INTRODUCTION

The HELIARC HW-9 Torch is designed for hand welding thin-gage materials. It can be used for welding with high-frequency stabilized a.c. or straight-polarity d.c. depending on the job requirements. The torch with the 12-1/2-foot cable, Part No. 16X28 can be used at currents up to 110 amperes continuous duty a.c. or d.c. Torch No. 16X44 with a 25-foot cable can be used at currents up to 75 amperes continuous duty.

1. SETTING UP THE HW-9 TORCH TO WELD

A. Equipment Needed
   Check to be sure you have the following before setting up the equipment.
   1. HELIARC HW-9 Torch, which includes:
      (a) Power cable-and-hose assembly
      (b) Torch cap
   2. An electrode and collet of proper size for the current you intend to use.
   3. A gas cup of proper size for the particular welding application.

Be sure this information reaches the operator. You can get extra copies through any Linde o
4. To control argon flow, one of the following:

(a) OXWELD R-502 Argon Regulator
(b) OXWELD L-23 Argon Flowmeter and a standard oxygen regulator
(c) Argon Flow Control Adaptor (Part No. 21X62) and a standard oxygen regulator.

5. Additional hose assemblies:

(a) A 1/4-in. argon hose assembly (equipped with standard oxygen "B" size hose connections) of suitable length for connecting the torch cable and hose assembly to the regulator or flowmeter outlet. The following standard OXWELD hose assemblies are available:

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1OY72</td>
<td>12-1/2-ft.</td>
</tr>
<tr>
<td>1OY68</td>
<td>25-ft.</td>
</tr>
</tbody>
</table>

6. Welding transformer and a high-frequency generator, if welding is to be with a.c.; a welding generator, if welding is to be with d.c.

7. Suitable lengths of 2/0 welding cable.

8. A clamp to ground a length of welding cable to the work.

9. A welder's helmet with the proper shade of glass for the welding current you intend to use.

<table>
<thead>
<tr>
<th>Glass No.</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Up to 30 amps.</td>
</tr>
<tr>
<td>8</td>
<td>30 to 75 amps.</td>
</tr>
<tr>
<td>10</td>
<td>75-110 amps.</td>
</tr>
</tbody>
</table>

B. Hose Connections

1. Connect the R-502 Regulator to the argon cylinder. (See F-8869, "Instructions and Parts List for the OXWELD R-502 Regulator," for instructions on attaching and adjusting the regulator.) If the Argon Flow Control Adaptor is to be used, installation instructions may be found in Form 9333 "HW-9 Flow Control Adaptor." The adaptor may be quickly and easily installed inside the handle of the torch. Once in place, any argon flow can be obtained by setting the argon pressure gauge to a particular pressure. A chart is supplied that lists gauge settings vs. shielding gas flows. The chart is in the form of a decal and can be attached to the torch handle for ready reference.

2. Connect the regulator outlet to the power cable adaptor inlet with a suitable length of 1/4-in. argon hose.

C. Electrical Connections

Before making any connections, refer to the schematic wiring diagrams in Figures 1 and 2 for a.c. and d.c. welding setups. Note that a foot switch is connected in an external circuit to interrupt welding current. Its use is recommended because it provides a convenient method of control. It also enables you to protect the weld puddle at the end of a seam with an atmosphere of argon and thus control crater cracking — especially with high-temperature alloys. If you have an a.c. setup, radio interference caused by high-frequency current will be greatly reduced, since no high-frequency current will flow when the welding current is shut off. If no foot switch is used, the arc must be broken by lifting the torch from the work.

A number of special electrical circuits have been designed and developed to control the various phases of the welding process automatically. By their use, you can conserve argon, provide greater convenience of operation, minimize radio interference, and give added protection to the equipment and operator. For specific details, write or call your nearest LINDE office. A booklet which gives descriptions and electrical diagrams of these control circuits (F-9087) can be obtained free of charge.

1. Connections for A.C. Welding

(a) Connect the torch power cable to the torch terminal of the high-frequency generator with a suitable length of 2/0 welding cable.

(b) Connect the work to the "work" terminal of the high-frequency generator with a suitable length of 2/0 welding cable. Secure the cable with a clamp to a clean surface of the work so that you have a good contact.

