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 can be used at currents up to 110 amperes continuous duty a.c. or d.c.

I. 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.

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>10Y72</td>
<td>12-1/2-ft.</td>
</tr>
<tr>
<td>10Y68</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>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-6869, "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 Setup

1. Power Requirements

(a) For a.c. welding, a single-phase transformer requiring a 230- or 460-volt, alternating current supply is generally used.

(b) For d.c. welding, a motor-generator or rectifier unit powered by a 230- or 460-volt, 3-phase alternating current supply is generally used.

NOTE: Be sure to obtain manufacturer's recommendations on power requirements for your transformer, rectifier or generator.

2. Special Control circuits: Several special control circuits have been developed to automatically control various phases of the welding process. By use of these circuits, you can conserve argon, reduce radio interference when using high-frequency current, and provide greater convenience of operation. For specific details, call or write your nearest LINDE office. A booklet (Form 9067) giving descriptions of the circuits and specifications for the equipment needed will be sent to you without charge upon request.

3. Electrical Connections: Before making any connections, refer to the schematic wiring diagrams for alternating current and direct current welding setups (Figs. 1 and 2). Note that a foot or torch switch can be connected in the control circuit to interrupt welding current. If no foot switch is used, the arc can be broken by lifting the torch from the work. A foot switch also enables you to shut off welding current without removing the argon protection at the end of a seam, thus controlling crater cracking (especially when weiging high-temperature alloys). In an ACHF setup, the use of a foot switch cuts out the high-frequency generator whenever you are not actually welding. This eliminates the radio interference caused by open circuit operation.

4. Connections for A.C. Welding (Fig. 1)

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

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

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

(d) Connect the input terminals of 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 across the primary of the welding transformer if a 230/460 volt generator is used, or across the coil of contactor WC if a 115 volt generator is used. When using a 230/460 volt generator, be sure that the primary jumper links are properly connected for the voltage to be used. This connection is made so that the power to the high-frequency generator is shut off when the welding contactor is open.

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

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

**NOMENCLATURE**

- ASV: Argon Solenoid Valve
- BL: Ballast Lamp
- F1, F2: Fuses
- MLS: Main Line Switch
- OCR: Open Circuit Relay
- T: Torch
- TDR: Time Delay Relay
- TRI: Transformer
- TS: Torch Switch
- TSR: Torch Switch Relay
- W: Workpiece
- WC: Welding Contactor

*NOTE:* If a motor-generator is used in place of the rectifier illustrated, the welding contactor (WC) need be only a one-pole contactor. The pole is then placed in the positive leg leading from the generator. (Preceding the ballast lamp (BL) and open circuit relay (OCR) if high frequency is being used.)

**CONTROL CIRCUIT, POWER AND ARGON**

**FOR NOMENCLATURE, SEE FIG. 1**
(f) The control circuit connections shown in the upper part of Fig. 1 may be used to provide control of the argon and the welding contactor.

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

5. Connections for D.C. Welding (Fig. 2)

(a) Connect a suitable length of 4/0 welding cable between the torch power cable adaptor and the "negative" high-frequency generator terminal for straight-polarity welding. Connect the "positive" terminal of the high-frequency generator to the work. Use suitable lengths of 4/0 welding cable for these connections. For good contact, secure the ground connection to clean bright metal of the workpiece with a clamp.

(b) Ground the high-frequency generator case.

(c) If you use a generator of the separately-excited type you can shut off welding current remotely without lifting the torch from the work by means of a foot or hand switch. For all other types of generators, obtain the manufacturer's recommendations on installing a remote current shutoff.

(d) Connect the input terminals of the high-frequency generator to the output terminals of the rectifier or motor generator.

(e) Connect the input side of the power supply 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.

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.

