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Be sure this information reaches the operator. You can get extra copies through your supplier.
Introduction

The LINDE HW-12 Tig Torch

... is a heavy-duty, water-cooled hand-welding torch for use with straight-polarity direct current (DCSP), reverse-polarity direct current (DCRP), or high-frequency stabilized alternating current (ACHF).

... is primarily designed for heavy-duty welding of material requiring welding currents of 300 to 500 amperes. Lighter materials may also be welded using reduced currents, proper size collets and collet body assemblies, and smaller electrodes.

... has a rated current capacity of 500 amp. in continuous service. Higher currents may be used at reduced duty cycles.

... uses either metal nozzles for longer service life, or high impact or ceramic cups.

... Contains IAA inert gas hose connections.

Design Features

... Efficient water-cooling system cools outer surface of collet body directly with flowing water. Metal nozzles are cooled by heat transfer to the torch body across a tapered seat and threaded connection.

... Enclosure of water flow passages within torch prevents flow constricted or leakage through accidental damage. Elimination of bulky external cooling tubes to nozzle improves operator's visibility, torch maneuverability, and access to confined spaces.

... Torch parts are readily disassembled for cleaning of water-cooling components. Straight internal flow passages are easily cleared with a cleaning rod.

... Quick-release collets require only a quarter turn of the torch cap to release the electrode for adjustment or replacement. No wrench is required, and adjustment of the electrode through the torch cap rather than through a hot gas cup prevents burning of the operator's fingers.

... Electrode stub loss is minimized by employing the shortest distance between the end of the metal nozzle and the bottom of the electrode for which satisfactory water-cooling can be provided.

... Molded Fiberite torch body insulation has excellent heat resistance. The torch does not require additional asbestos shielding to protect it against reflected heat.

... Uniform shielding gas distribution pattern requires less argon for good shielding. In many cases, a smaller nozzle can be substituted for the nozzle ordinarily required at a given current, permitting better access to confined spaces.

... Small post-weld electrode cooling time is required, due to efficient water-cooling and minimized exposed electrode length. This reduces the argon volume required to prevent oxide contamination of the electrode while cooling, and is especially important where the operation consists primarily of short welds.

... Either 3-in. or 7-in. electrodes may be used by mounting short or long interchangeable torch caps.

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I. Setting Up the HW-12 Torch

A. Required Torch Accessories

The following accessories are required to place the torch in operation:

1. Either a metal nozzle or high impact ceramic cup (see recommendations in Sec. II, Paragraph C). A Cup Adaptor (Part No. 10Z71) is required when standard ceramic cups are used.

2. Electrodes and Collets of corresponding size should be selected from the recommendations shown in Table 1. For a complete listing of part numbers refer to the Replacement Parts section of this booklet.

3. Power Cable Adaptor (45V11) is required for connection of welding cable and water hose. (See Fig. 1).

B. Power, Argon, and Water Supply Equipment

Refer to F-5847, "How to Plan a HELIARC (Tig) Manual Welding Installation" for detailed information. Figure 1 Illustrates a typical installation.

C. Additional Equipment

In addition to the items mentioned above, the customer must also have a supply of argon, welding transformer or generator, welding cable, cable lugs, and ground clamp.

D. Optional Accessories

The following optional accessories are offered for use with the HW-12 Torch:

1. Flow Switch, Torch Saver II (Part No. 40V51) to protect the torch and cables from overheating, where water supply pressure may fluctuate. (See Figure 1.)

2. An OXWELD V-30 Dual Shutoff Valve (Part No. 16X21) automatically shuts off the argon and water when the torch is hung on the valve arm. (See Figure 1.)

3. A 12-1/2 ft. Argon Hose Extension (Part No. 40V77) for connecting the regulator to the V-30 valve. (See Figure 1.)

4. Two 12-1/2 ft. Water Hose Extensions (Part No. 40V76) for connecting the V-30 valve to the water supply line and for connecting the water outlet of the power cable adaptor (or water outlet of flow switch, if used) to the drain. Lengths of 1/4-in. pipe may be used instead of hose, if desired.

