PAC620™ Torch

For PAC500™, HT400E®, 2XHT400E®

Instruction Manual
801960 – Revision 3

Hypertherm®
The world leader in plasma cutting technology

PAC620 Torch

For PAC-500, HT400E, 2XHT400E

Instruction Manual
IM-196

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ATTENTION

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage caused by the use of other than genuine Hypertherm parts is not covered by the Hypertherm warranty.

WARNING

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty

WARNING

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Hypertherm, Inc. warrants that its Products shall be free from defects in materials and workmanship, if Hypertherm is notified of a defect (i) with respect to the power supply within a period of two (2) years from the date of its delivery to you, and (ii) with respect to the torch and leads within a period of one (1) year from its date of delivery to you. This warranty shall not apply to any Product which has been incorrectly installed, modified, or otherwise damaged. Hypertherm, at its sole option, shall repair, replace, or adjust, free of charge, any defective Products covered by this warranty which shall be returned with Hypertherm's prior authorization (which shall not be unreasonably withheld), properly packed, to Hypertherm's place of business in Hanover, New Hampshire, or to an authorized Hypertherm repair facility, all costs, insurance and freight prepaid. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph or with Hypertherm's prior written consent. **The warranty above is exclusive and is in lieu of all other warranties, express, implied, statutory, or otherwise with respect to the Products or as to the results which may be obtained therefrom, and all implied warranties or conditions of quality or of merchantability or fitness for a particular purpose or against infringement. The foregoing shall constitute the sole and exclusive remedy for any breach by Hypertherm of its warranty.** Distributors/OEMs may offer different or additional warranties, but Distributors/OEMs are not authorized to give any additional warranty protection to you or make any representation to you purporting to be binding upon Hypertherm.

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In no event shall Hypertherm's liability, whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise, for any claim action suit or proceeding arising out of or relating to the use of the Products exceed in the aggregate the amount paid for the Products that gave rise to such claim.

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At all times you will have and maintain insurance in such quantities and types, and with coverage sufficient and appropriate to defend and to hold Hypertherm harmless in the event of any cause of action arising from the use of the Products.

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You may transfer any remaining rights you may have hereunder only in connection with the sale of all or substantially all of your assets or capital stock to a successor in interest who agrees to be bound by all of the terms and conditions of this Warranty.

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ILLUSTRATIONS

Section 1 SAFETY

In this section:

SAFETY

INTRODUCTION

Abbreviated safety precautions are printed on the power supply.

Before using the plasma arc cutting equipment (including compressed gas), each person operating, maintaining or supervising the use of this equipment must read the following safety instructions.

NOTES, CAUTIONS & WARNINGS

Throughout this manual, notes, cautions, and warnings are used to describe situations that require additional information. The following formats are used for each:

Notes: A note offers additional information, such as an operating tip, that aids the user in operating the plasma system.

Caution: A caution describes a situation that may cause damage to the plasma system and offers advice to avoid or rectify the situation.

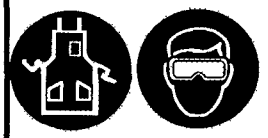
WARNING

A warning describes a situation that presents a physical danger to the operator, and offers advice to avoid or rectify the situation. Each type of warning displays an applicable danger symbol, ie. fire, explosion, electrical shock, etc.

WARNING

ELECTRIC SHOCK CAN KILL.
- Do not touch live electrical parts.
- Keep all panels and covers in place when the machine is connected to a power source.
- Insulate yourself from work and ground: wear insulating gloves, shoes and clothing.
- Keep gloves, shoes, clothing, work area, torch, and this machinery dry.

EXPLOSION WILL RESULT IF PRESSURIZED CONTAINERS ARE CUT.



ARC RAYS CAN INJURE EYES AND BURN SKIN.
- Wear correct eye and body protection.

NOISE CAN DAMAGE HEARING.
- Wear correct ear protection.

FUMES AND GASES CAN INJURE YOUR HEALTH.
- Keep your head out of the fumes.
- Provide ventilation, exhaust at the arc, or both to keep the fumes and gases from your breathing zone and the general area.
- If ventilation is inadequate, use an approved respirator.

HEAT, SPLATTER AND SPARKS CAUSE FIRE AND BURNS.
- Do not cut near combustible material.
- Do not cut containers that have held combustibles.
- Do not have on your person any combustibles such as a butane lighter or matches.
- Pilot arc can cause burns. Keep the torch nozzle away from yourself and others when the switch is depressed.
- Wear correct eye and body protection.

SAFETY

SAFETY INSTRUCTIONS

Burn Prevention

Eye Safety

To protect eyes against burns caused by high-intensity ultraviolet light, sparks and hot metal:

- Wear dark safety glasses/goggles with side shields or a welding helmet. Refer to the chart below for recommended lens shades:

Arc Current		Shield Shade
Up to 100 Amps		Shade No. 8
100 - 200 Amps		Shade No. 10
200 - 400 Amps		Shade No. 12
Over 400 Amps		Shade No. 14

- Replace the glasses/goggles or helmet when the shield becomes pitted or broken.
- Warn other people in the area not to look directly at the arc unless they wear a glasses/goggles or helmet.
- Prepare the cutting area in a manner that reduces the reflection and transmission of ultraviolet light:
  - Paint walls and other surfaces with dark colors to reduce reflection.
  - Install protective screens or curtains to reduce ultraviolet transmission.

Skin Safety

To protect skin against burns caused by high-intensity ultraviolet light, sparks and hot metal:

- Wear protective clothing:
  - Gauntlet gloves, safety shoes and hat.
  - Flame-retardant clothing which covers all exposed areas.
  - Cuffless trousers to prevent entry of sparks and slag.
- Hold any hand torch away from your body when pressing the start button because the pilot arc may come on immediately.

- Do not touch the front of the torch when starting it. After cutting, allow time for the front of the torch to cool.

Toxic Fume Prevention

To protect against the danger of toxic fumes which may be produced during cutting:

- Keep the cutting area well-ventilated.
- Remove all chlorinated solvents from the cutting area before cutting. Certain chlorinated solvents decompose when exposed to ultraviolet radiation to form phosgene gas.
- Wear proper breathing mask when cutting galvanized metal and use proper ventilation.
- Do not cut containers with toxic materials inside or containers that have held toxic materials. Clean such containers thoroughly before cutting.

WARNING

Do not cut metal or painted metals containing zinc, lead, cadmium or beryllium unless the operator, or anyone else subjected to the fumes, is wearing respiratory equipment or an air-supplied helmet.

Fire Prevention

Cutting with a plasma system produces hot metal, sparks and slag. Take the following precautions against fire:

- Make fire extinguishers available in the cutting area.
- Remove combustible material from the immediate cutting area to a distance of at least 35 feet (10 meters).
- Quench freshly cut metal or allow metal to cool before handling it or bringing it into contact with combustible materials.
- Never use a plasma system to cut containers with potentially flammable materials inside. Such containers must be thoroughly cleaned prior to cutting.

- Ventilate potentially flammable atmospheres before cutting with a plasma system. Never operate the plasma system in an atmosphere which contains heavy concentrations of dust, flammable gas or combustible liquid vapors.

Electric Shock Prevention

All Hypertherm plasma systems use high voltage (up to 280 VDC) to initiate the plasma arc. Take the following precautions when operating the plasma system:

- Keep your body and clothing dry.
- Do not stand in, sit on or lie on any wet surface when using the plasma system.
- Maintain proper insulation against electrical shock. If you must work in or near a damp area, use extreme caution. Wear insulated gloves and boots.
- Provide a wall-mounted disconnect switch with proper size fuses close to the power supply. This switch allows the operator to turn the power supply off quickly in an emergency situation.
- Conform to all local electrical codes for primary wiring sizes and types.
- Inspect the primary power cord frequently for damage or cracking of the cover. **Bare wiring can kill.** Do not use the system with a damaged power cord. If a power cord is damaged, replace it immediately.
- Inspect the torch leads. Replace if frayed or damaged.
- Never operate the plasma system unless the power supply unit covers are in place. Exposed power supply connections present a severe electrical hazard.
- Do not pick up the workpiece, including the waste cutoff, while you cut. Leave the workpiece in place or on the workbench with the work cable attached at all times.
- Before changing the torch parts, disconnect the main power or unplug the power supply. After changing the torch parts and returning the retaining cap to its operating position, plug the power supply in again.
- Never bypass or shortcut the safety interlocks.
- Before removing a power supply cover for maintenance, disconnect the main power at the wall disconnect switch or unplug the power supply. To avoid exposer to severe electrical hazard, wait five minutes after disconnecting the main power to allow capacitor discharge to occur.

Explosion Prevention

WARNING

The plasma system uses compressed gas. Proper precautions must be observed when handling and using compressed gas equipment and cylinders. Refer to the Standards Index in this manual.

When cutting with the plasma system:

- Do not cut in atmospheres containing explosive dust or vapors.
- Do not cut pressurized cylinders or any closed container.

Pressure Regulators

- Maintain all pressure regulators in proper working condition. Faulty regulators can cause damage or operator injury and must be serviced by trained repair technicians.
- Never use a regulator for any gas other than that for which it is intended.
- Never use a regulator that leaks, creeps excessively or is physically damaged in any way.
- Never attempt to lubricate a regulator with oil or grease.

Compressed Gas Cylinders

- Handle and use compressed gas cylinders in accordance with safety standards published by the Compressed Gas Association (CGA), American Welding Society (AWS) and Canadian Standards Association (CSA).
- Never use a cylinder that leaks or is physically damaged.
- Never use a cylinder that is not upright and secured in place.
- Never move or transport a cylinder without the protective valve cover in place.
- Never use a gas cylinder or its contents for any purpose other than that for which it is intended.
- Never lubricate cylinder valves with oil or grease.

- Never allow electrical contact between the plasma arc and a cylinder.
- Never expose cylinders to excessive heat, sparks, slag or open flame.
- Never use hammers, wrenches or other tools to open stuck cylinder valves.

Hoses

Label and color-code all gas hoses in order to clearly identify the type of gas in each hose. Consult applicable national or local codes.

- Never use the oxygen hose for any gas other than oxygen.
- Replace hose that is damaged by physical abuse or by sparks, heat or open flame.
- Lay hose out straight to prevent kinks.
- Coil excess hose and place it out of the way to prevent damage and to eliminate tripping danger.
- Examine hoses at regular intervals for leaks, wear, loose connections or other hazard.
- Keep hose lengths to a minimum to prevent damage, reduce pressure drop and to prevent possible volume flow restriction.

Hydrogen Detonation with Aluminum Cutting

WARNING

When cutting aluminum underwater or with the water touching the underside of the aluminum, free hydrogen gas may collect under the workpiece. Detonation of the hydrogen gas may occur while plasma cutting under these conditions.

- An effective means of eliminating the possibility of hydrogen detonation is to install an aeration manifold on the floor of the water table. Refer to the **Appendix** section at the rear of this manual for instructions on how to make an aeration manifold.

Grounding

Before operating the plasma system:

Input Power

- Be sure the power cord is plugged into a properly grounded outlet or that the power cord ground wire is properly connected to the ground in the disconnect box.
- If installation of the plasma system involves connecting the power cord to the power supply, ensure that the power cord ground wire is properly connected. Conform to CSA standards by placing the power cord ground wire on the stud first; then place the other wires on top of the power cord ground. Fasten the retaining nut tightly.
- Make sure that all electrical connections are tight to avoid excessive heating.

Work Table

- Clamp the work cable with good metal-to-metal contact to the workpiece (not the portion that will fall away) or to the work table.

Work Table

- Connect the work table to a good earth ground. Consult the U.S. National Electrical Code, Article 250, Section H *Grounding Electrode System*, or other appropriate national or local codes.

For additional information, refer to the *Standards Index* in this manual.

SAFETY REMINDERS

- All Hypertherm torches are designed with a safety interlock, which turns off the power supply when the retaining cap is loosened.
- Never bypass or shortcut the safety interlocks on any of the plasma system units.
- Never operate the plasma system with any of its covers not in place. This would be hazardous to the operator and other people in the area, and prevents the proper cooling of the equipment.
- Each Hypertherm plasma system is designed to be used only with specific Hypertherm torches. Do not substitute other torches which could overheat and present a potentially dangerous situation to the operator and any personnel in the area.

STANDARDS INDEX

The *Standards Index* contains a list of publications dealing with plasma arc cutting equipment safety practices. For additional information, refer to this *Standards Index*.

Section 2 DESCRIPTION AND SPECIFICATIONS

In this section:

DESCRIPTION AND SPECIFICATIONS

DESCRIPTION

The PAC620 torch is designed for use with PAC-500, HT400E/2X HT400E and HT4001 systems. The unique design of the PAC620 torch allows beveling cuts using nitrogen or oxygen as the plasma gases. A removable water tube in the torch head (with appropriate consumables) changes the torch from a beveling PAC620 to a standard cutting PAC620.

Four nozzle sizes provide nitrogen cutting capabilities on metal thicknesses of .035 inches (1 mm) to 3 inches (76 mm) on mild steel, stainless steel and aluminum. Consumables and water tube must be changed when switching from nitrogen to oxygen bevel-cutting, and when changing from beveling to standard cutting.

The PAC620 requires a special Operator's Panel or Flow Console for the PAC-500 and HT400E/2XHT400E systems to accommodate the higher water-flow rate (.7 gpm at full scale) of the beveling torch. This manual covers the modifications, operating data and parts necessary to use the PAC620 torch with the PAC-500, HT400E or 2XHT400E systems. ***For installation, operation, maintenance and parts for the PAC620 used with the HT4001 system, see the HT4001 instruction manual (IM200).***

For complete system installation, operation and maintenance instructions for the PAC-500, HT400E and 2XHT400E systems, see instruction manuals IM37 (PAC-500), IM46 (PAC-500L), IM74 (HT400E) or IM73 (2XHT400E).

