Caution

Only Qualified Divers, Trained for Underwater Burning Should Operate Underwater Burning Equipment. Please Read the Following References as well as Your Company's Safety Policy.

1 Consensus Standards for Commercial Diving Operations, Association of Diving Contractors, Houston, Texas
2 46 CFR 197.200 U. S. Coast Guard Commercial Diving Regulations
3 29 CFR 1910 Subpart “T”, OSHA Diving Regulations
5 NAVSHIPS 0994-001-9010, U. S. Navy Diving Manual
6 AWS F4.1 Recommended Safe Practices for Cutting, American Welding Society, P. O. Box 351040, Miami, FL 33135
7 ANSI Z49.1 Safety in Welding and Cutting

Warning

All Oxy lance burning products are cleaned for Oxygen service and packaged to prevent contamination from oils and grease. Avoid storing burning rods where they could become contaminated. Clean contaminated rods and burning equipment prior to use.

Recommended Safety Instructions for Your Company:
1 All equipment should be inspected and in good condition prior to operation.
2 Never allow oil, grease or flammable substances to come in contact with cutting equipment.
3 The operator should understand all safety precautions concerning the use of oxygen.
4 Electrical shock can cause death or injury. Insure equipment is properly installed and operated.
5 Never let the Diver/Burner become part of the electrical circuit.

Caution

Underwater Burning Produces a Combination of Unburned Oxygen and Hydrogen Gas. When Trapped in a Confined Area, this will Produce Explosions.

Warning

Never Burn Where There is a Pressure Differential Situation Either Blowing Out or Sucking In. Prior to Burning on Any Structure or Pipeline, You Must Insure That There Are No Hydro Carbons Present that Can Cause an Explosion.

Recommended Burning On Oil Platforms and Pipelines:
It is recommended that when there is doubt of the contents behind the area of the burn, you MUST drill an inspection hole prior to Oxy-Arc burning. **Do Not Burn on Pipelines Without Confirming that the Line Contains Nothing Flammable and that the Line is Flooded with Water.**

When burning on members of jacket legs, **Always** put a vent hole at the highest point where gases could collect.

When burning in the Vertical plane, **Always** start at the top and burn **Down**. This will allow the gasses to escape out of the kerf as well as the vent hole.

Where there is pressure differential, **Always** drill a hole and allow the pressure to equalize prior to burning. **Your Fingers or Hand Can Be Sucked in the Hole, Resulting In Serious Injury or Death. Use Caution When Drilling the Hole.**

Burning Below the Mudline:
When burning below the mudline, it is best to jet and airlift or pump the mud from behind the cut to prevent Oxygen and Hydrogen from being trapped in the mud. **Oxygen and Hydrogen Trapped in the Mud Can Result in an Explosion.** If the mud cannot be completely removed, it is best to leave it packed tight and use the same cutting technique as for concrete filled piles.

Concrete Filled Piles

**Vertical Cuts:** The tip of the rod should be pointed slightly up and then drag the rod downward. This will prevent Oxygen and Hydrogen from being forced into pockets in the concrete ahead of the cut.

**Circumferential Cuts:** Never cut in a straight line around the pile. Make an angle or miter cut starting at a high point and progressing in a downward direction (1 to 2 inches down per foot at circumference). Cut one-half of the pile in this manner and stop. Go back to the starting point and cut the other half of the pile in the same
downward manner. Always point the rod tip away from the diver and drag the rod towards the diver (away from the kerf). Using the above techniques will allow gas bubbles to escape in a natural upward direction, and the drag method will prevent gas bubbles from being forced into void areas.

**Ships and Barges**
Extreme caution should be used for burning projects on ships and barges. We can only cover the obvious in this safety data sheet. Before undertaking major projects, a study of the ship should be performed by experts in the salvage business and all divers should be made aware of all of the hazards that they may encounter. The following is a list of hazards that will always be present:

**Fuel Tanks and Cargo Holds**
Never burn into an area that contains fuel. Never burn into cargo holds that contain flammable or explosive materials.

**Hulls, Double Bottoms and Doubler Patches**
Be aware that there are many areas in ships’ hulls where Oxygen and Hydrogen can become trapped. Insure that these areas are properly vented. Again, on vertical cuts, work from the top down. Insure that all voided areas are flooded prior to burning.

**Phnomo Hose** - Use the diver’s phnomo hose to force air into cuts to dilute hydrogen gases in trapped areas.

**Operating Instructions**
Equipment required:
2. High Volume Oxygen regulator and sufficient Oxygen supply.
3. Knife switch, either single or double pole.
4. Ground lead with a ground clamp that will insure solid contact. (Preferable: a screw type or welded on ground plate.)
5. Direct Current Welding machine that is capable of 400 amps. (See the manual on your machine for duty cycle rating.) A.C. Welding Machines are NOT Recommended for Underwater Use.