5. A Transparent Torch Cap (Part No. 56Y84). This cap, used with 7-in. electrodes, enables the welder to judge the length of the remaining electrode without removing the torch cap.

6. Short Torch Cap (Part No. 56Y45). This cap is required when the torch is used with 3-in. electrodes, especially where access to confined spaces is required.

FIG. 1 – HW-12 Installation
II. Installation

A. Hose Connections

Fig. 1 indicates the correct method of assembling the accessories used to supply argon and cooling water to the HW-12 Torch. Detailed instructions covering the mounting and use of each individual accessory are packed with the equipment.

B. 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 and water, 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, Control Circuits for HELIARC (Tig) Welding) giving descriptions of the circuits and specifications for the equipment needed is available upon request.

3. Electrical Connections (see Fig. 2). The torch power cable terminates in a power cable adaptor (optional) permitting you to connect the torch to the output terminal of a transformer, motor generator, rectifier, or a high-frequency generator. When using high-frequency, be sure to ground 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, motor generator, or rectifier to the work terminal of the high-frequency generator. Provision should be made for turning the high-frequency generator on and off as required.

C. Nozzles, Cups, Collet Bodies, and Collets

1. Metal Nozzles and Ceramic Cups: Four sizes of metal nozzles are used with the HW-12 Torch. The No. 12 Nozzle is used for welding thick sections, particularly where wide shielding gas coverage is desired, for example, in joints with large tolerance gaps. By ordering Cup Adaptor (18271) five sizes of ceramic or high impact cups may also be used. For the most effective argon protection, select the proper nozzle or cup size according to the recommendations in Table I. Metal nozzles provide longer service life than ceramic or high impact cups, and should be used wherever possible. Despite their higher initial cost, they will almost always prove more economical over any appreciable service period.

In ACHF service, however, metal nozzles can be damaged by accidental grounding before the arc is established. Where occasional grounding cannot be avoided with reasonable care, ceramic or high impact cups should be used. Ceramic cups should not be used with welding currents over 250 amps., and should be used in d.c. service only where definitely preferred for a specific purpose.

IMPORTANT NOTE: A nozzle insulating sleeve (85Z99) is supplied with the Torch. This sleeve is inserted into the torch body as shown in Figure 3.
### TABLE I
Electrode, Metal Nozzle, and Cup Sizes for Various Welding Currents

<table>
<thead>
<tr>
<th>Electrode Diameter in.</th>
<th>Cup or Metal Nozzle No.</th>
<th>Welding Currents, Amps</th>
<th>DCSP</th>
<th>DCRP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Using pure tungsten electrodes</td>
<td>Using conventional thoriated electrodes†</td>
<td>Using pure or conventional thoriated tungsten electrodes</td>
</tr>
<tr>
<td>.040</td>
<td>6</td>
<td>10-60</td>
<td>60-80</td>
<td>15-80</td>
</tr>
<tr>
<td>1/16</td>
<td>6</td>
<td>50-100</td>
<td>100-150</td>
<td>70-150</td>
</tr>
<tr>
<td>3/32</td>
<td>6, 8</td>
<td>100-160</td>
<td>160-235</td>
<td>150-250</td>
</tr>
<tr>
<td>1/8</td>
<td>8</td>
<td>150-210</td>
<td>225-325</td>
<td>250-400</td>
</tr>
<tr>
<td>5/32</td>
<td>8</td>
<td>200-275</td>
<td>300-425</td>
<td>400-500</td>
</tr>
<tr>
<td>3/16</td>
<td>8, 10</td>
<td>250-350</td>
<td>400-525</td>
<td>500-800 b</td>
</tr>
<tr>
<td>1/4</td>
<td>10, 12</td>
<td>325-475</td>
<td>500-700 b</td>
<td>800-1100 b</td>
</tr>
</tbody>
</table>