SPECIFICATIONS

Water Pump Supply Requirements

Flow Rate	2.0 gallons (7.5 liters) per minute
Pressure at above Flow Rate	30-60 psi per torch
Water Temperature	< 80° F (27° C) at water supply inlet
Water Hardness	< 300 ppm
Total Dissolved Solids	< 350 ppm

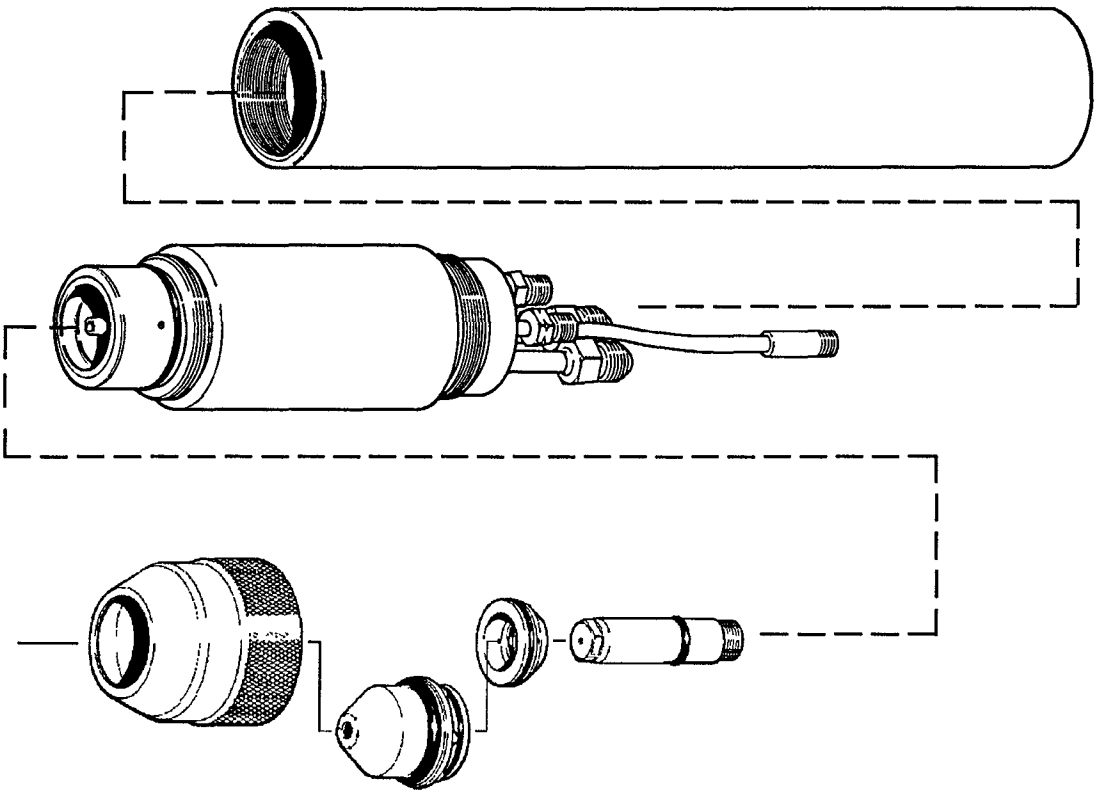
Water Drain Requirements

Cooling Water	1.7 gallons (6.4 liters) per minute per torch Note: If using a water chiller, cooling water is a closed-loop system.
Injection Water	0.5 gallons (1.9 liters) per minute per torch

Gas Supply Requirements

Nitrogen Flow Rate	368 cfh at full scale
Nitrogen Pressure at above Flow Rate	150 psi
Oxygen Flow Rate	114 cfh at full scale
Oxygen Pressure at above Flow Rate	120 psi
Gas Purity	99.995% pure

PAC620 Torch (028741)



See **Section 4: Parts List** for part number breakdown

Figure 2-1 PAC620 Torch

Maximum cutting thickness	3 inches (76 mm)
Maximum current	750 amps
Dimensions	Dia.: 2 inches (51 mm) Length: 17.5 inches (444 mm)
Weight (without leads)	2.5 pounds (1.1 kg)

Operator's Panel - 1 Torch (028739) - used with PAC-500 system

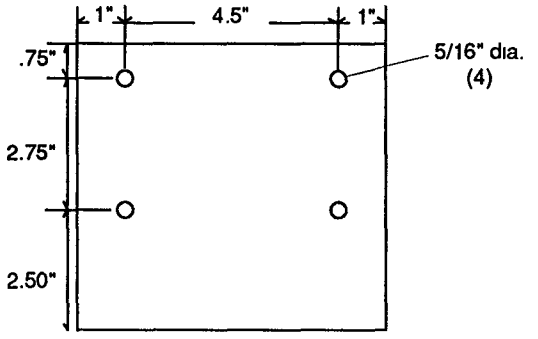


Figure 2-2 1-Torch Operator's Panel - Mounting Dimensions

Dimensions and Weight:

Width ..... 6-1/2 inches (165 mm)
Height ..... 14 inches (355 mm)
Depth ..... 6 inches (152 mm
Weight ..... 12 pounds (5.5 kg)

Operator's Panel - 2 Torch (028740) - used with PAC-500 system

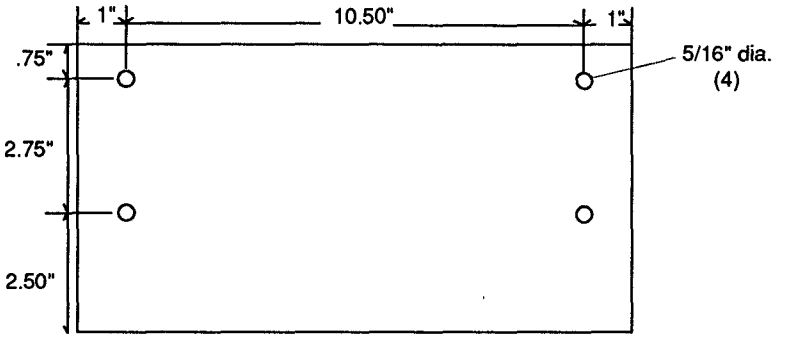


Figure 2-3 2-Torch Operator's Panel - Mounting Dimensions

Dimensions and Weight:

Width ..... 12-1/2 inches (317 mm)
Height ..... 14 inches (355 mm)
Depth ..... 6 inches (152 mm
Weight ..... 12 pounds (5.5 kg)

See **Section 4: Parts List** for part number breakdown

Flow Console (055026) - used with HT400E and 2X HT400E systems

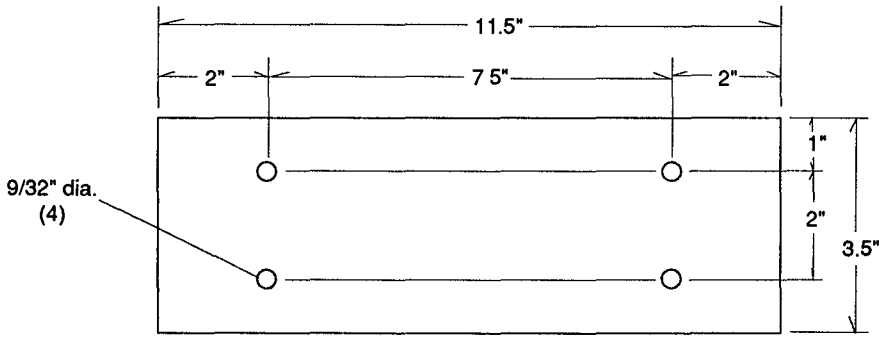


Figure 2-4 HT400E Flow Console

Dimensions and Weight:

Width ..... 11 -1/2 inches (292 mm)
Height ..... 14 -1/2 inches (368 mm)
Depth ..... 3 - 1/2 inches (89 mm)
Weight ..... 23 pounds (10.4 kg)

See **Section 4: Parts List** for part number breakdown

Section 3a INSTALLATION & OPERATION - w/PAC-500 SYSTEM

In this section:

INSTALLATION & OPERATION - w/PAC-500 SYSTEM

INSTALLATION

This installation procedure covers the hookup of the PAC620 torch and the Operator's Panel to the PAC-500 system. Figures in this section apply to the standard PAC-500 Control Console used with the 1-Torch Operator's Panel. For more information on the PAC-500 systems, see instruction manual IM37: PAC-500, or IM46: PAC-500L.

Operator's Panel Installation

There are two Operator's Panels to accommodate the PAC620 torch with the PAC-500 system: #028739 - 1-Torch Operator's Panel, and #028740 - 2-Torch Operator's Panel. See **Parts List Section 4** for parts list breakdown of Operator's Panel and leads.

1. Mount the Operator's Panel in a convenient location for the operator's use. See **Section 2** for mounting dimensions.

2. Attach the connector end of the Operator's Panel cable to the **1RECP** receptacle at the rear of the PAC-500 Control Console - Fig. 3a-1.

3. Attach the four other leads to the rear of the Control Console as indicated in Fig. 3a-1.

Note: Water and gas connectors for PAC-500L Control Console are located in the center of the panel.

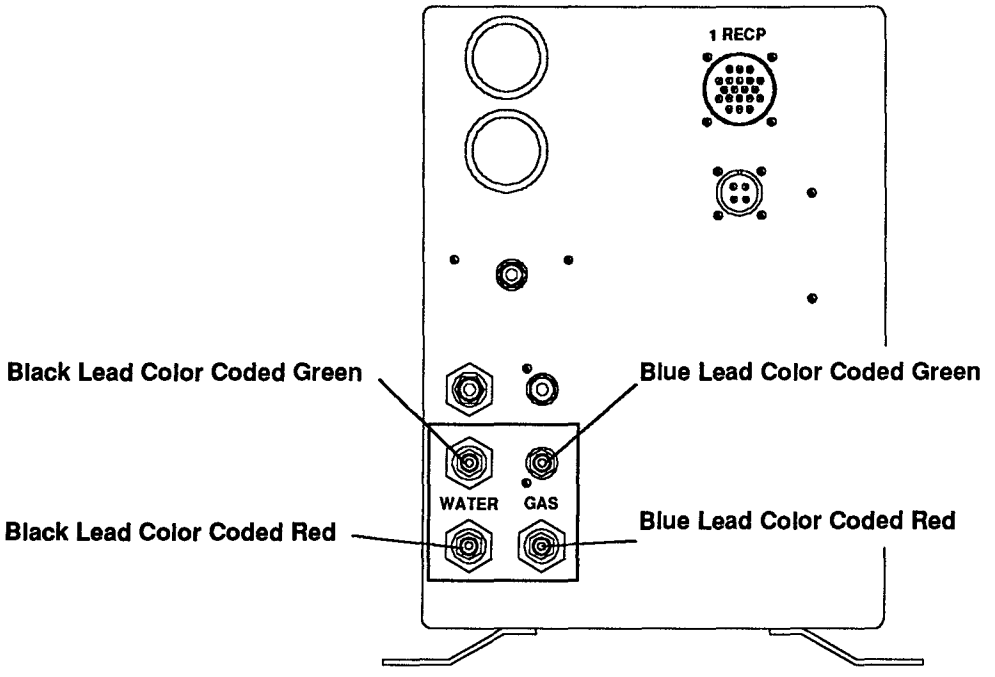


Figure 3a-1 PAC-500 Control Console - Lead Connections

4. Feed the other end of the leads through the basket-weave strain relief on the rear of the Operator's Panel and make plumbing connections as outlined in Fig. 3a-2. (See page 4-6 for reference of the 2-Torch Operator's Panel.) Match the wire labels to the locations on terminal strip 4TB for electrical connections.

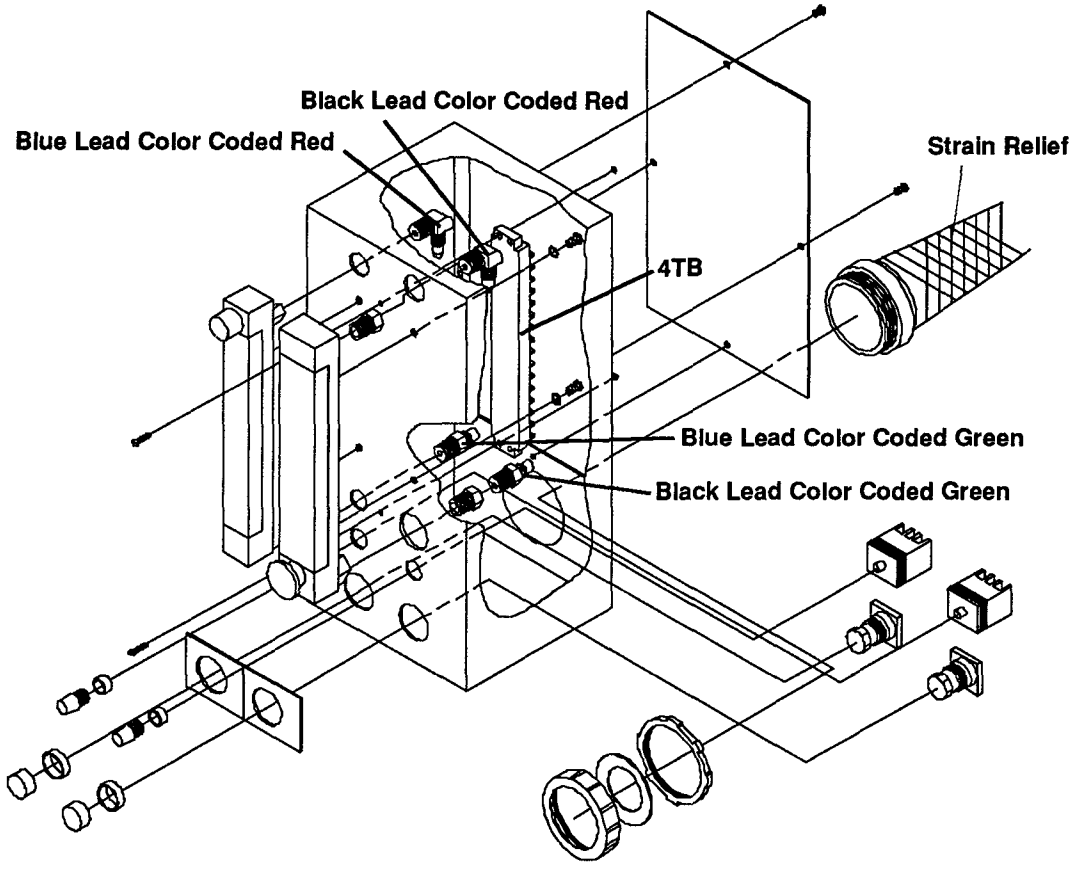


Figure 3a-2 PAC-500 1-Torch Operator's Panel - Lead Connections

Torch Installation

1. Mount the PAC620 torch to the torch holder on the guidance machinery and set to beveling angle.

Caution:	**Be certain that torch holder grabs the plastic sleeve and not the stainless steel torch body.**

2. Route the torch leads to the Control Console. Support leads as necessary.

3. Pass the two 3/8" (9.5 mm) I.D. water-cooled leads (red and green band colored) and the pilot arc lead (white) through the brass ring of the Control Console - Fig. 3a-3.

4. Connect the 1/4" (6 mm) I.D. blue lead to the torch **GAS OUT** connector of the Control Console and the 1/4" (6 mm) I.D. red lead to the **WATER OUT** connector - Fig. 3a-3. Note that the red lead is left-hand threaded.

   Note also : Water and gas connectors, and brass ring for PAC-500L Control Console are located in the center of the panel.

