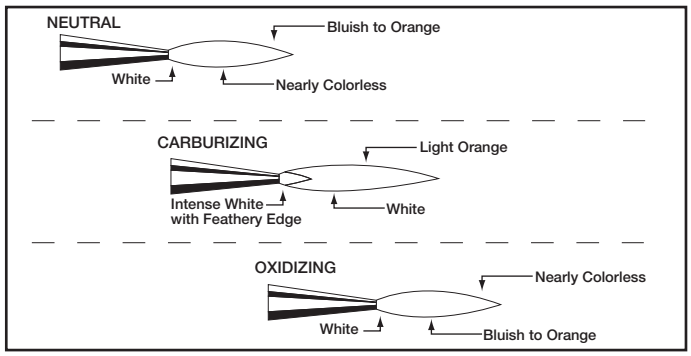


Figure 13. Neutral, Carburizing and oxidizing Flames

Welding Rod. Welding rods are available for all types of welding, including mild steel, cast iron and aluminum, in the following sizes: 1/16", 3/32", 1/8", 5/32", 3/16", 1/4". The size needed will be determined by the type of weld, the thickness of the metal, and the amount of filler metal required.

Gas Welding Practices and Exercises. Gas welding is not a difficult art. The following exercises of torch movement are good practice, and make subsequent welding easy.

Exercise 1
1. Take a small welding tip and set proper pressures.

2. Point flame directly into steel (Fig. 14) (1/8" stock recommended) with the flame cone just above the metal surface.

3. When a puddle is formed, move torch back and forth and move the puddle across the steel. Do this slowly.

4. It is necessary to have good penetration, and this comes from a deep puddle. It is helpful to lean the tip about 45º away from the direction you want the puddle to move.

Exercise 2
1. Place two pieces of 1/8" steel together as shown in Figure 15.

2. Make the puddle again and with a back and forth torch motion, move the puddle along the seam. Go slowly to get good penetration.

Note: This can be checked by turning parts over. The penetration should be visible from the bottom side. Test the weld strength by attempting to tear the parts apart.

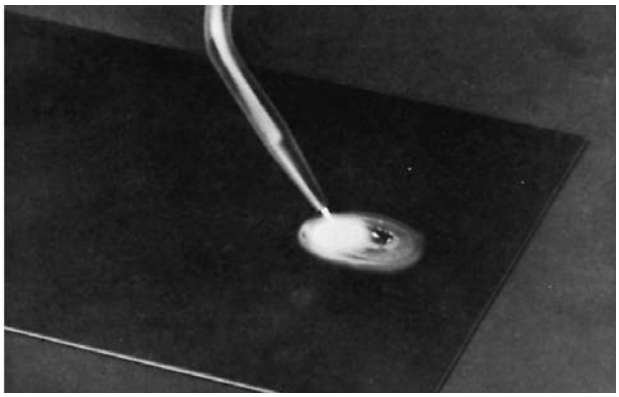


Figure 14. Excercise 1

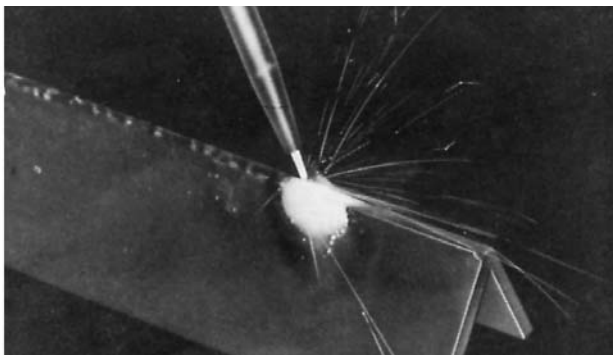


Figure 15. Excercise 2

Exercise 3
Note: Repeat Exercise 2, but add welding rod this time.

1. While flame is directed at the steel in order to form the puddle, put rod into the flame (Fig. 16).

2. When rod gets red, maintain this temperature by moving it in and out of the flame. Once the weld is started, dip into the puddle. this builds up the weld so that the top is rounded instead of concave as when no rod was used.

Note: Remember, welding rod is necessary on all double joints and once the welder is experienced, he will prefer to use rod on all welds, regardless of how thin the steel.

3. Material 3/16" or thicker should be bevelled before welding. A 30º bevel (Fig. 17) on each piece is best. This is necessary to obtain good penetration through the entire thickness. A rod is necessary filler metal on all welds made from bevelled edges. Once the torch movement and puddle control are mastered, the welder can make vertical, horizontal, or flat welds. He now has a tool that will repay its cost many times over.