(c) Connect the high-frequency generator to the terminals of the transformer secondary with suitable lengths of 2/0 cable.

(d) Connect the transformer primary to one set of terminals of the main contactor. Then connect the other terminals of the main contactor to the 230- or 460-volt main power supply. Be sure to select a conductor which will carry the maximum current you will use.

(e) Connect the high-frequency generator to the lines leading from the main contactor to the transformer primary. Make this connection so that power to the high-frequency generator is shut off when the main contactor is open.

(f) Connect one terminal of the main contactor coil to one side of the main power supply. Connect the other terminal to one of the contacts of the auxiliary contactor. Connect the remaining terminal of the auxiliary contactor to the other side of the main power supply. Connect one terminal of the auxiliary contactor coil to one terminal of the foot switch. Connect the remaining terminals of the auxiliary contactor coil and the foot switch to opposite sides of the control circuit (6 to 24 volts a.c.).

(g) Make a ground connection from the "work" terminal of the high-frequency generator.

continued on page 4
FIG. 1 – Schematic Diagram for HELIARC A.C. Welding

FIG. 2 – Schematic Diagram for Heliarc D.C. Welding

NOTE 1: HEAVY LINES INDICATE CHANGES TO BE MADE IN GENERATOR CIRCUIT
NOTE 2: X INDICATES "BREAK CONNECTION HERE"
MAKE NO OTHER GROUND CONNECTION.
Connect the case of the high-frequency generator and the case of the transformer to the "work" terminal of the high-frequency generator.

2. Connections for D.C. Welding

(a) For straight-polarity d.c. welding, connect the torch power cable to the generator terminal marked "electrode" or "negative." Connect the workpiece to the generator terminal marked "work" or "positive." Use suitable lengths of 2/0 welding cable to make these connections. If the generator has a polarity switch, be sure that it is set in the straight-polarity position.

(b) Connect the 2/0 welding cable leading to the work to a ground clamp. Secure the clamp to clean, bright metal of the workpiece so that good contact is established.

(c) Make separate ground connections to the work and to the generator case.

(d) If your generator is a separately excited type such as that shown in Figure 2, welding current can be shut off remotely without lifting the torch from the work. This is done by means of a foot or hand switch which actuates a field relay. The field relay is paralleled with a 0.25 MFD, 600-volt discharge condenser. For all other types of generators, obtain the manufacturer's recommendations on installing a remote current shutoff.

   Connect one terminal of the foot switch to the relay. Connect the remaining terminals of the switch and of the relay to opposite sides of the separate control circuit a.c. supply. (24 volts a.c. maximum.)

(e) Connect the motor side of the generator to the 3-phase, 230- or 460-volt a.c. main power supply.

D. Installing Gas Cups, Electrodes and Electrode Holders (SEE FIGURE 3)

CAUTION: BE SURE TO SHUT OFF POWER BEFORE INSTALLING OR ADJUSTING ELECTRODES.

1. From Table I, select the size of electrode for the welding current you intend to use. Then select a collet corresponding in size to the electrode.

   Do not use currents in excess of 75 amperes with the torch having a 25 foot cable, Part No. 16X44.

2. Remove the collet body from the torch head. Insert the electrode and collet into the collet body. Then screw the collet nut into the torch head to tighten the collet on the electrode.

   Ceramic cups can be used to the full capacity of the torch.

TABLE I

<table>
<thead>
<tr>
<th>Electrode Size (in.)</th>
<th>ACHF*</th>
<th>DCSP**</th>
<th>DCRP***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pure Tungsten</td>
<td>Thoriated Tungsten</td>
<td>Pure or Thoriated</td>
</tr>
<tr>
<td>0.020</td>
<td>5-15</td>
<td>5-20</td>
<td>5-20</td>
</tr>
<tr>
<td>0.040</td>
<td>10-60</td>
<td>15-80</td>
<td>15-80</td>
</tr>
<tr>
<td>1/16</td>
<td>50-100</td>
<td>70-110</td>
<td>70-110</td>
</tr>
</tbody>
</table>

* In general, for DCSP, the lower end of the specified current range applies to the pure tungsten electrodes and the upper end to the thoriated tungsten electrodes.