*The maximum current values shown in the table for ACHF have been determined using an unbalanced wave transformer. If a balanced wave transformer is used, either reduce the maximum values in the table by about 10 per cent or use the next larger size electrode. This is necessary because of the higher heat input to the electrode in a balanced wave setup.*

**NOTE:** All current values are metered readings. Most transformers deliver about 15 per cent more current than shown on their scale readings.

| b | Exceeds the rated capacity of the torch. |
| t | Balanced electrode tip ends can be formed and maintained at these a.c. current levels. |

2. **Electrodes:** Table 1 indicates the correct electrodes for various welding ranges. Note that thoriated electrodes are required to obtain rated capacity with ACHF currents. The HW-12 can be used for applications above the 500 amp. range only at reduced duty cycles.

3. **Collet Bodies:** A collet body for 1/8-in. to 1/4-in. collets is supplied assembled in the torch. An accessory collet body for .040-in. to 1/8-in. collets is also supplied with the torch. To change or replace a collet body, see appropriate steps in Section IV.

4. **Electrode Collets:** Collets are available for seven standard electrode sizes (.040-in. to 1/4-in. diameter). To install a collet and an electrode, proceed as follows:

   (a) Remove the torch cap from the torch.

   (b) Insert a collet for the electrode size you intend to use into the top of the torch head.

   (c) Insert an electrode of corresponding size into the top of the collet. Allow the electrode to protrude 1/8- to 3/16-in. beyond the end of the nozzle or cup for butt welding, and 1/4- to 3/8-in. for fillet welding. Then screw the torch cap onto the torch head and tighten it just enough to hold the electrode firmly.

5. **Safety Precautions**

   1. Use a standard welder's helmet with the proper shade of glass for the welding current to be used.

   2. Wear suitable clothing to protect exposed skin from arc burns.

   3. Be sure to shut off power before adjusting or replacing electrodes.

   4. When welding copper indoors, provide good ventilation or use a respirator.

   5. If you use chlorinated solvents for degreasing or cleaning the workpiece, do not weld near degreasing tanks.

   6. Shield your welding station to protect neighboring workers from ultra-violet radiation.


E. **Final Steps Before Welding**

1. Check all argon and water connections for tightness. Turn on the cooling water supply. The 500-ampere rating of the torch is based on a cooling water flow of a minimum of one quart per 35 seconds (about 25-1/2 gallons per hour) at an inlet temperature of not higher than 60 deg. F., with about 25 psi inlet pressure. Water pressures up to 50 psi at the inlet of the torch hose can be used. If the inlet pressure is above 50 psi, a water regulator should be installed to prevent possible damage to the plastic hose.

2. With the regulator flow-adjusting valve closed, slowly open the argon cylinder valve (to prevent a sudden rush of gas into the regulator); then fully open the argon cylinder valve.

3. Open the regulator flow-adjusting valve until the desired flow is obtained.

4. Set the welding transformer or generator for desired welding current.

5. Close the foot or hand switch, if one is used.

6. Draw a test arc on a heavy piece of scrap steel or copper.


For complete information on Tig welding, including recommended argon flows, welding currents and joint preparation, see F-51-006 "How to do Tig (HELIARC) Welding."
III. General Notes on Torch Operation

A. Torch Cooling System
1. Use Clean Cooling Water
   (a) The cooling water which circulates through the torch body and power cable must be clean and free from dirt and other solid material. Otherwise the torch passages may become clogged, thereby cutting off or greatly reducing the flow of cooling water.

   (b) If torch water passages become clogged, first remove lower torch-end parts and collet body so that foreign particles may emerge freely. Then flush torch with water, or clean flow passages by inserting a 3/32-in. diameter wire through the hose connection fittings.

   (c) If you cannot avoid using dirty water, and a torch saver flow switch, Part No. 40V51, is not used, install a suitable strainer at the cooling water inlet to prevent clogging. A strainer is available from Linde under Part No. 86W69 or from Hays Manufacturing Co., Cat. No. 2400.