3. Screw the cup onto the collet body. The No. 5 ceramic cup is recommended for most work. Where it is necessary to use the HW-9 Torch in very confined spaces, the somewhat smaller No. 4 ceramic cup should be used. The No. 6 cup is preferred for fillet welding or when welding metals requiring wide gas shielding. Cups designed for the HELIARC HW-10 torch may also be used on the HW-9 torch. Adaptor No. 322117 must be obtained if HW-10 cups are to be used.

4. Adjust the electrode so that it extends 1/8-in. to 3/16-in. beyond the end of the cup. This is done by turning the collet insulator sleeve about one-quarter turn to the left, adjusting the electrode, and tightening the collet insulator sleeve again with the fingers. A transparent torch cap, available as an accessory, will aid in determining when a new electrode is needed.

NOTE: Because of the electrical characteristics of HELIARC welding, transformers not

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<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 10-20</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.

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KEEP TORCH HOSE OFF HOT METAL
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</td>
<td>No. 4</td>
</tr>
<tr>
<td>Av. Current Per Bulb (amps)</td>
<td>3.3</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 “Arcctol” 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-cap 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 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. Use a standard welder's helmet with the proper shade of glass for the welding current to be used (see Table in Sec. 1-A.
B. Wear suitable clothing to protect exposed skin from arc burns.
C. Be sure to shut off power before adjusting or replacing electrodes.
D. When welding copper indoors, provide good ventilation or use a respirator.
E. If you use chlorinated solvents for degreasing or cleaning the workpiece, do not weld near degreasing tanks.
F. Shield your welding station to protect neighboring workers from ultra-violet radiation.

For further details on safety precautions, refer to F-8925, "Precautions and Safe Practices for Electric Welding."

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.

PREVENT ARGON DILUTION - KEEP YOUR GAS CUP AND ARGON HOSE CONNECTION TIGHT
### Parts List

**For Light-Duty Air-Cooled "Heliarc" Welding Torch HW-9 (Series 2)**

**Part No.**<br>16X28 (12-1/2-ft.)<br>16X44 (20-ft.)

### A. Replacement Parts

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>85W49</td>
<td>&quot;O&quot; Ring (2 used)</td>
</tr>
<tr>
<td>56Y35</td>
<td>Torch Body</td>
</tr>
<tr>
<td>56Y38</td>
<td>Cable and Hose Assembly (12-1/2 Ft.) (16X28)</td>
</tr>
<tr>
<td>56Y97</td>
<td>Cable and Hose Assembly (25 Ft.) (16X44)</td>
</tr>
<tr>
<td>84Z28</td>
<td>Torch Handle</td>
</tr>
<tr>
<td>84Z31</td>
<td>Torch Cap (short)</td>
</tr>
<tr>
<td>84Z85</td>
<td>Cable Adaptor</td>
</tr>
<tr>
<td>105Z26</td>
<td>Insulator Sleeve</td>
</tr>
<tr>
<td>105Z27</td>
<td>Collet Body</td>
</tr>
<tr>
<td><strong>SUPPLIED</strong></td>
<td></td>
</tr>
<tr>
<td>56Y40</td>
<td>Torch Cap (long)</td>
</tr>
</tbody>
</table>

### B. Accessories

(These parts must be purchased separately.)

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21X62</td>
<td>Argon Flow Control Adaptor</td>
</tr>
<tr>
<td>56Y83</td>
<td>Transparent Torch Cap (long)</td>
</tr>
<tr>
<td>84Z33</td>
<td>1/15-in. Collet</td>
</tr>
<tr>
<td>84Z34</td>
<td>.020-in. Collet</td>
</tr>
<tr>
<td>84Z35</td>
<td>.040-in. Collet</td>
</tr>
<tr>
<td>84Z36</td>
<td>No. 4 Ceramic Cup</td>
</tr>
<tr>
<td>84Z37</td>
<td>No. 5 Ceramic Cup</td>
</tr>
<tr>
<td>84Z86</td>
<td>No. 6 Ceramic Cup</td>
</tr>
<tr>
<td>322117</td>
<td>Adaptor for HW-10 Ceramic Cups</td>
</tr>
</tbody>
</table>

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