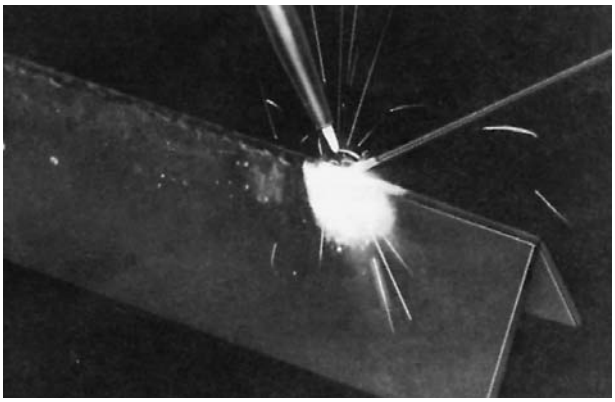


Figure 16. Excercise 3

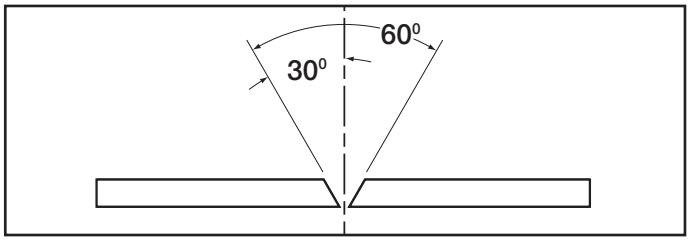


Figure 17. Proper 30 Degree bevel for welding

Braze Welding
Braze welding (FIg. 18) differs from gas welding because the two pieces of metal are not fused together. The brazing rod melts at a lower temperature than the parent metal, and the braze strength comes from the surface overlay of the brazing rod.

The advantage of braze welding over gas welding is that it is the best way to join dissimilar metals, or repair cast iron. For instance, braze welding is the correct way to fix a pump water jacket. Almost any two metals can be joined, except aluminum and magnesium. Braze welding is separated into two types, depending on the type of rod used.

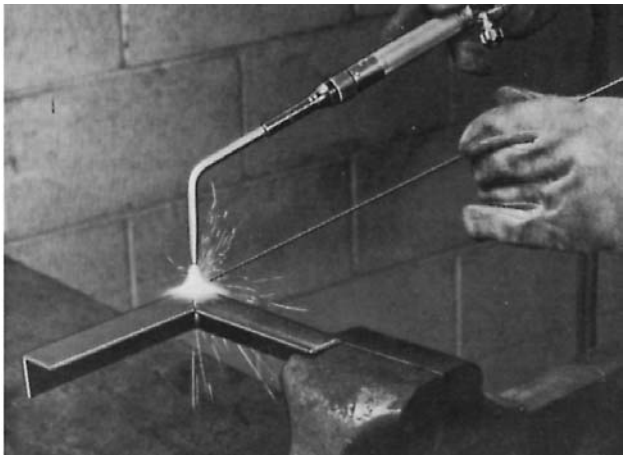


Figure 18. Braze Welding

Bronze Brazing. Bronze is less expensive than silver alloy and should be used when the fit between the metals to be joined is not close. The metals must be well cleaned, then the flame is played onto them until they become a dull red color. Both pieces must be of equal temperature or the rod will flow to the hotter piece. Heat the rod by placing it in the flame, then dip into the flux can. Notice that the heat causes the flux to stick to the rod. If prefluxed rod is used, this heating and dipping step may be eliminated. Once the rod is fluxed, and the metals brought to the proper temperature, touch the rod to the joint, put the flame onto the rod, and melt it. The rod then melts and flows over the heated area, bonding the metal together. Abundant flux must be used. Without enough flux, the rod will not "stick" to the metals.

Silver Brazing. Silver brazing is a little faster than bronze brazing. This is because silver alloy melts at a lower temperature, and less heat is required; however, the joint must fit tightly. Bronze bridges a gap much better than silver alloy. Instead of putting flux on the rod, the joint should be painted with the flux. The way to determine when the metals are at proper temperatures is to watch the flux. when it bubbles, it is time to apply the rod. The rod melts as it is touched to the metal and flows over the fluxed area.

Steel Flame Cutting. Steel flame cutting (Fig. 19) is a simple process that can be quickly mastered. Only carbon steel can be cut with the oxy-fuel gas method, since cast iron, stainless steel, aluminum, brass and other ferrous metals do not burn the way steel does.

The way to cut steel is to heat it to its kindling temperature (a red color), and then burn it rapidly with pure oxygen. A cutting torch provides both the preheat flames and pure oxygen cutting stream. Fuel gas and oxygen are combined in the torch head and burn at the torch tip with a flame temperature of 4000º-6000ºF. These are the preheat flames. The center hole in the cutting tip is for the pure oxygen, which flows through to cut the steel after the metal is sufficiently preheated.

Note: Cutting tips are available in a variety of styles and a wide range of sizes. The proper size is to be determined by the material thickness to be cut. Refer to the current product catalog, Tip Chart (P/N 9500593) or our website at *www.harrisproductsgroup.com* for a complete listing of sizes and pressure settings.

Figure 19. Steel Flame Cutting

Cutting

1. Make certain that correct tip is tightly secured in the torch head.

2. Set proper pressure on regulators.

3. Lighting Procedures:

Cutting Attachment. Always open oxygen valve wide on torch handle. Follow lighting procedure in welding torch instructions, using fuel gas valve or torch handle and preheat oxygen valve on cutting attachment to adjust preheat flames.

Cutting Torch. Use the same procedure as in welding torch instructions. After setting flame, depress cutting oxygen lever and open preheat oxygen valve slightly to re-set flame.