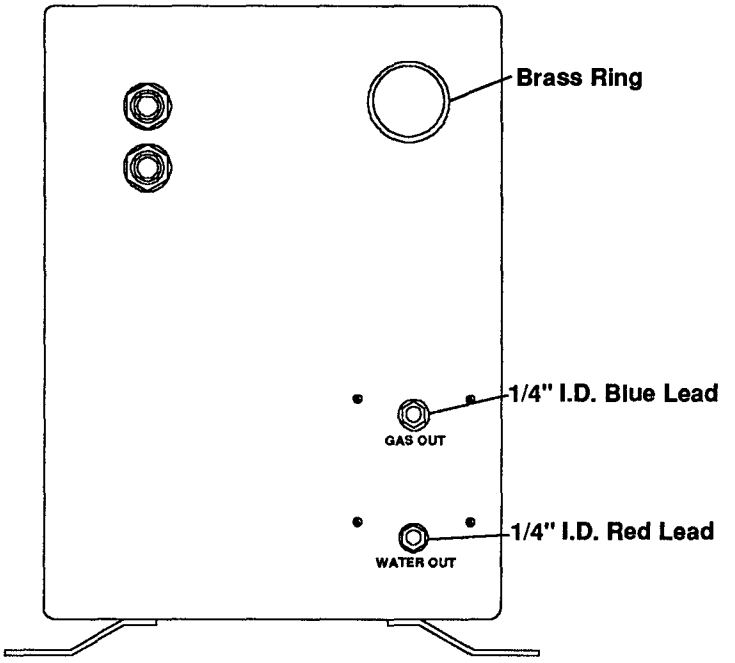


Figure 3a-3 PAC-500 Control Console - Torch Connections-1

5. Connect the water-cooled leads to the cathode block as shown in Fig. 3a-4. Be certain to connect red-banded lead to red fitting and green-banded lead to green fitting.

6. Connect the pilot arc lead to the air core transformer as shown in Fig. 3a-4.

This completes the installation of the PAC620 torch. Refer to instruction manual IM37 or IM46 for more information and wiring diagrams on the PAC-500 systems.

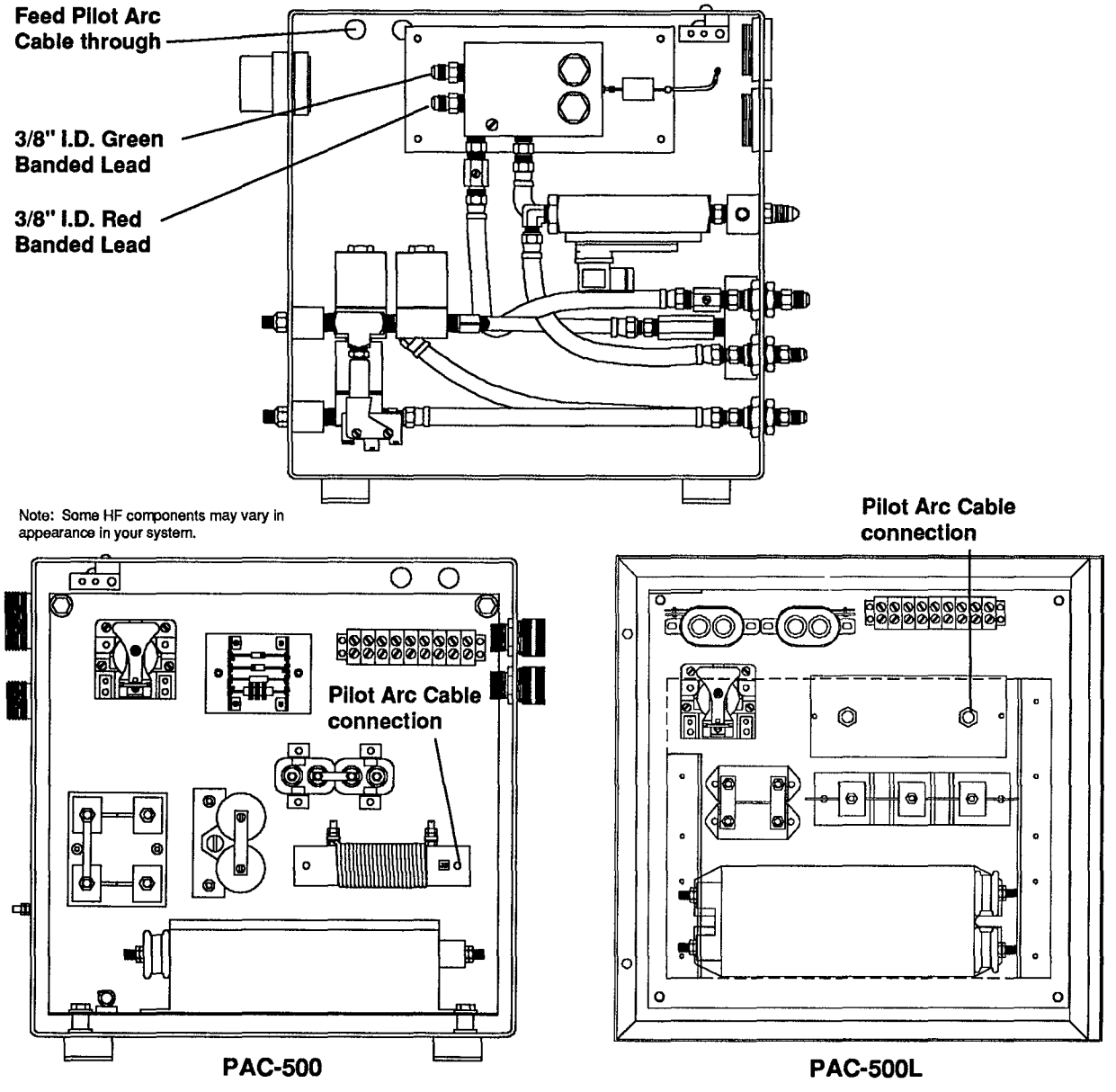


Figure 3a-4 PAC-500 Control Console - Torch Connections-2

OPERATION

WARNING

Before operating the PAC620 , you must read the *Safety* section of this manual thoroughly!

The following procedure outlines the operation of the PAC-500 system with the PAC620 torch from the application of 3Ø power to the end of a cut using nitrogen as the plasma gas. See IM-37 PAC-500 instruction manual for a description of the PAC-500 system.

Operator Action:

1. From the Operating Data Charts determine the correct nozzle size for the type and thickness of material you are cutting. See *Changing Consumable Parts* to insert nozzle.
2. Turn on the fused disconnect switches supplying 3Ø power to the PAC-500 system.
3. If using a water-chiller instead of a water supply, activate by pressing the start button on the front of the chiller.
4. Place the ON/OFF switch on the Operator's Panel to ON. White light will go on.
5. From the Operating Data Charts determine the correct voltage setting for the type and thickness of metal you are cutting. Set the voltage on your particular remote voltage system.
6. From the Operating Data Charts determine the correct current setting for the type and thickness of metal you are cutting. Set the current on your particular remote current system.
7. From the Operating Data Charts determine the correct torch-to-work distance. Adjust the torch height to the proper setting.
8. Place the TEST/RUN switch on the Operator's Panel to TEST. Water and gas will flow through the torch.
9. From the Operating Data Charts determine the correct flow rates for injection water and gas. Set the flow rates.
10. Place the TEST/RUN switch on the Operator's Panel to RUN. Water and gas will stop flowing through the torch.

11. If using IHS, place the IHS switch to ON.

12. Press master START switch.

Automated Action:

- If using IHS, probes extend down and torch indexes down toward work after .5 second delay. IHS probes then retract.
- Water and gas solenoids in Control Console activated. Water and gas flow for 5 seconds.
- Green light on Operator's Panel goes on if all interlocks are satisfied and main contactor closes.
- Power supply initiates a pilot arc after .5 seconds.
- Transfer of arc if workpiece is at correct distance from torch. Current ramped up to preset values on V/C remotes.
- Machine motion and cutting begins.
- Arc extinguished, cutting stops due to:

  A. Stop signal to power supply
  B. Plate overrun
  C. Water or gas pressures drop too low
  D. Interlock switch(es) deactivated
  E. TEST/RUN switch put in TEST position.

OPERATING TIPS

- Do not exceed the current limit for each nozzle. The limits are:

  .120 nozzles - 260 amps maximum
  .166 nozzles - 400 amps maximum
  .187 nozzles - 600 amps maximum
  .220 nozzles - 750 amps maximum

- When the operating range of two nozzles overlap, use the larger nozzle to produce the best cut quality.
- Do not pierce metal greater than 1-1/2 inches with the .187 nozzle.
- Do not pierce metal greater than 2 inches with the .220 nozzle.

COMMON CUTTING FAULTS

- Torch pilot arc will initiate, but will not transfer. Cause can be:

  1. Work cable connection on cutting table not making good contact.

- The workpiece is not totally penetrated, and there is excessive sparking on top of the workpiece. Causes can be:

  1. Current is set too low (check *Operating Data Chart* information).
  2. Cut speed is too high (check *Operating Data Chart* information).
  3. Torch parts are worn (see *Changing Consumable Parts*).
  4. Metal being cut is too thick for nozzle size (check *Operating Data Chart* information).

- Dross forms on the bottom of the cut. Causes can be:

  1. Cutting speed is too slow or too fast (check *Operating Data Chart* information).
  2. Arc current set too low (check *Operating Data Chart* information).
  3. Torch parts are worn (see *Changing Consumable Parts*).

- Short consumable life. Cause can be:

  1. Arc current, arc voltage, travel speed, motion delay, gas and/or water flow rates, or initial torch height not set as specified in *Operating Data Chart*.
  2. Contaminated gas. Gases must be 99.995% pure.
  3. Leaking gas hoses or gas fittings.

TECHNICAL QUESTIONS

Claims for defective merchandise -- All units shipped from Hypertherm undergo rigorous quality control testing. However, if your system does not function correctly:

1. Re-check all pre-installation and installation requirements and connections in PAC-500 Instruction Manual: IM37 (#800370) or PAC-500L Instruction Manual: IM46 (#800460).

2. If you are unable to solve the problem, call your distributor. He/she will be able to help you, or refer you to an authorized Hypertherm repair facility.

3. If you need assistance, call Customer Service at 1-800-643-0030 or Field Service at 1-800-643-9878.

OPERATING DATA CHARTS

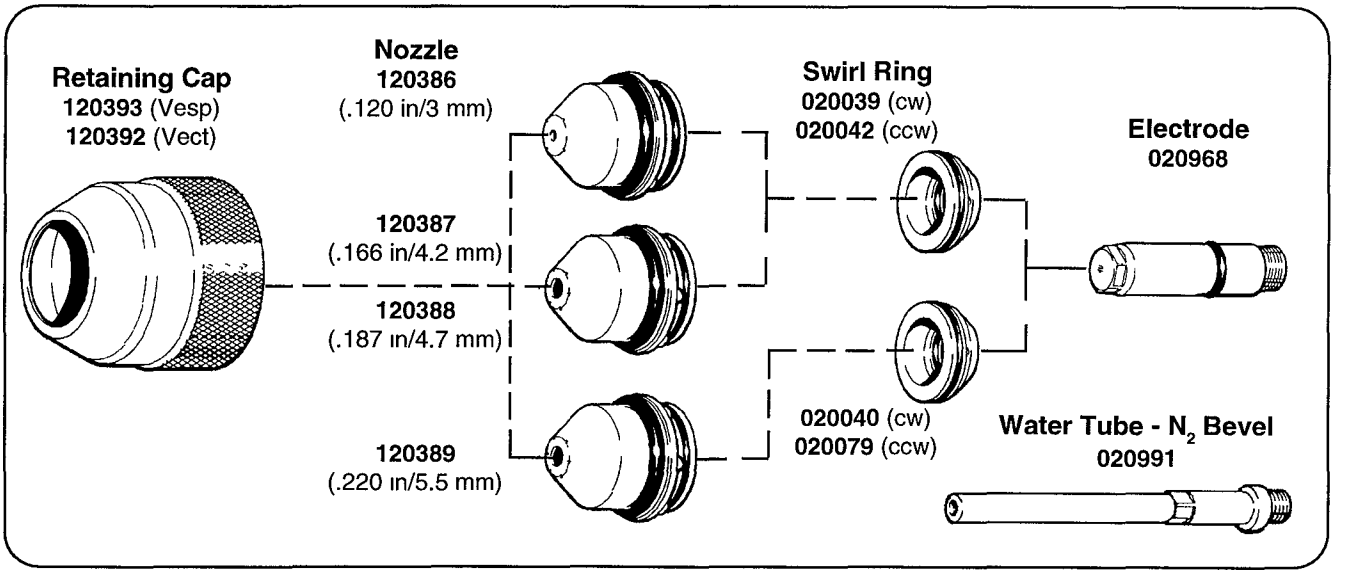
The Operating Data Charts on the following pages provide the necessary information for the PAC-500 system operator to be successful in plasma arc cutting using the PAC620 torch. The PAC-500 provides a wide travel speed operating window: usually ± 10 ipm (± 254 mm/min) on most materials. The data listed in the charts are for making cuts with minimal dross.

Following the PAC620 beveling torch operating data charts are the operating data charts for the PAC620 configured as a standard cutting torch.

Before cutting, check all settings and adjustments and check for damaged torch parts and worn consumable parts.

PAC620 Torch - Beveling Consumables

Operating Data Chart - w/PAC-500 system
Mild Steel or Stainless Steel - Nitrogen Plasma

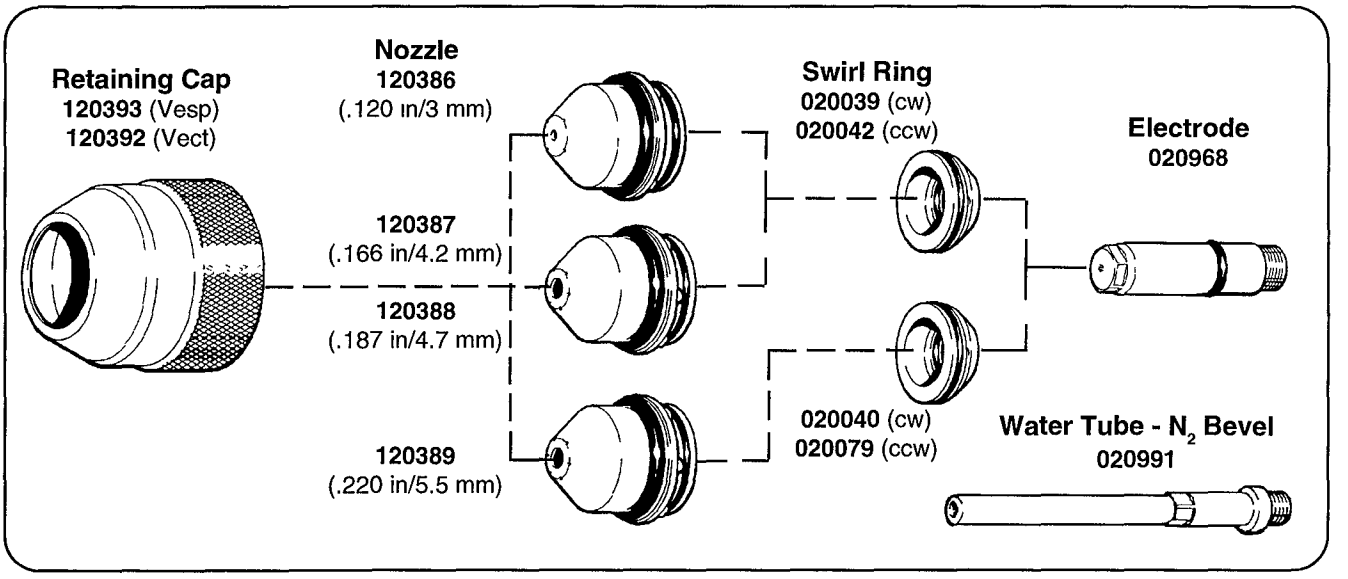


Nozzle	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
.120 260A max.	.035	1	30	45	125	230	1/8	3	425	10800
	.075	2	30	45	130	230	1/8	3	285	7240
	1/8	3	30	45	145	240	3/16	5	190	4825
	1/4	6	30	45	155	240	3/16	5	145	3680
.166 400A max.	1/8	3	45	62	125	290	1/4	6	170	4320
	1/4	6	45	62	135	340	1/4	6	140	3555
	3/8	10	45	62	145	360	1/4	6	120	3050
	1/2	13	45	62	145	380	5/16	8	90	2285
	3/4	19	45	62	150	400	5/16	8	50	1270
	1	25	45	62	155	400	3/8	10	30	760
.187 600A max.	1/2	13	55	65	140	480	3/8	10	100	2540
	3/4	19	55	65	145	500	3/8	10	70	1780
	1	25	55	65	150	550	3/8	10	60	1525
	1-1/2	38	55	65	165	580	3/8	10	30	760
	2	50	55	65	175	600	7/16	11	20	510
.220 750A max.	1-1/4	32	60	73	170	700	1/2	13	40	1015
	2	50	60	73	175	725	1/2	13	25	635
	3	76	60	73	185	750	5/8	16	12	300

Notes: Minimum N_2 inlet supply pressure remains at one setting of 150 psi (10.3 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting.