** Maximum values for unbalanced wave transformers. Balanced wave reduces maximum by about 30 per cent.

*** NOTE: All current values are metered readings. Transformers designed for metal-arc welding deliver about 15 per cent more current than shown on their scale readings.


df-fig
specifically designed for HELIARC welding should not be operated at more than 70% of their rated capacity. The manufacturer's recommendations should be obtained regarding the use of such transformers for HELIARC welding.

E. Final Steps Before Welding
1. Open the argon cylinder valve slowly to prevent a sudden rush of gas into the regulator; then open fully.
2. Open the regulator or flowmeter flow-adjusting valve until the float shows the desired argon flow.
3. Set the welding transformer or generator for the desired welding conditions.
4. Close the foot or hand switch.
5. Draw a test arc on a piece of scrap steel or copper.

For complete information on HELIARC welding, including argon flows, etc. see F-6190, "How to Weld with HELIARC Torches." This book is packed with each HW-9 Torch.

II. GENERAL NOTES ON TORCH OPERATION

A. Electric Power Requirements
1. For a.c. welding, a single phase transformer is generally used. This will require a 230- or 460-volt a.c. power supply. For exact information on power-supply requirements obtain the specifications supplied by the manufacturer of your transformer.

2. For d. c. welding, a motor-generator unit is generally used which requires a 230- or 460-volt, 3 phase a.c. power supply. For exact information on power requirements, obtain the specifications supplied by the manufacturer of your motor generator unit.

3. Many welding generators have poor arc stability characteristics when welding current is less than 25% of maximum generator rating. In such cases, a standard resistor in the ground line between generator and workpiece will give arc stability at currents as low as 10 amp.

For very low currents (down to 2 amps.), an incandescent bulb resistor is recommended. Mount several bulb sockets on a board, and connect the sockets in parallel. Connect the socket bank in series in the ground welding lead. Current passed will depend on number and size of bulbs in the sockets. Current passed per bulb, given a 90-volt open-circuit, is shown below. For lower open-circuit voltages, current drops in proportion to the voltage reduction.

<table>
<thead>
<tr>
<th>Photoflood Lamps</th>
<th>Std. Lighting Lamps</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 2 Per Bulb (amps)</td>
<td>3.3</td>
</tr>
<tr>
<td>No. 4 Per Bulb (amps)</td>
<td>6.6</td>
</tr>
</tbody>
</table>

With a ground line resistance, the generator current control is largely ineffective. When easily variable currents are needed (as in cases of uneven joint thickness or poor fit-up) a variable resistance should be placed in the generator exciter circuit to vary the generator voltage. The "Arctro" welding controller, a foot-pedal control made by Worthington-Mullenbach, Plainfield, New Jersey, will be found very suitable for this purpose.

4. Special reactors are available from transformer manufacturers to provide very low current ranges when alternating current is used.

B. Torch Hose
1. Make certain that all argon hose connections and the gas-cup connections are gas-tight. If they are not, the argon may become diluted by air due to leakage, resulting in incomplete arc protection. The electrode should be silvery in color when it cools. A bluish color denotes air leakage. When welding aluminum, the presence of a dark gray deposit on or beside the weld, or a cloudy weld puddle, also indicates air leakage.

2. Keep hose off hot metal. Plastic hose softens and begins to lose strength when heated to about 125 deg. F.

3. For instructions on hose repair and replacement, see below.

C. Keep the Electrode Clean

When weld spatter sticks to the electrode, a black soot may appear when you weld aluminum; or a reddish deposit may appear when you weld stainless steel. To clean the electrode, simply draw an arc for a few seconds on a piece of scrap steel or copper.

ALWAYS SHUT OFF THE CURRENT BEFORE YOU ADJUST OR REPLACE ELECTRODES
III. PRECAUTIONARY INFORMATION

A. General Information
Virtually every occupation has certain potential hazards. This is just as true of HELIARC and sigma welding as it is with any other welding method. Operators should be aware of the potential hazards and observe the necessary precautions for their protection as well as that of their fellow employees and property.

B. Fire Protection
Sparks, spatter, and the heat of welding operations are a potential fire hazard if welding is done near combustible materials. If the work location cannot be moved away from combustible materials, the logical alternatives are to move the combustible materials to a safe location or to protect them from all sources of ignition by non-combustible tarpaulins, partitions or shields.