2. Torch Saver II, Part No. 40V51. This accessory should be used to protect the torch from overheating in case of water supply fluctuation or failure. When water flow falls below a safe limit the switch shuts off the welding current until the required flow is restored. Instructions for installation and operation (Form 9743) are packed with each assembly. Additional copies are available without charge from your nearest Linde office.

B. Torch Hose
1. Make certain that all argon hose connections and the nozzle or 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, a dark gray deposit on or beside the weld, or a cloudy weld puddle, 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. If the power cable, argon, or water hose becomes damaged, it is recommended that you purchase a new assembly or send the damaged assembly to the nearest Linde repair station for possible repair. DO NOT TRY TO REPAIR IT YOURSELF.

C. Nozzle Compound
HW-12 Metal Nozzles are dipped in LINDE 65 Nozzle Compound prior to packing. The silicone coating prevents the adherence of spatter to the nozzles and ensures the maintenance of a complete and uniform gas shielding pattern. A four ounce can of this compound (Part No. 08N65) or a 1 qt. can (Part No. 08N75) should be obtained to maintain the protective coating on the nozzles.

D. Electrodes
1. If weld spatter sticks to the electrode, a black soot may appear when welding 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 heavy piece of scrap steel or copper (do not use a carbon block).

2. Should contamination of the electrode occur due to contact with the weld puddle, shut off the power and remove the electrode from the torch. Break off a small piece from the end, and then replace the electrode. Always remove the electrode before breaking it off, to minimize waste of electrodes. It is advisable to nick the electrode slightly with a grinding wheel at the point where the break is to be made. Then remove the contaminated end with pliers gripped close to the nick.

E. Factors Affecting High-Frequency Starting in Tig Welding
Properly applied, high-frequency starting will give quick, clean, positive starts. However, there are many factors which influence starting performance. Since most of these factors are relatively easy to control, there should be no difficulty in obtaining good starts. The following are some of the items which should be checked.

1. Thoriated tungsten electrodes will usually provide better starting than straight tungsten electrodes.

2. Use the proper size electrode. Grinding a point on the end of the electrode will usually improve the starting performance of an oversize electrode.

3. If the torch uses a metal cup, ground the cup to the torch mounting or to the work through a resistor. The value of this resistor is not critical and a resistor on the order of 10,000 ohms, 25 watts, will be entirely satisfactory. Do not use the small radio-type resistor since they will usually be damaged by the high voltage, high frequency. The use of this grounding method will
sometimes double the electrode-to-work distance over which a start can be consistently made, and it usually eliminates failure to start.

4. Where a modern low-power high-frequency unit is used and where the torch is equipped with a shielded cable, remove the shield from the torch cable. If this cannot be done easily, removing the ground connection from the shield will usually help.

5. Gas flow is an important factor. Too high or too low a gas flow will make high-frequency starting more difficult.

6. Some high-frequency units including the early model of Linde Part No. 22N36 use a small size bypass condenser. Increasing the size of this condenser to 10 or 20 mfd will usually improve the starting reliability because it permits more of the low frequencies generated by the high-frequency unit to pass through the spark. These low frequencies add considerable energy to the spark and help develop the cathode spot required for starting.

7. Check the spark gaps to make certain that they are clean and properly adjusted.

8. Periodically blow out the high-frequency unit to prevent accumulations of dust which might cause leakage.

9. Keep the length of cable between the high-frequency unit and the torch as short as possible. This cable should be suspended from insulated hangers and not run over the floor or over or near metal surfaces. Avoid loops in this cable. Also, keep this cable away from other cables to avoid high-frequency pick up by the other cables.

IV. Disassembly

(See Fig. 4)

1. Unscrew the torch cap. Inspect "O" ring (85W50) for nicks, cracks, excessive distortion and flatness. Replace with a new part if defective. This "O" ring acts as a seal against argon leakage and air entrainment.

2. Remove the electrode and electrode collet.

3. Unscrew the nozzle from the water jacket (85Z98).

4. Hold the water jacket adaptor (84Z92) with a strap wrench to keep it from turning, and unscrew the water jacket (85Z98). Inspect insulator gasket (86Z23), backup ring (11N60), and "O" ring (lower 85W55) which are removed with the jacket. Replace if defective.