PAC620 Torch - Beveling Consumables

Operating Data Chart - w/PAC-500 system
Aluminum - Nitrogen Plasma

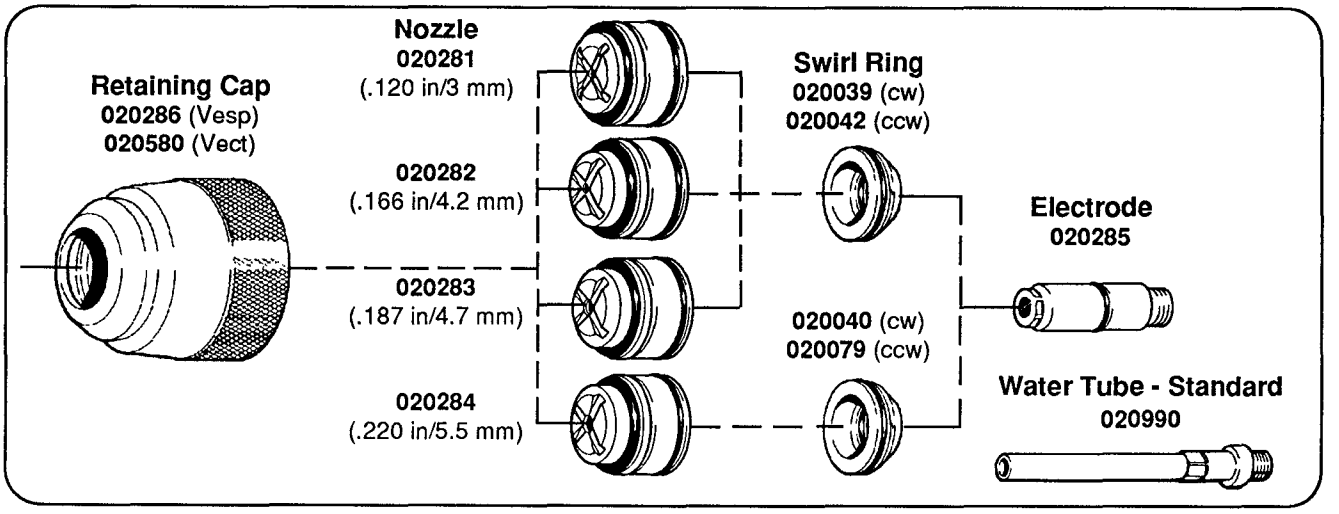


Nozzle	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
.120 260A max.	.035	1	30	45	125	240	1/8	3	520	13210
	.075	2	30	45	130	240	1/8	3	340	8635
	1/8	3	30	45	135	260	3/16	5	230	5840
	1/4	6	30	45	145	260	1/4	6	170	4320
.166 400A max.	1/8	3	55	62	140	280	1/4	6	220	5590
	1/4	6	55	62	150	315	1/4	6	165	4190
	3/8	10	55	62	150	340	1/4	6	130	3300
	1/2	13	55	62	150	360	1/4	6	110	2800
	3/4	19	55	62	150	380	5/16	8	60	1525
	1	25	55	62	165	380	3/8	10	35	890
.187 600A max.	1	25	55	65	165	500	3/8	10	70	1780
	1-1/2	38	55	65	170	600	3/8	10	35	890
	2	50	55	65	170	600	3/8	10	25	635
.220 750A max.	2	50	60	73	175	700	1/2	13	30	760
	3	76	60	73	200	750	5/8	16	20	510

Notes: Minimum N_2 inlet supply pressure remains at one setting of 150 psi (10.3 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting.

PAC620 Torch - Standard Consumables

Operating Data Chart - w/PAC-500 system
Mild Steel or Stainless Steel - Nitrogen Plasma

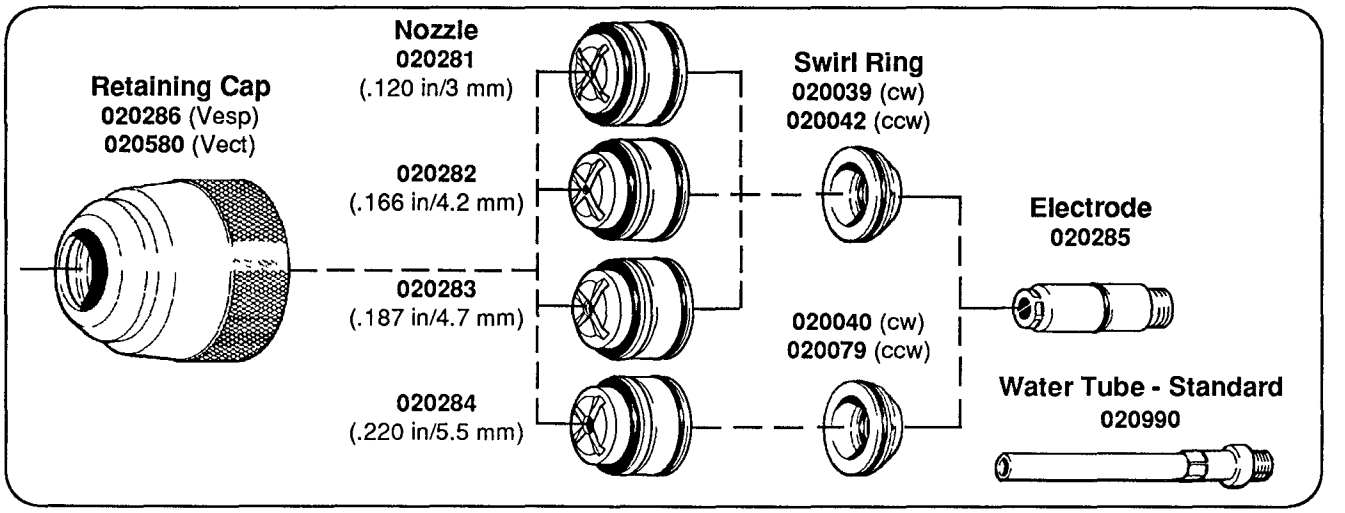


Nozzle	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
.120 260A max.	.035	1	30	45	125	250	1/8	3	450	11430
	.075	2	30	45	130	250	1/8	3	300	7620
	1/8	3	30	45	135	260	1/4	6	200	5080
	1/4	6	30	45	145	260	5/16	8	145	3685
.166 400A max.	1/8	3	45	62	140	300	1/4	6	175	4445
	1/4	6	45	62	140	350	1/4	6	145	3685
	3/8	10	45	62	145	350	1/4	6	125	3175
	1/2	13	45	62	150	400	1/4	6	95	2415
	3/4	19	45	62	150	400	5/16	8	50	1270
	1	25	45	62	155	400	3/8	10	30	760
.187 600A max.	1/2	13	45	65	145	480	5/16	8	110	2800
	3/4	19	45	65	155	500	3/8	10	70	1780
	1	25	45	65	160	550	3/8	10	60	1525
	1-1/2	38	45	65	170	600	3/8	10	30	760
	2	50	45	65	180	600	3/8	10	20	510
.220 750A max.	2	50	70	73	180	700	1/2	13	25	635
	3	76	70	73	200	750	5/8	16	12	300

Notes: Minimum N_2 inlet supply pressure remains at one setting of 150 psi (10.3 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting.

PAC620 Torch - Standard Consumables

Operating Data Chart - w/PAC-500 system
Aluminum - Nitrogen Plasma



Nozzle	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
.120 260A max.	.035	1	30	45	125	250	1/8	3	525	13335
	.075	2	30	45	130	250	1/8	3	350	8890
	1/8	3	30	45	135	260	3/16	5	230	5840
	1/4	6	30	45	145	260	1/4	6	170	4320
.166 400A max.	1/8	3	45	62	140	300	1/4	6	230	5840
	1/4	6	45	62	145	325	1/4	6	180	4570
	3/8	10	45	62	150	350	1/4	6	150	3810
	1/2	13	45	62	150	375	1/4	6	120	3050
	3/4	19	45	62	160	400	5/16	8	60	1525
	1	25	45	62	170	400	3/8	10	35	890
.187 600A max.	1	25	45	65	155	500	3/8	10	80	2030
	1-1/2	38	45	65	170	550	3/8	10	45	1145
	2	50	45	65	180	600	3/8	10	30	760
.220 750A max.	2	50	70	73	180	700	1/2	13	30	760
	3	76	70	73	200	750	5/8	16	15	380

Notes: Minimum N_2 inlet supply pressure remains at one setting of 150 psi (10.3 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting.

CHANGING CONSUMABLE PARTS

WARNING

Always disconnect the power supply from the main power source before inspecting or changing the torch parts.

The consumable parts should be inspected before cutting for wear, and replaced when needed. **Always place the consumables on a clean, dry, oil free surface after removing. Dirty consumables can cause the torch to malfunction.** Refer to Figure 3a-5.

Removal and Inspection

1. Unscrew the **Retaining Cap**.
2. Remove the **Nozzle** from the **Torch Main Body**. Tools are not necessary to remove the nozzle. Check the ceramic portion of the nozzle for signs of wear and arcing.
3. Remove the **Electrode** by unscrewing it from the torch head using a 7/16" (11 mm) socket wrench (a 7/16" (11 mm) socket wrench comes in the Spare Parts Kit #028742). Replace the electrode if the crater in the center of the insert gets excessively large (greater than .050 inch (1.3 mm) deep).
4. Remove the **Swirl Ring** from the electrode and inspect it for plugged holes or other damage.
5. If the tip of the **Water Tube** is damaged at all, see *Changing the Water Tube* on page 3a-16.

Replacement

Before replacing the consumable parts, clean the current ring in the torch. Use a clean paper towel or cotton swab to remove any dirt, grease, etc., from the current ring.

1. Replace the electrode by screwing it back into the torch head. Use the 7/16" (11mm) socket wrench to tighten down the electrode. **Do not overtighten.**
2. Prior to installing the swirl ring, apply a light coating of silicone grease to both O-rings. As a guideline, you should be able to feel the grease on your fingers, but not see it. **Do not use an excessive amount of grease.** The swirl ring ports can become plugged by grease, causing improper gas flow during operation.

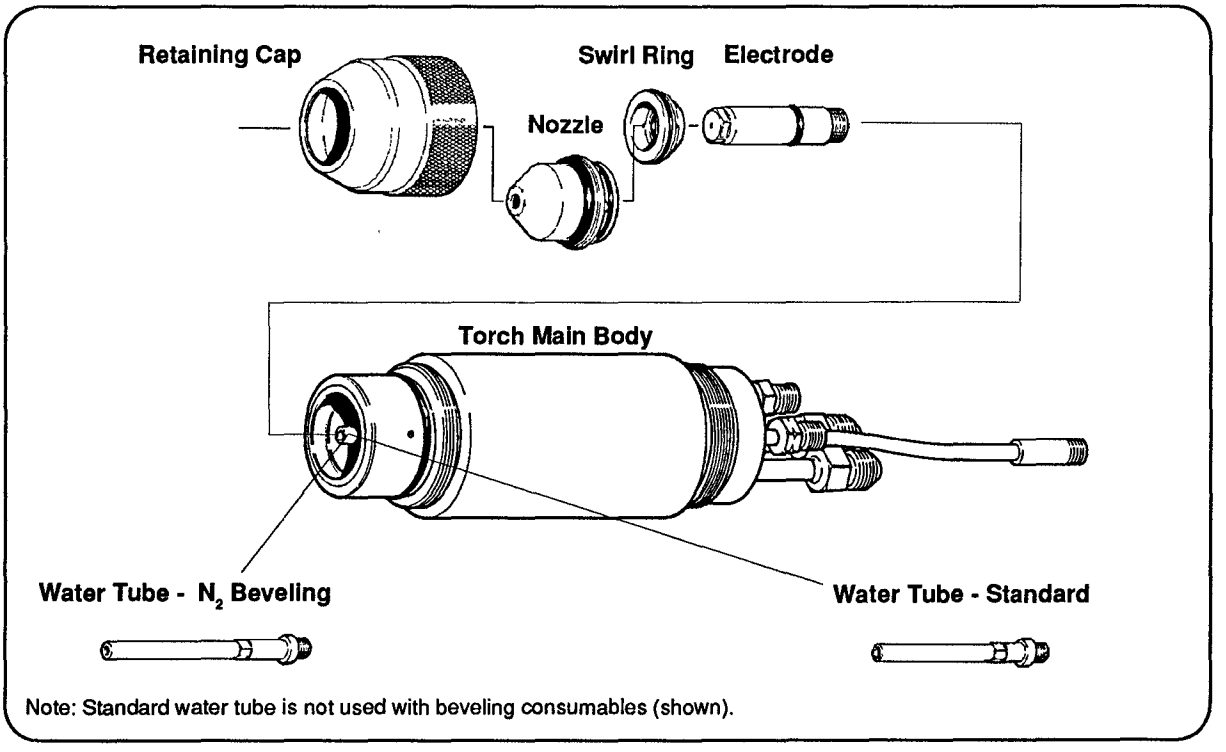
When installing the swirl ring, place the smaller diameter end towards the torch main body.

3. When replacing the nozzle, apply a light coat of silicone grease to the O-ring on the O.D. of the copper portion of the nozzle. Insert the nozzle into the torch and push it into place.

4. Replace the retaining cap by **tightening it snugly by hand to insure good electrical contact** between the nozzle and the torch.

   If the cap does not go on easily, clean the threads on the torch body and the retaining cap and apply a small amount of silicone grease to the O-ring located just below the threads of the torch main body.