1. Welding should be done preferably in an area having a concrete floor. (Avoid the use of wet sand or metal floor covering since these materials would only create an electric shock hazard.)

2. Avoid welding in areas susceptible to infiltration of combustible vapors or dust.

3. The possibility of spatter reaching combustible materials by rolling along the floor or passing through holes or cracks should be guarded against.

4. Where welding must be done near wooden construction, be sure that the structure is adequately protected.

5. Welding cables and external electrical connections should be of a size approved to carry the maximum load without overheating. Frayed or worn cables should be repaired or replaced immediately to prevent fires caused by short circuiting.

6. Welding of containers which previously held flammable liquids is extremely dangerous unless they are first properly cleaned and purged of all flammable liquids and vapors.

C. Electric Shock Hazards
1. Always shut off power to the welding generator or transformer before cleaning, adjusting, or replacing an electrode, electrode holder, welding head or wire reel. Do not touch any uninsulated torch parts when the generator or transformer is turned on.

2. Overloaded welding cables will overheat and burn the insulation. Eventually, the cable may become exposed and create not only a shock hazard, but a fire hazard as well.

3. Repair or replace leaking water hose immediately.

D. Burn Hazards
1. Wear a standard arc-welding helmet to protect the eyes, face, and neck from the effects of ultraviolet radiation. The helmet should have the correct shade of lens to avoid eye strain. The recommended shade of lens for various current ranges is given in the Table in Section II.

2. Protect all exposed skin surfaces from arc burn. Operators' sleeves should be rolled down at all times. Wear flameproof gauntlet gloves except in cases where low current values are used. If sweating of the hands is excessive, wear rubber gloves underneath the flameproof gloves to afford protection against accidental electric shock.

3. Flameproof protective clothing such as leather caps, shoulder covers, vests, leggings, and sleeves offer excellent protection, not only against arc rays, but against sparks and spatter as well.

4. Wear the proper type of shoe. Shoes that are too low or too loose will allow hot spatter to get inside and burn the feet. High shoes fitted with bellows tongues can prevent this.

5. Keep outer clothing, such as jumpers and overalls, clean of oil and grease.

6. After welding, mark hot metal to caution fellow workers or visitors.

7. Never wear cotton, asbestos, or other cloth-type gloves when using high-frequency current. Kid, chrome leather, or rubber gloves, when clean and in good condition will give the necessary protection against high-frequency puncture wounds.

E. Potential Hazards of Toxic or Noxious Fumes and Gases
1. Lead
   Lead is toxic in virtually every form, but it is most toxic when inhaled in the form of fumes or fine dust.

2. Cadmium
   Cadmium oxide fumes are formed when welding is done on cadmium plated metals or metals containing cadmium. Cadmium oxide fumes have a high degree of toxicity.

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*keeplelectrodes clean and free of splatter*
The toxicity of cadmium is greatest when cadmium is overheated and the cadmium oxide fumes thus formed are inhaled.

3. Beryllium

The fumes, dusts, and mists of beryllium and beryllium-bearing alloys are highly toxic in virtually every form.

4. Zinc

Inhalation of fumes from welding galvanized sheet, brass or other alloys containing zinc can cause metal fume fever (frequently known as "zinc chills," "galvo," or by other terms).

5. Copper

Copper oxide fumes are given off when copper is welded. As with galvanized materials, these fumes in high concentrations may induce metal fume fever.

6. Chlorinated Solvents

Special precautions must be taken when certain chlorinated solvents (such as carbon tetrachloride, trichloroethylene, and tetrachloroethylene) are used for degreasing metals prior to welding. The vapors of these solvents are harmful. When they are exposed to the heat of the welding arc they break down chemically to form highly toxic fumes (phosgene). Make certain that the material is thoroughly dry before welding. It is also important that welding operations be remote from degreasing tanks containing chlorinated solvents since these solvents vaporize readily and the vapors may reach the arc. It has been demonstrated that intense ultra-violet rays will break down trichloroethylene into phosgene.

7. Fluoride-Bearing Fluxes

Suitable supplied air respirators should be used by operators working with a fluoride-bearing flux for prolonged periods or where ventilation is inadequate.

8. Ozone

Ozone is generated when these methods of welding are used. Ozone is toxic and a respiratory irritant. Studies have indicated that with proper ventilation harmful amounts are not present in the breathing zone of the operator.