**Setting Up Equipment**
1. Place Oxygen supply in a location that will prevent damage to the Oxy-Arc supply hoses. Insure that all regulators, supply hoses and torches are free of oil, grease or other materials that are flammable. Insure all cylinders are properly secured (Ready for Sea).
2. Regulate O2 pressure to the required pressure (over bottom pressure) for the material to be cut. (See recommended O2 pressure table.)
3. Check entire burning system for O2 leaks using leak check.
4. For single pole knife switch, run jumper lead from the **Negative** terminal of the welding machine to the knife switch. Attach the lead to the receiver side of the switch. Attach the burning rig to the blade side of the switch.

**Caution**
Most knife switches and welding lead lugs are made of copper. Insure that these are clean and free of corrosion. Where the welding lead lug attaches to the knife switch of the welding machine, put the lug in direct contact with the base of the terminal. If spacers are required to help tighten the lug, put them on top. Steel spacers between two copper plates can create arcing and resistance, affecting current flow to the cutting rod.

5. The knife switch should be located on the dive station so that it can be operated by the person operating the diver’s radio.
6. Attach the ground lead to the **Positive** terminal on the welding machine. Check that the machine is set for **Straight Polarity** if there is a selector switch. (If there is no switch, just remember the word “Pig”, Positive is Ground.
7. A polarity test can be performed by taking a bucket (plastic is recommended) and filling it with salt water. Submerge the ground and the burning rod in the water. Maintaining a separation of 2 inches, call for the knife switch to be made hot. If the polarity is correct, a stream of hydrogen bubbles will rise from the tip of the burning rod.

**Underwater Burning**
1. The diver should attach the ground to the work as near as possible to the cut. The ground should be situated so the diver **Will Not** be in a position between the ground and the area where s/he will be burning.
2. When the diver is in position and ready to begin the cut, s/he will direct the topside crew to **Make It Hot**. S/he then may fine tune the amperage settings on the machine and the O2 pressure.
3. While burning, keep the tip of the electrode in constant contact with the metal to be cut. The amount of pressure and the rod angle will depend on the thickness of the material and what is behind it. Do not try to hold an arc; this will only slow your progress.

4. For increased production, it is recommended that the surface be free of heavy oxidation, barnacles or any other material that will reduce or prevent proper electrical conduction.

5. For burning thicker materials (e.g., over 1.5") the diver may have to push and pull the rod in and out of the cut in a slight sawing motion.

**Warning:** Never leave the knife switch hot when not actually burning. The bubbles that form in the torch head and the burning rod are Hydrogen and can explode. Prior to making the knife switch hot, purge the torch and rod with Oxygen to insure that no Hydrogen is present. Leaving the knife switch cold when not burning will reduce corrosion damage to the torch.

<table>
<thead>
<tr>
<th>Material Thickness</th>
<th>Oxygen Pressure</th>
<th>Amperage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8&quot; to 3/8&quot;</td>
<td>30 to 40 PSI</td>
<td>250 to 300</td>
</tr>
<tr>
<td>1/2&quot; to 3/4&quot;</td>
<td>40 to 60 PSI</td>
<td>300</td>
</tr>
<tr>
<td>1&quot; to 1.5&quot;</td>
<td>60 to 70 PSI</td>
<td>300</td>
</tr>
<tr>
<td>1.75&quot; and over</td>
<td>70 to 80 PSI</td>
<td>300 to 400</td>
</tr>
</tbody>
</table>

To insure adequate O₂ flow, we recommend 3/8" I.D. hose for the entire length of your Oxy-Arc.

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**Amperage/Voltage vs Cable Length**

The amperage and open circuit voltage settings on the welding machine will depend on the length of the Oxy-Arc system and the size of the welding lead in the system.

When selecting the welding lead to be used for the Oxy-Arc system, you must measure the total length of the Oxy-Arc, the jumper lead from the machine to the knife switch, and the ground lead. This is the total length of the electrical circuit.

**Example:** A 350 foot Oxy-Arc with a 50 foot jumper from the machine to the knife switch, and a 200 foot ground, has a total circuit length of 600 feet. In this case, using 3/0 (000) cable to maintain 300 amps at the electrode, the welding machine settings would need to be increased by 28 amps, and the open circuit voltage by 1.4 volts. The amperage drop would be 28 amps (2 amps per 50 feet of cable) and 1.4 volts (2 volts per 100 feet) at 300 amps for 600 feet. (Reference Amperage Chart.)

A common practice that creates problems for the diver is to have an Oxy-Arc with 3/0 (000) welding lead and then use 2/0 (00) for the jumper and the ground. Another bad practice is to use old, damaged welding lead for the ground lead because "It's just a ground." Every piece of cable in the circuit needs to be the same size cable, and should be good quality cable, free of damage. All splices must be tight and waterproof. The number of splices should be kept to a minimum. Do not use twist lock quick connects for splices.

The knife switch has to be well maintained. This includes removing all corrosion from the contact surfaces (blades), and from the base where the lead lugs attach. Do not use steel washers between the lugs on the lead and the knife switch. If spacers are required, put them on top of the cable lug.