   Note: Failure to tighten the retaining cap snugly (or to keep the threads and current ring clean) will result in pitting of the stainless steel current ring. This can cause gas and water leaks around the upper nozzle O-ring, impairing cut quality. However, the **retaining cap should be tightened by hand only.**



Note: Standard water tube is not used with beveling consumables (shown).

Figure 3a-5 Changing Consumable Parts

Changing the Water Tube

Problems and causes you may find with a defective or improperly installed water tube:

- Short electrode life: Water tube not screwed in tightly; wrong water tube for consumables
- Flow switch interlock shutting down the system: Water flow restricted due to loose water tube.
- Humming or rattling sound coming from the torch: Water tube bent or loose

If you suspect a problem with the water tube, you may need to replace it.

1. Disconnect power supply from power source.
2. Remove all consumables from torch (see *Changing Consumable Parts* - pg. 3a-14).
3. Verify that the correct water tube is installed - The standard water tube (020990) is recessed about 5/64 of an inch (2 mm) from the end of the torch head. The nitrogen beveling water tube (020991) extends about 19/64 of and inch (7.5 mm) from the end of the torch head. Note: part numbers are laser engraved on the water tubes.
4. Look for any damage or bends in the water tube.
5. Remove and replace the water tube by using the water tube wrench (027347) supplied in the parts kit (028742) - Fig. 3a-6. **When installing water tube, do not overtighten!** Snug down by hand only.

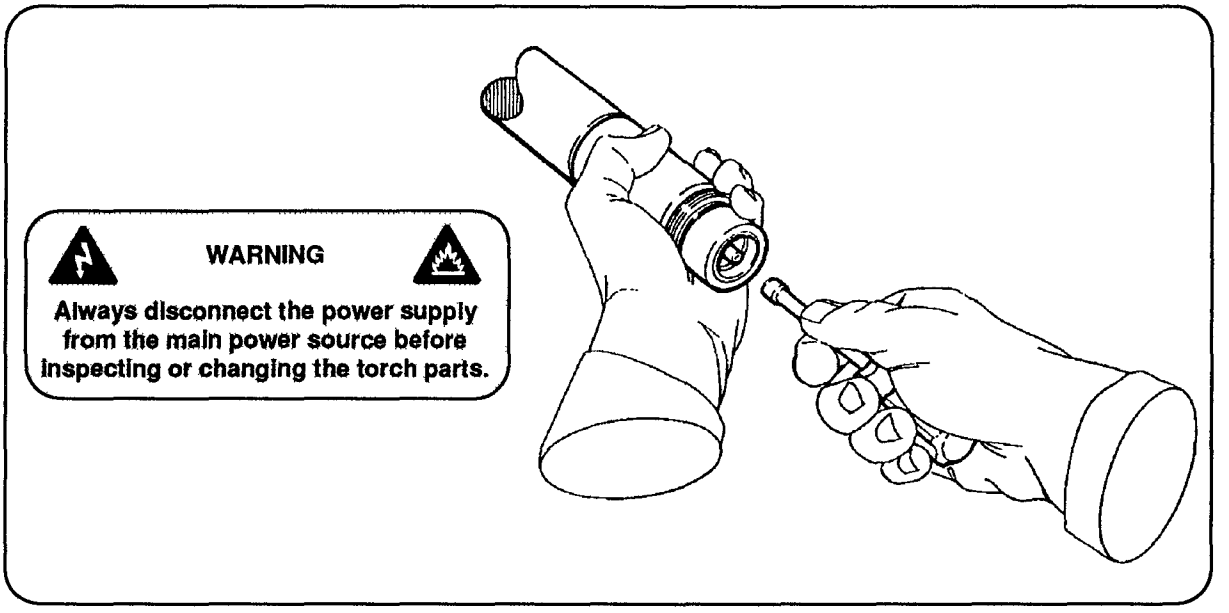


Figure 3a-6 Changing the Water Tube

Section 3b INSTALLATION & OPERATION - w/HT400E/ 2X HT400E

In this section:

INSTALLATION

To install the PAC620 to the HT400E/2X HT400E systems, follow the instructions below. You must use the beveling flow console hoses to make connections between the flow console and the HF console. See page 4-13 for hose package part numbers.

Flow Console Installation - Fig. 3b-1

1. Make connections from gas supplies to O_2 In and N_2 In at the rear of the flow console(s).
2. Make connections from O_2 Out and N_2 Out of the flow console(s) to the O_2 IN and N_2 IN of the HF console(s).
3. Remove the Water IN Nozzle(s) #4 plumbing fitting from the HF Console(s), and replace with the #6 fitting (015012) that comes with the parts kit (028759).
4. Make connections from Water IN Nozzle of HF console(s) to H_2O Out fitting of flow console(s).
5. Make connections from Water OUT Nozzle fitting of HF console(s) to H_2O In fitting of flow console(s).

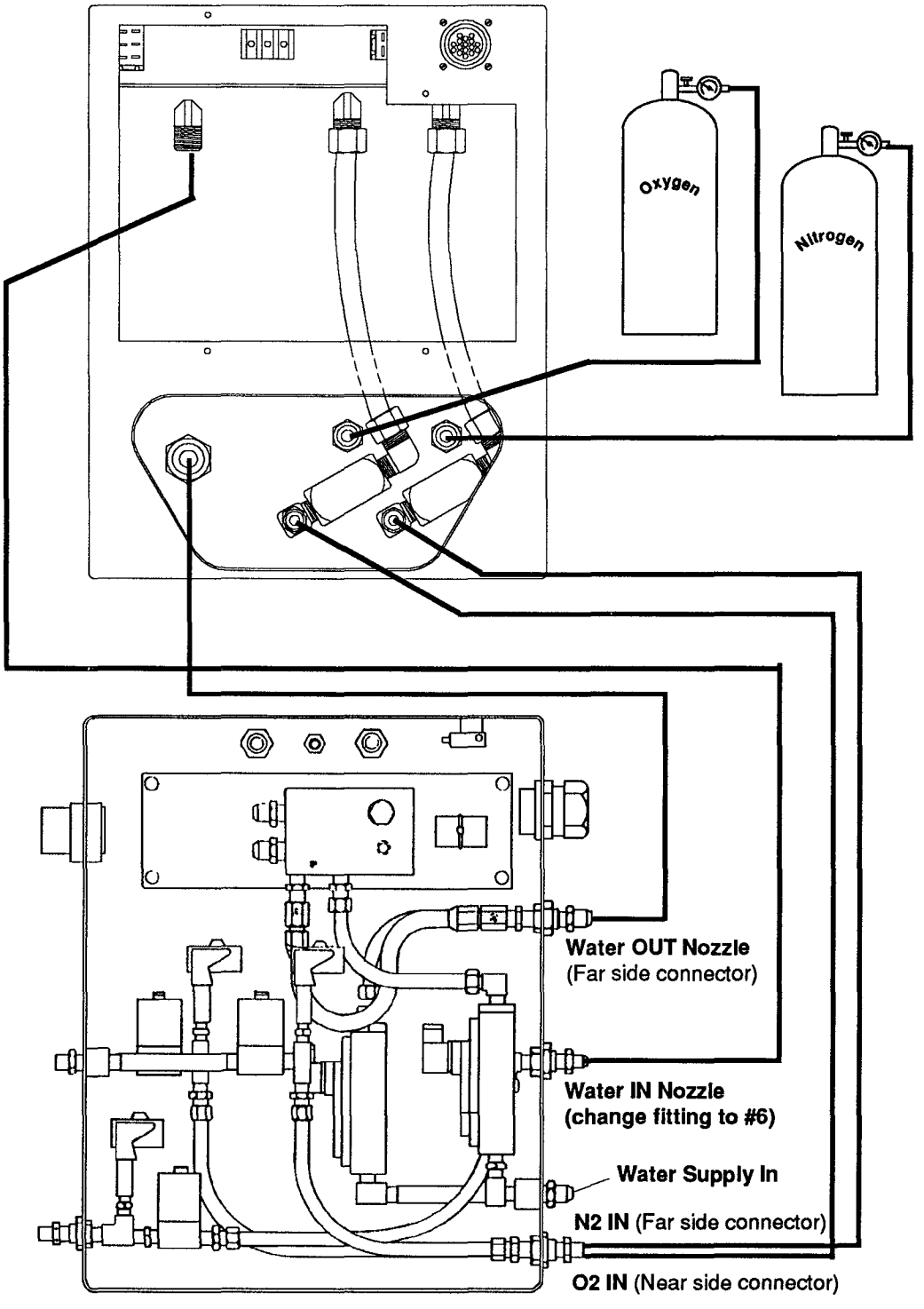


Figure 3b-1 Flow Console to HF Console Connections

Torch Installation - Fig. 3b-2

Procedure below is for the HT400E. See IM73 for hookup and wiring diagrams to the 2X HT400E system.

1. Mount the PAC620 torch to the torch holder on the guidance machinery.
2. Route the torch leads to the high-frequency console. Support leads as necessary.
3. Pass the two water-cooled leads (red and green band colored) and the pilot arc lead (white) from the torch through the brass ring of the high-frequency console.
4. Connect the water-cooled leads to the cathode block as shown in Fig. 3b-2 Be certain to connect red-banded lead to red fitting and green-banded lead to green fitting.
5. Connect the pilot arc lead to the air core transformer as shown in Fig. 3b-2.
6. Connect the green hose to the torch gas-out connector of the high-frequency console and the red hose to the water-out connector.

This completes the installation of the PAC620 torch to the HT400E high-frequency console. Refer to instruction manual IM74 for more information and wiring diagrams on the HT400E system.

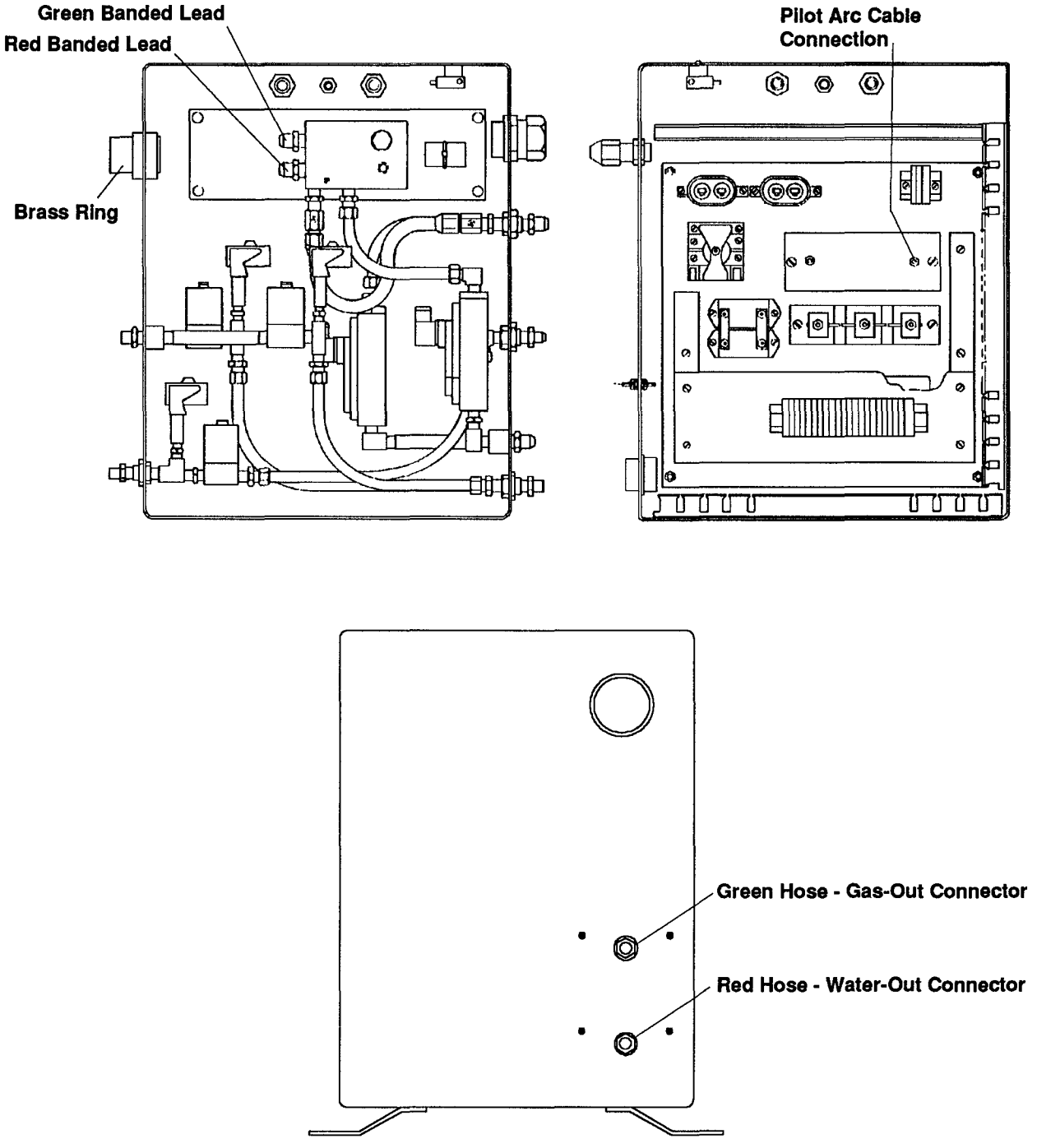


Figure 3b-2 HF Console (Slave shown) - Torch Connections

OPERATION

WARNING

Before operating the PAC620 , you must read the *Safety* section of this manual thoroughly!

The following procedure outlines the operation of the HT400E system with the PAC620 beveling torch from the application of 3Ø power to the end of a cut using oxygen as the plasma gas. See IM-74: HT400E instruction manual for a description of the HT400E 400-amp system. See also IM73: 2X HT400E instruction manual for a description of the 2X HT400E system, and the *Sequence of Events* section for operation procedure with the 2XHT400E system..

Operator Action:

1. From the Operating Data Charts determine the correct nozzle size for the type and thickness of material you are cutting. See *Changing Consumable Parts* to insert nozzle.

2. Turn on the fused disconnect switches supplying 3Ø power to the HT400E system.

3. If using a water-chiller instead of a water supply, activate by pressing the start button on the front of the chiller.

4. Place the N_2/O_2 switch on the flow console to O_2.

5. Set the machine motion delay potentiometer on the power supply control board to the desired setting (0.1 to 4 seconds).

6. From the Operating Data Charts determine the correct voltage setting for the type and thickness of metal you are cutting. Set the voltage on the V/C remote.

7. From the Operating Data Charts determine the correct current setting for the type and thickness of metal you are cutting. Set the current on the V/C remote.

8. From the Operating Data Charts determine the correct flow rates for injection water and gas. Set the flow rates by first using one of the following methods:

   A. Place the HT400E flow console Run/Set switch to Set.

   B. Place the remote V/C control Test/Run switch to Test and push the Start button.

   C. At the machine I/O console, place the Test/Run switch to Test and then activate the Start switch.

Turn the metering valves on the flow console to set flow rates.

9. Place the Run/Set switch to Run. If using remote switches, activate the Stop switch and then place the Test/Run switch to the Run position.