4. Move flame to edge of steel and position preheat cones just above metal.

5. When steel becomes red, slowly depress cutting oxygen lever to release oxygen stream to cut through steel.

6. Slowly move torch in direction of the cut.

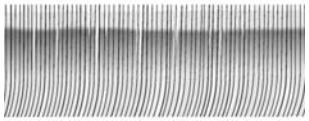
Note:

1. The correct cutting speed is accompanied by a sputtering sound, and a steady stream of sparks. This results in a clean, slagfree cut with square top and bottom edges (A, Fig. 20).

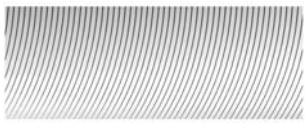
2. Too fast a movement does not allow enough time for the oxygen stream to cut all the way through the metal. slag fills the kerf and the two pieces are not severed (B, Fig. 20).

3. Too slow a movement leaves a rounded top edge with slag sticking to the bottom of the metal (C, Fig. 20).

4. The size of the preheat flame (D, Fig. 20) determines how quickly the cut can be started. Often, a small preheat flame is desirable to conserve gases and prevent melting of the top edges.



A. Perfect cut shows regular surface with slightly sloping drag lines. Surface can be used for many purposes without machining.



B. Extremely fast not enough time is allowed for slag to blow out of the kerf. Cut face is often slightly concave.

C. Extremely slow produces pressure marks which indicate too much oxygen fro cutting conditions.

D. Preheat too hot rounded top edge caused by too much preheat. Excess preheat does not increase cutting speed. It only waste gas.

Maintenance Instructions

Check Valves

Leak test Check Valves at least every six months, as follows:

1. Shut off fuel gas supply and disconnect hose from check valve.

2. Set oxygen regulator to 5 PSI, open all gas valves on torch or cutting attachment.

3. Plug tip and check for reverse flow to fuel gas check valve. Use soapy water or immerse in water to check for leaks. Set pressure to zero after test.

4. Reconnect fuel gas hose and disconnect oxygen hose.

5. Repeat Steps 2 and 3 using fuel gas regulator as pressure source.

6. Reconnect hoses and purge system before use.

Regulator Test

A leak test of the regulators may be made as follows: (Also see your "Regulator Instruction Manual".)

1. Shut off fuel gas regulator by turning adjusting key counter-clockwise until loose.

2. Close fuel gas cylinder valve.

3. Close fuel gas torch valve.

Note: Watch cylinder pressure gauge for several minutes. A pressure drop indicates a leak in the inlet side. Tighten connection and recheck. Also watch the delivery pressure gauge. A rise in pressure indicates a leak in the regulator valve. If leak cannot be stopped - DO NOT USE THE REGULATOR. All gauges should read zero when the pressure is removed. If they do not, the gauges may be damaged. If damaged, check system for cause of damaged gauges. Have the damage repaired by a qualified repairmen, replacing the damaged gauges. Repeat procedure shown above for the oxygen regulator.

Cleaning Gauges

The gauge crystals are made of Lexan®. Use only soapy water to clean, then wipe dry using soft cloths. Do not use solvents. General Electric Co®.

Changing Cylinders

A cylinder is depleted and is considered empty when it is unable to deliver fuel gas or oxygen to torch tip at the set pressure.

1. Close supply valve of depleted cylinder and bleed off all gas in depleted line at torch. Close torch valve.

2. Disconnect hose and regulator from depleted cylinder.

3. Screw Valve Protection Cap onto cylinder, mark "Empty," and remove.

4. Follow procedure under Set-Up Instructions with the new cylinder.

5. Purge system.

Purging System

Warning: Purge only in a well ventilated area. Do not direct flow of any gas towards any person or any flammable materials. Do not purge near open flames or any source of ignition.

1. Slowly open oxygen supply valve, then open fully and adjust regulator to proper pressure with torch valve closed.

2. Open torch valve and allow gas to flow about one second for each ten feet of hose. Close torch valve after purging.

3. Slowly open fuel gas supply valve not more than one full turn, then adjust regulator to proper pressure with torch valves closed.

4. Open torch valve and allow gas to flow about one second for each ten feet of hose. Close torch valve after purging.

Torches and Cutting Attachments

1. Periodically check for leaks, using soapy water or by immersing in water and checking for bubbles.

2. Tighten connections and packing nuts to stop leaks. Do not use excessive force.

Storage

When not in use, store the equipment in a clean and safe place.

Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Welding tip popping	• Tip is operated at too low heat valve • Tip too large • Too close to work	• Increase pressures, and consult appropriate tip chart • Use smaller size tip •Raise tip from work
Flames not clearly defined, smooth or even	Dirty tip	Clean with tip cleaner or replace tip
Regulator not holding constant pressure	Defective seat	Return unit for replacement
Cutting tip popping	Too loose Nicked seat	Tighten tip nut
Leak around needle valve	Packing nut loose	Tighten packing nut
Dificult to light	Too much Pressure	Consult appropriate tip chart
Flame change when cutting	• Oxygen needle valve on torch handle partl closed •Oxygen cylinder almost empty	• Open oxygen valve wide • Replace cylinder with full one