**Amperage/Voltage Loss Chart**

To maintain 300 Amps at the Electrode, Increase the Machine Amperage by the Following Amounts for the Combined Length of the Burning Circuit Indicated:

<table>
<thead>
<tr>
<th>Lead, Jumper &amp; Ground</th>
<th>100 Feet</th>
<th>150 Feet</th>
<th>200 Feet</th>
<th>300 Feet</th>
<th>400 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/0 (0) Cable</td>
<td>+10 Amps</td>
<td>+14 Amps</td>
<td>Not Recommended For These Lengths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/0 (00) Cable</td>
<td>+2 Amps</td>
<td>+4 Amps</td>
<td>+8 Amps</td>
<td>Not Recommended</td>
<td></td>
</tr>
<tr>
<td>3/0 (000) Cable</td>
<td>+0 Amps</td>
<td>+0 Amps</td>
<td>+4 Amps</td>
<td>+12 Amps</td>
<td>+20 Amps</td>
</tr>
</tbody>
</table>

For lengths beyond 400 feet, add 4 Amps per 100 feet of cable. If problems are encountered at long lengths, increase cable size to 4/0 (0000) cable, or double the cable (2 Leads, 2 Grounds and 2 Jumpers of 2/0 (00), or 3/0 (000) cable. These Amp settings are figured on cable in like new condition with a minimum of splice connections. Older cable may have more resistance.

Any defect in the electrical circuit is a potential for an increase in resistance, short circuiting, and loss of amperage to the Electrode. Defects can result in injury and/or poor performance.
**Problem Areas and Finding Them**

When problems occur with the power to the torch, look for these defects:

Holes in the insulation. If they are in the water or have been in the water, holes in the welding lead will bleed a red oxide color that will look like paint on the lead.

Run your hand along the lead. Hot spots in the insulation indicate a break or partial break in the lead. The heat is the result of resistance or arcing between broken wires.

While the knife switch is hot, look for arcing from the lead to the deck. This is a common problem that happens when old welding lead is used for jumper leads. If you have Amp or Volt meters on the machine and the Volt meter is reading zero and the Amp meter is high or pegged, the hot lead has a short circuit (grounded out) in it.

Inspect all splices to insure they are tight and waterproof.

Check connections at the machine and the knife switch.

Check the entire length of the jumper lead and the Oxy-Arc to insure that neither is grounded out.

**Inspect All Equipment Before and After Each Dive.**

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**Trouble Shooting Guide**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak Arc Rod Will Not Burn</td>
<td>Welder Idling</td>
<td>Increase the RPMs to the correct setting for welding/burning</td>
</tr>
<tr>
<td></td>
<td>Lead/ Ground Loose</td>
<td>Clean Lugs and retighten connections</td>
</tr>
<tr>
<td></td>
<td>Knife Switch</td>
<td>Clean lugs and knife switch; retighten connections</td>
</tr>
<tr>
<td></td>
<td>Improper Ground</td>
<td>Inspect ground; make sure it is on clean metal and it is tight</td>
</tr>
<tr>
<td></td>
<td>Loose / Broken Splices</td>
<td>Inspect and repair any damaged splices</td>
</tr>
<tr>
<td></td>
<td>Broken Lead/ Ground</td>
<td>Inspect lead/ground and repair as required</td>
</tr>
<tr>
<td>Difficult To Maintain Arc</td>
<td>Welding Lead Too Small</td>
<td>Insure that welding lead is the proper size for the length</td>
</tr>
<tr>
<td></td>
<td>Machine Setting Low</td>
<td>Increase amp/volt settings to compensate for circuit length</td>
</tr>
<tr>
<td></td>
<td>Machine Too Small</td>
<td>Insure the machine is capable of supplying high enough amps</td>
</tr>
<tr>
<td></td>
<td>Duty Cycle Too Low</td>
<td>Insure the machine is capable of high duty cycle at high amp setting</td>
</tr>
<tr>
<td></td>
<td>Damaged Lead</td>
<td>Inspect leads to insure they are not damaged and are water tight</td>
</tr>
<tr>
<td></td>
<td>Loose Ground</td>
<td>Insure that the ground is tight and on clean metal</td>
</tr>
<tr>
<td>Electrode Burns Too Fast</td>
<td>Amperage Set Too High</td>
<td>Adjust welding machine to proper amperage setting</td>
</tr>
<tr>
<td></td>
<td>Polarity Reversed</td>
<td>Insure that the system is set for straight polarity</td>
</tr>
<tr>
<td></td>
<td>High Oxygen Pressure</td>
<td>Adjust pressure for the proper thickness and depth</td>
</tr>
<tr>
<td>Electrode Welds, Not Burns</td>
<td>Low Oxygen Pressure</td>
<td>Check O₂ supply to insure there is adequate O₂</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check torch for obstructions in the hose and electrode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Insure that the pressure setting is correct for the material/ depth</td>
</tr>
</tbody>
</table>

**Electrical Shock**

| Damaged Lead/ Ground | Inspect all leads for holes, cuts or abrasions, and repair |

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