10. If using IHS, place the master IHS switch to On.

11. If using automatic torch control, place AUTO/MANUAL switch to AUTO.

12. Press Start switch.

Automated Action:

- If using IHS, probes will extend down and torch will index down toward work after .5 second delay. IHS probes will then retract.
- Water and gas solenoids in HF console activated. Water and gas flow for 2 seconds.
- Main contactor closes if all interlocks are satisfied.
- Power supply initiates a pilot arc after .5 seconds.
- Transfer of arc if workpiece is at correct distance from torch. Current ramped up to preset values on V/C remotes.
- Machine motion and cutting begins.
- .5 seconds after arc transfer, automatic torch height control is activated.
- Arc extinguished, cutting stops due to:

    A. Stop signal to power supply

    B. Plate overrun

    C. Water or gas pressures drop too low

    D. Interlock switch(es) deactivated

    E. Test/Run switch put in Test position.

OPERATING TIPS

- Do not exceed the current limit for each nozzle. The limits are:

  .120 nozzles - 260 amps maximum
  .166 nozzles - 400 amps maximum
  .187 nozzles - 600 amps maximum
  .220 nozzles - 750 amps maximum

- When the operating range of two nozzles overlap, use the larger nozzle to produce the best cut quality.

- Do not pierce metal greater than 1-1/2 inches with the .187 nozzle.

- Do not pierce metal greater than 2 inches with the .220 nozzle.

COMMON CUTTING FAULTS

- Torch pilot arc will initiate, but will not transfer. Cause can be:

  1. Work cable connection on cutting table not making good contact.

- The workpiece is not totally penetrated, and there is excessive sparking on top of the workpiece. Causes can be:

  1. Current is set too low (check *Operating Data Chart* information).
  2. Cut speed is too high (check *Operating Data Chart* information).
  3. Torch parts are worn (see *Changing Consumable Parts*).
  4. Metal being cut is too thick.

- Dross forms on the bottom of the cut. Causes can be:

  1. Cutting speed is too slow or too fast (check *Operating Data Chart* information).
  2. Arc current set too low (check *Operating Data Chart* information).
  3. Torch parts are worn (see *Changing Consumable Parts*).

- Short consumable life. Causes can be:

  1. Arc current, arc voltage, travel speed, motion delay, gas and/or water flow rates, or initial torch height not set as specified in *Operating Data Chart.*

  2. Contaminated gas. Gases must be 99.995% pure.

  3. Leaking gas hoses or gas fittings.

TECHNICAL QUESTIONS

Claims for defective merchandise -- All units shipped from Hypertherm undergo rigorous quality control testing. However, if your system does not function correctly:

1. Recheck all pre-installation and installation requirements and connections in HT400E Instruction Manual: IM74 (#800740), and/or 2X HT400E Instruction Manual: IM73 (#800730)..

2. If you are unable to solve the problem, call your distributor. He/she will be able to help you, or refer you to an authorized Hypertherm repair facility.

3. If you need assistance, call Customer Service at 1-800-643-0030 or Field Service at 1-800-643-9878.

OPERATING DATA CHARTS

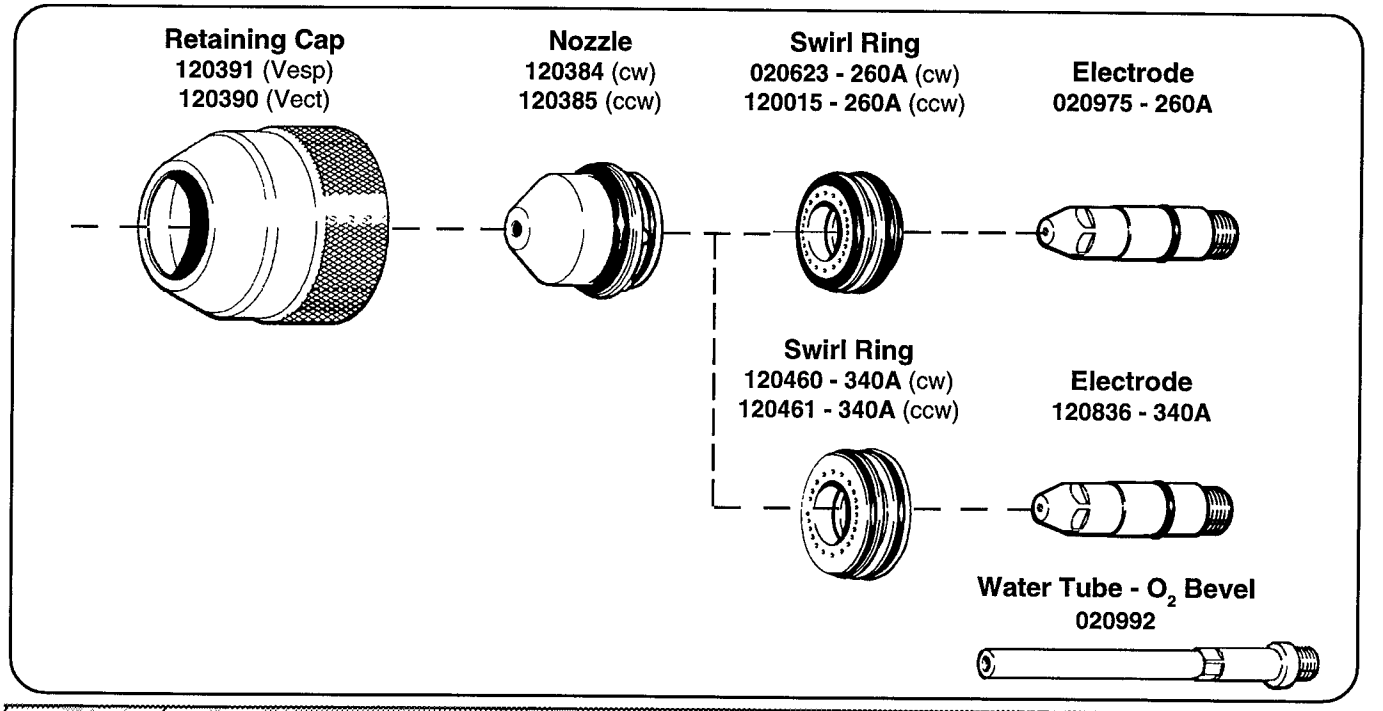
The Operating Data Charts on the following pages provide the operator the necessary information for successful plasma arc cutting with the PAC620 torch on the HT400E or 2X HT400E systems. The HT400E/2X HT400E provide a wide travel speed operating window: usually ± 10 ipm (± 254 mm/min) on most materials. The data listed in the charts are for making 90° cuts with minimal dross.

Before cutting, check all settings and adjustments and check for damaged torch parts and worn consumable parts.

PAC620 Torch - Beveling Consumables

Operating Data Chart - w/HT400E/2X HT400E systems

Mild Steel - Oxygen Plasma



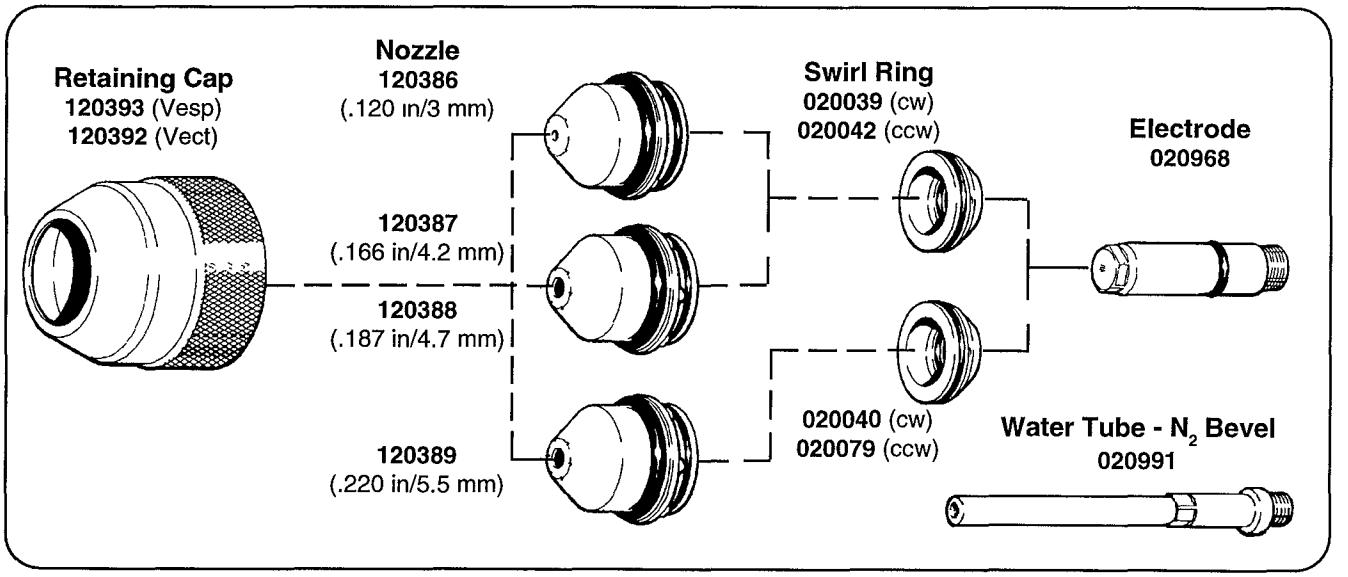
Electrode and Swirl Ring	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
260A	1/4	6	36	73	120	260	1/8	3	165	4190
	1/2	13	36	73	125	260	1/8	3	100	2540
	3/4	19	36	73	135	260	3/16	5	65	1650
	1	25	36	73	140	260	1/4	6	45	1145

Electrode and Swirl Ring	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
340A	1/2	13	45	73	130	340	3/16	5	110	2800
	3/4	19	45	73	140	340	3/16	5	85	2160
	1	25	45	73	145	340	1/4	6	65	1650
	1-1/4	32	45	73	145	340	1/4	6	45	1140

Notes: Minimum O_2 inlet supply pressure remains at one setting of 120 psi (8.2 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting.

PAC620 Torch - Beveling Consumables

Operating Data Chart - w/HT400E/2X HT400E systems
Mild Steel or Stainless Steel - Nitrogen Plasma

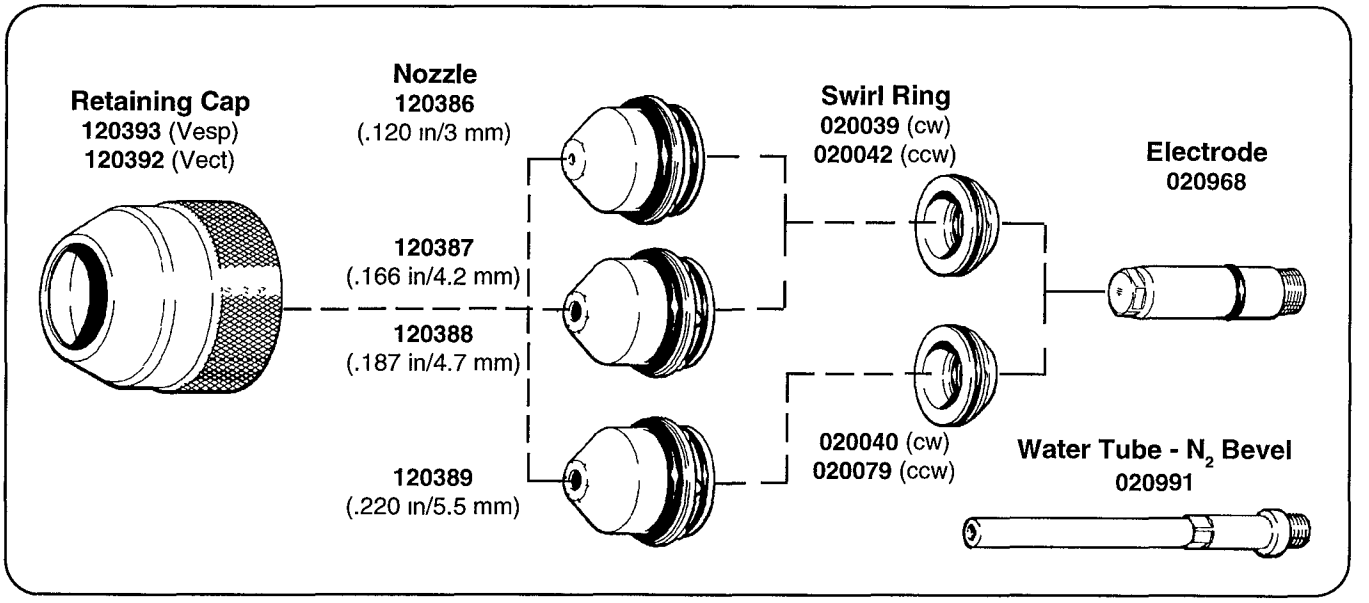


Nozzle	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
.120 260A max.	.035	1	30	45	125	230	1/8	3	425	10800
	.075	2	30	45	130	230	1/8	3	285	7240
	1/8	3	30	45	145	240	3/16	5	190	4825
	1/4	6	30	45	155	240	3/16	5	145	3680
.166 400A max.	1/8	3	45	62	125	290	1/4	6	170	4320
	1/4	6	45	62	135	340	1/4	6	140	3555
	3/8	10	45	62	145	360	1/4	6	120	3050
	1/2	13	45	62	145	380	5/16	8	90	2285
	3/4	19	45	62	150	400	5/16	8	50	1270
	1	25	45	62	155	400	3/8	10	30	760
.187 600A max.	1/2	13	55	65	140	480	3/8	10	100	2540
	3/4	19	55	65	145	500	3/8	10	70	1780
	1	25	55	65	150	550	3/8	10	60	1525
	1-1/2	38	55	65	165	580	3/8	10	30	760
	2	50	55	65	175	600	7/16	11	20	510
.220 750A max.	1-1/4	32	60	73	170	700	1/2	13	40	1015
	2	50	60	73	175	725	1/2	13	25	635
	3	76	60	73	185	750	5/8	16	12	300

Notes: Minimum N_2 inlet supply pressure remains at one setting of 150 psi (10.3 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting.