9. Oxides of Nitrogen

These irritating fumes are found to be present in most welding operations; however, studies have indicated that when reasonable ventilation is utilized, they are present in concentrations below those considered harmful.

F. Ventilation

An effective control of fumes and vapors is a local exhaust system which will remove the contaminants before they become diffused with air throughout the work area. An important consideration of an adequate method of ventilation for HELIARC or sigma welding is that it must not disturb the shielding gas stream and thereby result in weld contamination. When highly toxic materials, such as lead-, cadmium-, or beryllium-bearing metals are welded, the operator should use a filter type respirator approved for the specific fume (by the U.S. Bureau of Mines), or an air supplied respirator. The use of an air supplied respirator is also advisable when welding in a closely confined space.

IV. HOSE REPAIR AND REPLACEMENT

Power Cable-and-Hose Assembly

If the power cable-and-hose assembly becomes damaged, we recommend that you purchase a new assembly or send the damaged cable-and-hose assembly to the nearest LINDE apparatus repair station where it will be repaired for a nominal charge plus the cost of parts, if such repair is advisable. DO NOT TRY TO REPAIR IT YOURSELF. The connection fittings at each end of the assembly are crimped to the cable and insulator hose by special crimping tools to obtain a strong and completely gas-tight joint. A satisfactory repair job cannot be made without these tools.
Replacement Parts List

FOR
LIGHT-DUTY AIR-COOLED "HELIARC"
WELDING TORCH HW-9

16X28 (12 1/2 ft.)
16X44 (25 ft.)

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>85W49</td>
<td>&quot;O&quot; Ring (3 used 25-ft., 16X44) (2 used, 12-1/2-ft., 16X28)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56Y35</td>
<td>Torch Body</td>
<td>56Y40</td>
<td>Torch Cap (long)</td>
</tr>
<tr>
<td>56Y38</td>
<td>12-1/2 ft. (16X28)</td>
<td>85W49</td>
<td>&quot;O&quot; Ring</td>
</tr>
<tr>
<td>56Y42</td>
<td>Cable and Hose Assembly (25 ft.) (16X44)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>84Z28</td>
<td>Torch Handle</td>
<td>21X62</td>
<td>Argon Flow Control Adaptor</td>
</tr>
<tr>
<td>84Z29</td>
<td>12-1/2 ft. (16X28)</td>
<td>56Y83</td>
<td>Transparent Torch Cap (long)</td>
</tr>
<tr>
<td>105Z27</td>
<td>Collet Body (25-ft., 16X44)</td>
<td>84Z33</td>
<td>1/16-in. Collet</td>
</tr>
<tr>
<td>105Z28</td>
<td>Collet Body (12-1/2-ft., 16X28)</td>
<td>84Z34</td>
<td>.020-in. Collet</td>
</tr>
<tr>
<td>84Z31</td>
<td>Torch Cap (short)</td>
<td>84Z35</td>
<td>.040-in. Collet</td>
</tr>
<tr>
<td>84Z85</td>
<td>Cable Adaptor</td>
<td>84Z36</td>
<td>No. 4 Ceramic Cup</td>
</tr>
<tr>
<td>85Z75</td>
<td>Insulator Sleeve (25-ft., 16X44)</td>
<td>84Z37</td>
<td>No. 5 Ceramic Cup</td>
</tr>
<tr>
<td>105Z26</td>
<td>Insulator Sleeve (12-1/2-ft., 16X28)</td>
<td>84Z86</td>
<td>No. 6 Ceramic Cup</td>
</tr>
</tbody>
</table>

PARTS SUPPLIED
TORCH CAP—56Y40 (LONG)
"O" RING—85W49 (5/16' ID)

CABLE & HOSE ASSEMBLY
56Y38 (12-1/2 FT. LONG)
56Y42 (25 FT. LONG)

CABLE ADAPTOR 84Z85

5/16-32
"O" RING—85W49 (5/16' ID)
CAP—84Z31 (SHORT)
SLEEVE
105Z26 (12-1/2 FT.)
85Z75 (25 FT.)

3/8-24
HANDLE—84Z28

3/8-16
"O" RING—85W49 (5/16' ID)
(25 FT ONLY)

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Lithographed in U.S.A.
F-9181-F IMD J-4337-55