5. Insert the drill rod collet body wrench (60Y04), supplied with the torch, through opposing argon drillings in the collet body. Unscrew collet body (11N65 or 11N66) from the torch body. Inspect "O" ring (85W07) without removing it from the torch body (use a beam of light). This "O" ring acts as an important seal between gas and water, but does not normally require replacement.

6. Unscrew water jacket adaptor (84Z92) from the torch body. Inspect "O" ring (upper 85W55). Replace if defective. THIS STEP IS NOT NECESSARY TO CHANGE OR REPLACE A COLLET BODY.

7. To reassemble, follow the preceding steps in reverse order. Moisten the upper end of collet body (11N65 or 11N66) before screwing into torch body (this assists passage through "O" ring 85W07). The shoulder on the collet body should fit tightly against the lower end of the torch body to assure good electrical contact. Be certain that the water jacket (85Z98) is sufficiently tightened for a leak-proof connection.

V. Series Changes

This booklet covers the HW-12 (Series 3) torch. It may also be used with the earlier models listed below if the changes which have been made are taken into consideration. The Series 3 torch contains a plastic back-up ring 11N60 which eliminates any possibility of water leakage due to shearing of the insulator gasket. Modified collet bodies 11N65 and 11N66 are used with the back-up ring. The Series 3 torch also contains IAA inert gas hose connections, which contain external male fittings whereas earlier torches contained female fittings.

Series 2 torches are similar to Series 3 torches except that the Series 2 torch does not contain a back-up ring 11N60 and uses collet bodies 85Z14 and 85Z15.

Series 1 torches are similar to Series 2 torches except that the Series 1 torch uses nozzles 84Z96, 84Z97, and 84Z98 and water jacket 56Y62. The Series 1 torch does not contain an insulating sleeve 85Z69.
VI. Replacement Parts Data

FIG. 4 – LINDE HW-12 (Series 3) Hand-Welding Torch with 12½ ft. Cable & Hose – Part No. 16X37

Accessories
(Not Supplied with HW-12 Torch, Part No. 16X37)

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11N17</td>
<td>Argon Hose Coupling</td>
<td>#56Y45</td>
<td>Torch Cap (small)</td>
</tr>
<tr>
<td>40V81</td>
<td>Torch Saver II, Flow Switch</td>
<td>#56Y84</td>
<td>Transparent Torch Cap (long)</td>
</tr>
<tr>
<td>40V77</td>
<td>Argon Hose Extension (12-1/2 ft.)</td>
<td>11N18</td>
<td>Water Hose Coupling</td>
</tr>
<tr>
<td>40V76</td>
<td>Water Hose Extension (12-1/2 ft.)</td>
<td>19Z71</td>
<td>Cup Adaptor (for Ceramic or High Impact Cups)</td>
</tr>
</tbody>
</table>

* Includes "O" Ring (1/16-in. I.D.), Part No. 85W50.

NOZZLES, CUPS, AND COLLETS

<table>
<thead>
<tr>
<th>Metal Nozzles</th>
<th>Ceramic Cups</th>
<th>High Impact Cups</th>
<th>Torch Collets</th>
</tr>
</thead>
<tbody>
<tr>
<td>86Z201</td>
<td>85Z07</td>
<td>14N57</td>
<td>84Z59</td>
</tr>
<tr>
<td>86Z202</td>
<td>85Z08</td>
<td>14N58</td>
<td>84Z60</td>
</tr>
<tr>
<td>86Z203</td>
<td>85Z09</td>
<td>14N59</td>
<td>84Z81</td>
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<tr>
<td>86Z206</td>
<td>85Z10</td>
<td>14N60</td>
<td>84Z82</td>
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<td></td>
<td>85Z11</td>
<td>14N61</td>
<td>85Z16</td>
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<td></td>
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<td>85Z18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>85Z19</td>
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