PAC620 Torch - Beveling Consumables

Operating Data Chart - w/HT400E/2X HT400E systems
Aluminum - Nitrogen Plasma

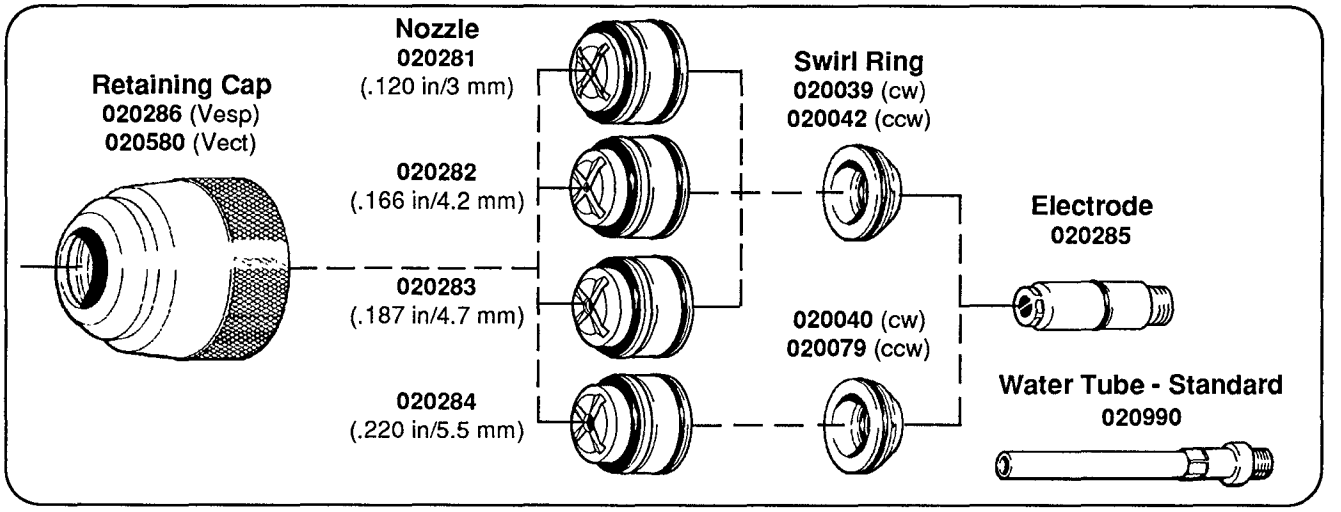


Nozzle	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
.120 260A max.	.035	1	30	45	120	240	1/8	3	520	13200
	.075	2	30	45	125	240	1/8	3	345	8760
	1/8	3	30	45	130	250	3/16	5	230	5840
	1/4	6	30	45	140	260	1/4	6	170	4320
.166 400A max.	1/8	3	55	62	140	280	1/4	6	220	5590
	1/4	6	55	62	150	315	1/4	6	165	4190
	3/8	10	55	62	150	340	1/4	6	130	3300
	1/2	13	55	62	150	360	1/4	6	110	2795
	3/4	19	55	62	150	380	5/16	8	60	1525
	1	25	55	62	165	380	3/8	10	35	890
.187 600A max.	1	25	55	65	165	500	3/8	10	70	1780
	1-1/2	38	55	65	170	600	3/8	10	35	890
	2	50	55	65	170	600	3/8	10	25	635
.220 750A max.	2	50	60	73	175	700	1/2	13	30	760
	3	76	60	73	200	750	5/8	16	20	510

Notes: Minimum N_2 inlet supply pressure remains at one setting of 150 psi (10.3 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting.

PAC620 Torch - Standard Consumables

Operating Data Chart - w/HT400E/2X HT400E systems
Mild Steel or Stainless Steel - Nitrogen Plasma

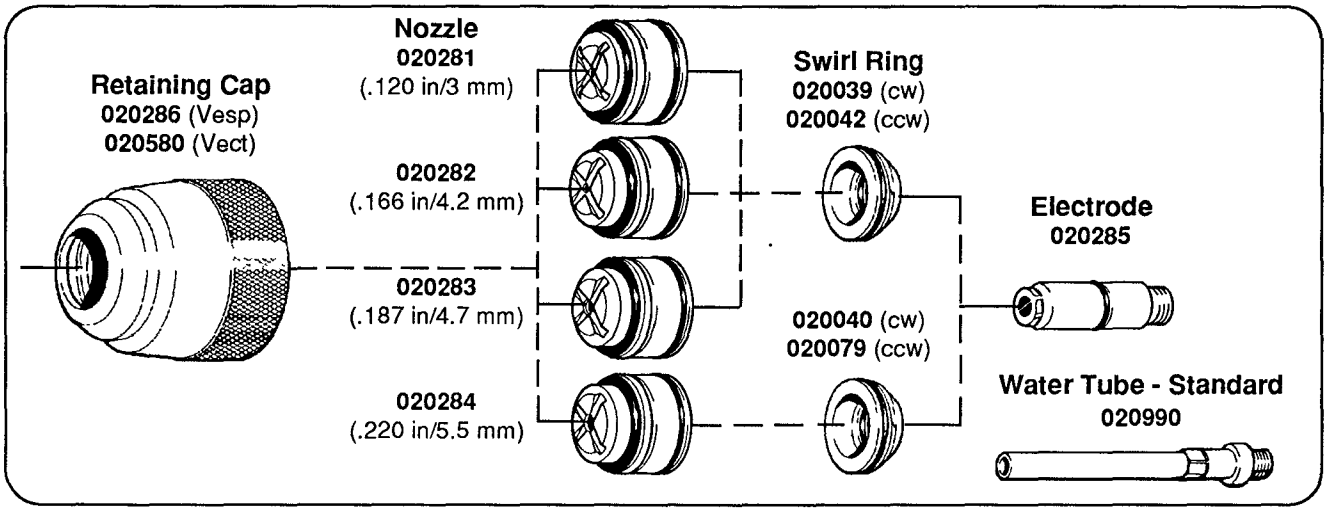


Nozzle	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
.120 260A max.	.035	1	30	45	125	250	1/8	3	450	11430
	.075	2	30	45	130	250	1/8	3	300	7620
	1/8	3	30	45	135	260	1/4	6	200	5080
	1/4	6	30	45	145	260	5/16	8	145	3685
.166 400A max.	1/8	3	45	62	140	300	1/4	6	175	4445
	1/4	6	45	62	140	350	1/4	6	145	3685
	3/8	10	45	62	145	350	1/4	6	125	3175
	1/2	13	45	62	150	400	1/4	6	95	2415
	3/4	19	45	62	150	400	5/16	8	50	1270
	1	25	45	62	155	400	3/8	10	30	760
.187 600A max.	1/2	13	45	65	145	480	5/16	8	110	2800
	3/4	19	45	65	155	500	3/8	10	70	1780
	1	25	45	65	160	550	3/8	10	60	1525
	1-1/2	38	45	65	170	600	3/8	10	30	760
	2	50	45	65	180	600	3/8	10	20	510
.220 750A max.	2	50	70	73	180	700	1/2	13	25	635
	3	76	70	73	200	750	5/8	16	12	300

Notes: Minimum N_2 inlet supply pressure remains at one setting of 150 psi (10.3 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting.

PAC620 Torch - Standard Consumables

Operating Data Chart - w/HT400E/2X HT400E systems
Aluminum - Nitrogen Plasma



Nozzle	Material Thickness (in)	(mm)	Gas Flow Setting (%)	Water Flow Setting (%)	Arc Volts (V)	Arc Current (A)	Torch-to Work Distance (in)	(mm)	Travel Speed (ipm)	(mm/min)
.120 260A max.	035	1	30	45	125	250	1/8	3	540	13715
	.075	2	30	45	130	250	1/8	3	360	9145
	1/8	3	30	45	135	260	3/16	5	240	6100
	1/4	6	30	45	145	260	1/4	6	180	4570
.166 400A max.	1/8	3	45	62	140	300	1/4	6	230	5840
	1/4	6	45	62	145	325	1/4	6	180	4570
	3/8	10	45	62	150	350	1/4	6	150	3810
	1/2	13	45	62	150	375	1/4	6	120	3050
	3/4	19	45	62	160	400	5/16	8	60	1525
	1	25	45	62	170	400	3/8	10	35	890
.187 600A max.	1	25	45	65	155	500	3/8	10	80	2030
	1-1/2	38	45	65	170	550	3/8	10	45	1145
	2	50	45	65	180	600	3/8	10	30	760
.220 750A max.	2	50	70	73	180	700	1/2	13	30	760
	3	76	70	73	200	750	5/8	16	15	380

Notes: Minimum N_2 inlet supply pressure remains at one setting of 150 psi (10.3 bar) for all material thickness.
Water chiller pump outlet pressure remains at 170 psi (11.7 bar) for all material thickness.
Set initial torch height (before piercing) to approximately twice the Torch-to-Work distance for the material you are cutting

CHANGING CONSUMABLE PARTS

WARNING

Always disconnect the power supply from the main power source before inspecting or changing the torch parts.

Inspect the consumable parts before cutting for wear, and replaced when needed. **Always place the consumables on a clean, dry, oil free surface after removing. Dirty consumables can cause the torch to malfunction.** Refer to Figure 3b-3.

Removal and Inspection

1. Unscrew the **Retaining Cap**.
2. Remove the **Nozzle** from the **Torch Main Body**. Tools are not necessary to remove the nozzle. Check the ceramic portion of the nozzle for signs of wear and arcing.
3. Remove the **Electrode** by unscrewing it from the torch head using a 7/16" (11mm) socket wrench (a 7/16" (11mm) socket wrench comes in the Spare Parts Kit (028759). Replace the electrode if the crater in the center of the insert is greater than .050 inch (1.3 mm) deep. Use the electrode gauge assembly (004147) to check crater depth.
4. Remove the **Swirl Ring** from the electrode and inspect it for plugged holes or other damage.
5. If the tip of the **Water Tube** is damaged at all, see *Changing the Water Tube* on page 3b-17.

Replacement

Before replacing the consumable parts, clean the **Current Ring** in the torch. Use a clean paper towel or cotton swab to remove any dirt, grease, etc., from the current ring.

1. Replace the electrode by screwing it back into the torch head. Use the 7/16" (11mm) socket wrench to tighten down the electrode. **Do not overtighten.**
2. Prior to installing the swirl ring, apply a light coating of silicone grease to both O-rings. As a guideline, you should be able to feel the grease on your fingers, but not see it. **Do not use an excessive amount of grease.** The swirl ring ports can become plugged by grease, causing improper gas flow during operation.

When installing the swirl ring, make sure to place the smaller diameter end up toward the rear of the torch.

3. When replacing the nozzle, apply a light coat of silicone grease to the O-ring on the O.D. of the copper portion of the nozzle. Insert the nozzle into the torch and push it into place.

4. Replace the retaining cap by **tightening it snugly by hand to insure good electrical contact** between the nozzle and the torch.

   If the cap does not go on easily, clean the threads on the torch body and the retaining cap and apply a small amount of silicone grease to the **O-ring** located just below the threads of the torch body.

   Note: Failure to tighten the retaining cap snugly (or to keep the threads and current ring clean) will result in pitting of the stainless steel current ring causing gas and water leaks around the upper nozzle O-ring, impairing cut quality. However, **the retaining cap should be tightened by hand only.**

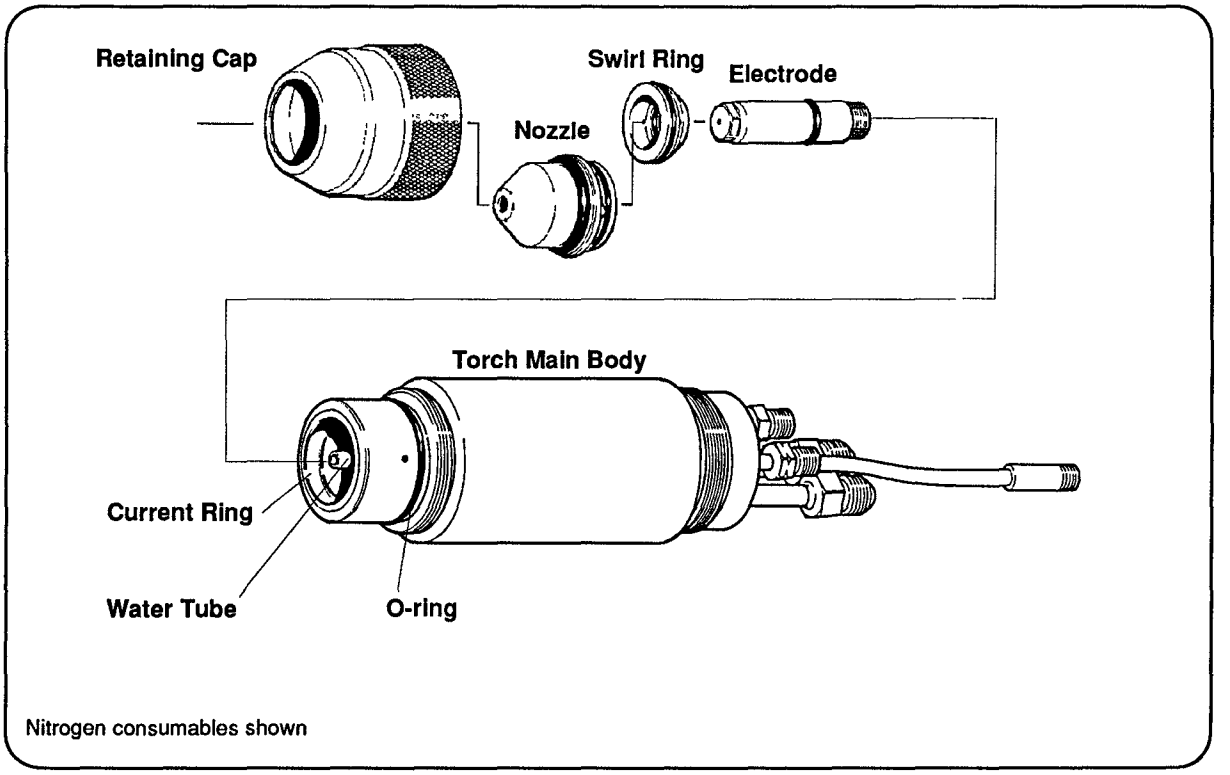


Figure 3b-3 Changing Consumable Parts

Changing the Water Tube

Problems and causes you may find with a defective or improperly installed water tube:

- Short electrode life: Water tube not screwed in tightly; wrong water tube for consumables
- Flow switch interlock shutting down the system: Water flow restricted due to loose water tube.
- Humming or rattling sound coming from the torch: Water tube bent or loose

If you suspect a problem with the water tube, you may need to replace it.

1. Disconnect power supply from power source.
2. Remove all consumables from torch (see *Changing Consumable Parts* - pg. 3b-15).
3. Verify that the correct water tube is installed - The standard water tube (020990) is recessed about 5/64 of an inch (2 mm) from the end of the torch head. The nitrogen beveling water tube (020991) extends about 19/64 of an inch (7.5 mm) from the end of the torch head. The oxygen beveling water tube (020992) extends about 23/64 of an inch (9.1 mm) from the end of the torch head. Note: part numbers are laser engraved on the water tubes.
4. Look for any damage or bends in the water tube.
5. Remove and replace the water tube by using the water tube wrench (027347) supplied in the spare parts kit - Fig. 3b-4. **When installing water tube, do not overtighten!** Snug down by hand only.

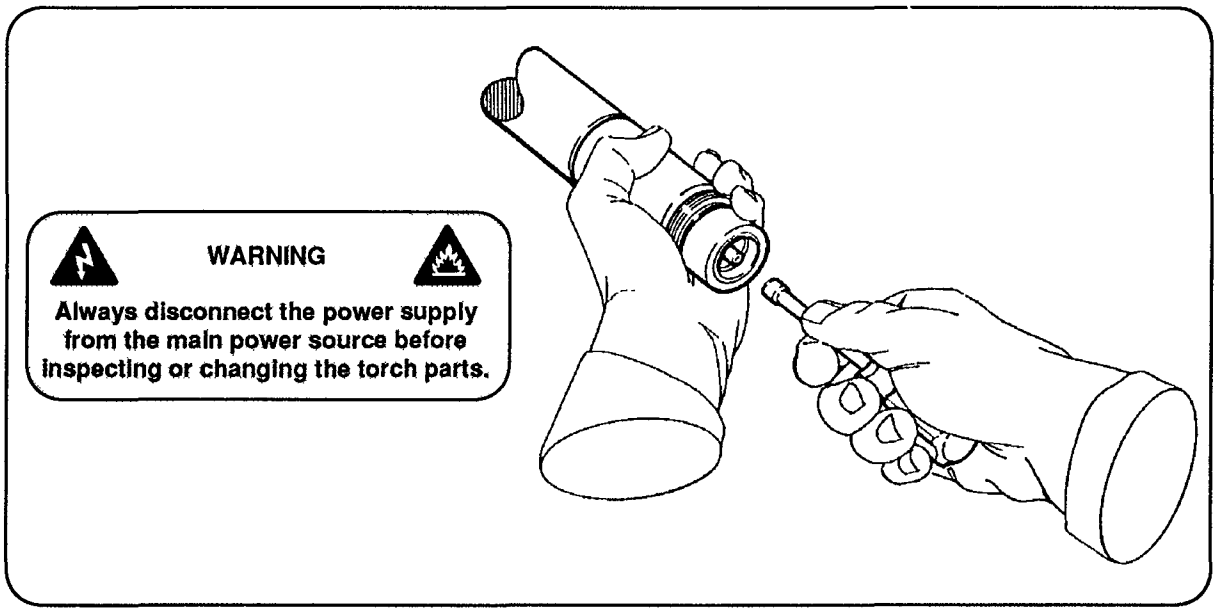


Figure 3b-4 Changing the Water Tube

Section 4 PARTS LIST

In this section:

PARTS LIST

PAC620 TORCH

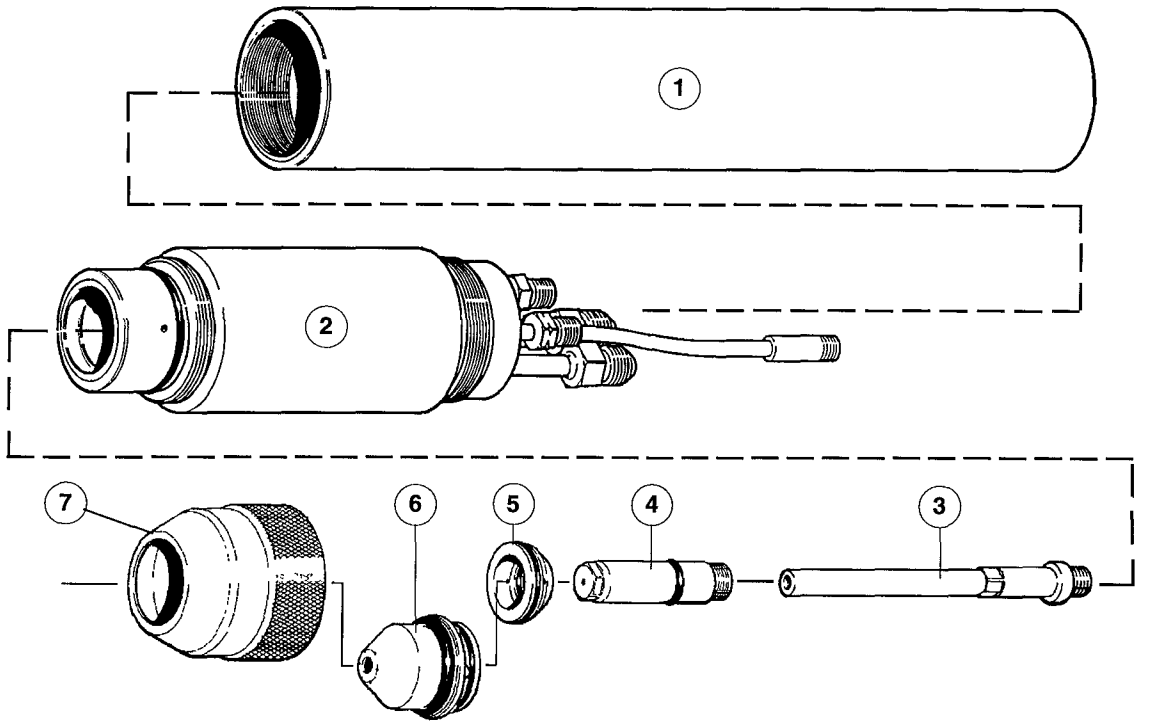


Figure 4-1 PAC620 Torch

Item	Part Number	Description	Qty.
	028741	**PAC620 Bvlng Trch Assy**	
1	020749	Mounting Sleeve:PAC610/620 Torch	1
2	**020970**	**PAC620 Bev Torch Main Body**	1
3	020991	Water Tube:620 Bev N2 Electdcool	1
4	020968	Electrode:PAC620 Bev N2	1
5	020039	Swirl Ring: .120/.166/.187 N2	1
6	120387	Nozzle:PAC620 Bev. .166 N2	1
7	120392	Ret Cap:PAC620 Bev N2 Noz Vectra	1

Item	Part Number	Description	Qty.
	128067	**PAC620/Precision Sleeve Bvlng Trch Assy**	
1	120161	13100 Trch Mounting Sleeve	1
2	**020970**	**PAC620 Bev Torch Main Body**	1
3	020991	Water Tube:620 Bev N2 Electdcool	1
4	020968	Electrode:PAC620 Bev N2	1
5	020039	Swirl Ring: .120/.166/.187 N2	1
6	120387	Nozzle:PAC620 Bev. .166 N2	1
7	120392	Ret Cap:PAC620 Bev N2 Noz Vectra	1

CONSUMABLE PARTS KITS

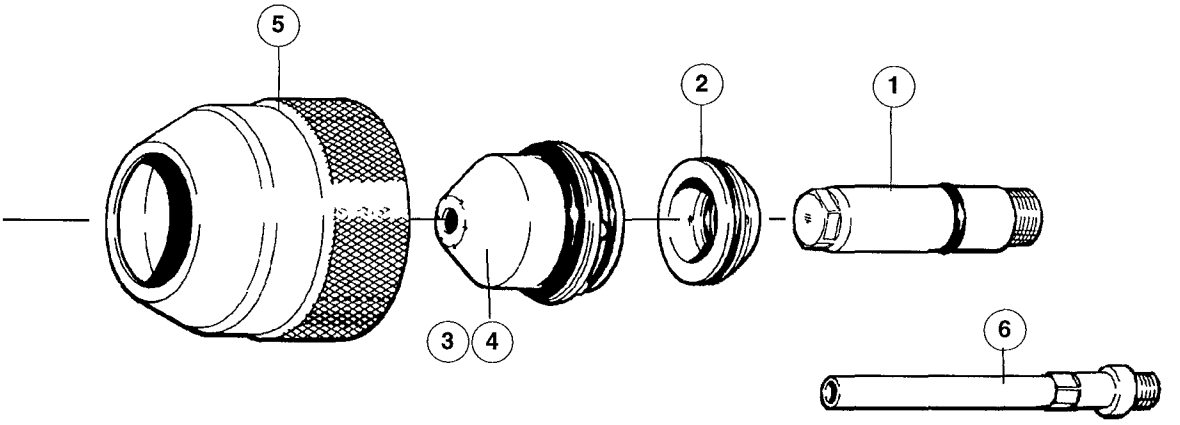


Figure 4-2 PAC620 Beveling Nitrogen Consumables

PAC620 Beveling Nitrogen Consumable Parts Kit (028742) - For PAC-500 System - Fig. 4-2

Item	Part Number	Description	Qty.
	028742	**Parts Kit: PAC620 Bev N2 Consum**	
1	020968	Electrode	5
2	020039	Swirl Ring: .120/.166/.187 N2	2
3	120387	Nozzle: PAC620 Bev .166 N2	10
4	120388	Nozzle .187/600 Amp	5
5	120392	Ret Cap: PAC620 Bev N2 Noz (Vectra)	1
6	020990	Water Tube:400/600/170	1
	001067	Box:Gray Plastic	1
	015012	Adapter: 1/4NPT X #6 Male Brass	2
	027001	Electrode Wrench:7/16 Hex	1
	027012	Lubricant:Silicone 2-Oz Tube	1
	027347	Tool:Water Tube Replacement	1
	025028	Kit:170/400/500/600/610 O-rings	1

CONSUMABLE PARTS KITS - (Cont.)

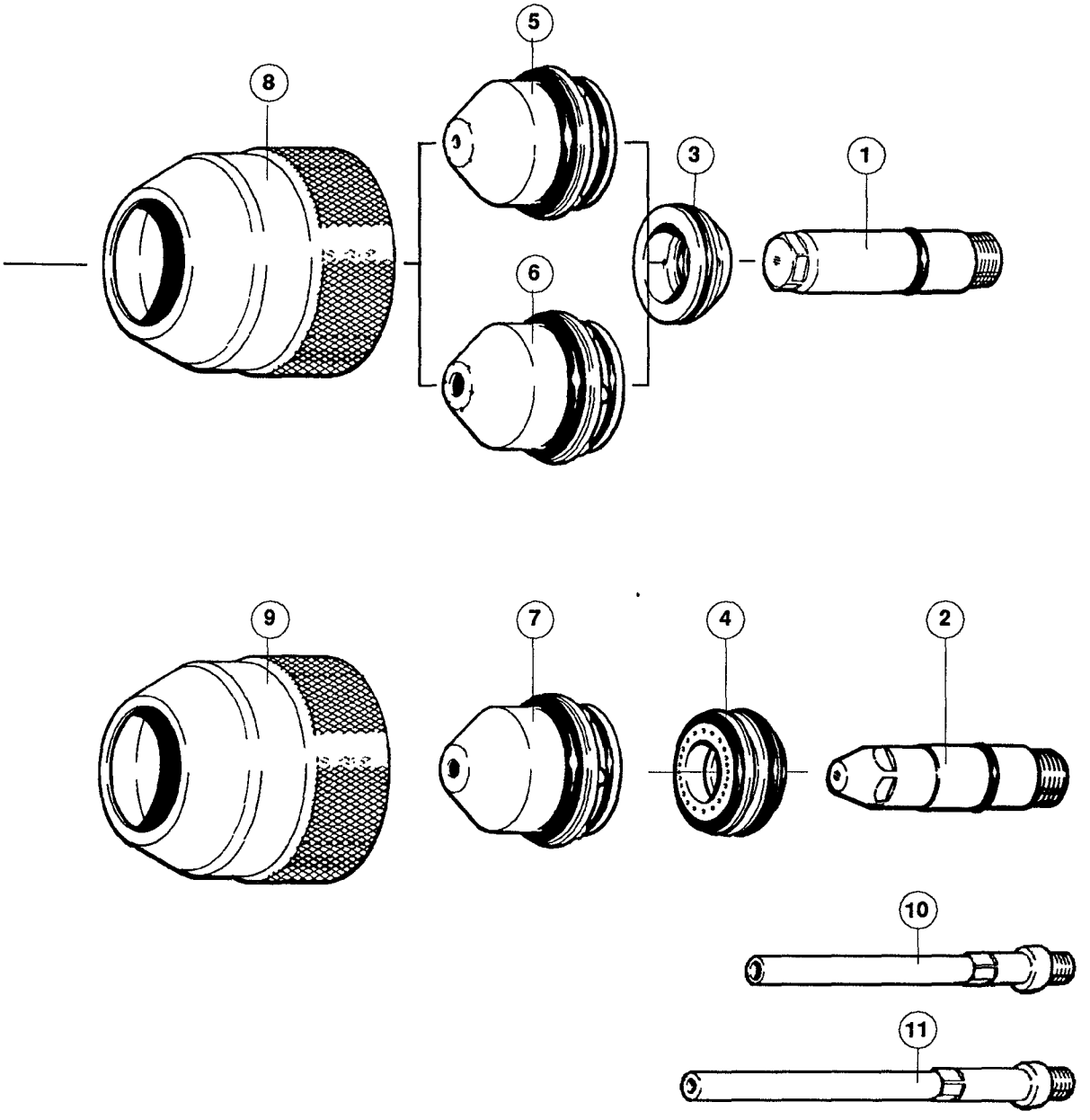


Figure 4-3 PAC620 Beveling Nitrogen/Oxygen Consumables

PAC620 Beveling Nitrogen/Oxygen Consumable Parts Kit (028759) - For HT400E/2XHT400E Systems - Fig. 4-3

Item	Part Number	Description	Qty.
	028759	**Parts Kit: PAC620 Bev N2/O2 Consum**	
1	020968	Electrode: PAC620 Bev N2	3
2	020975	Electrode: PAC620 Bev O2	5
3	020039	Swirl Ring: .120/.166/.187 N2	2
4	020623	Swirl Ring: PAC170/HT4000 Bev	2
5	120386	Nozzle: PAC620 Bev .120 N2	3
6	120387	Nozzle: PAC620 Bev .166 N2	5
7	120384	Nozzle: PAC620 Bev .099 O2	5
8	120392	Ret Cap: PAC620 Bev N2 Noz (Vectra)	1
9	120390	Ret Cap: PAC620 Bev O2 Noz (Vectra)	1
10	020990	Water Tube:400/600/170	1
11	020992	Water Tube: 620 Bev O2 Electdcool	1
	001067	Box:Gray Plastic	1
	004146	Orifice: HT400 Torch Critical	1
	004147	Electrode Gauge Assembly	1
	015012	Adapter: 1/4NPT X #6 Male Brass	2
	027001	Electrode Wrench:7/16 Hex	1
	027012	Lubricant:Silicone 2-Oz Tube	1
	027347	Tool:Water Tube Replacement	1
	025028	Kit:170/400/500/600/610 O-rings	1

PAC600 Standard Consumables Parts Kit (028358)

- For PAC-500 or HT400E/2XHT400E Systems - See pg. 3a-12 or 3b-13 for picture of consumables

Item	Part Number	Description	Qty.
	028358	**Parts Kit: PAC600 Consum**	
	001067	Box:Gray Plastic	1
	015145	Adptr:1/4NPT X G-1/4-BSPP Brass	1
	015146	Adptr:1/4NPT X G-3/8-BSPP Brass	1
	015147	Adptr:1/4NPT X G-1/2-BSPP Brass	1
	020039	Swirl Ring:.120/.166/.187 N2	2
	020282	Nozzle:PAC600 .166 N2	10
	020283	Nozzle:PAC600 .187 N2	5
	020285	Electrode:PAC600 N2	5
	020580	Ret Cap:PAC600 Tpr Noz (Vectra)	1
	025028	KIT:17/400/500/600/610 O-RING	1
	027001	Electrode Wrench:7/16 Hex	1
	027012	Lubricant:Silicone 2-Oz Tube	1
	027347	Tool:Water Tube Replacement	1

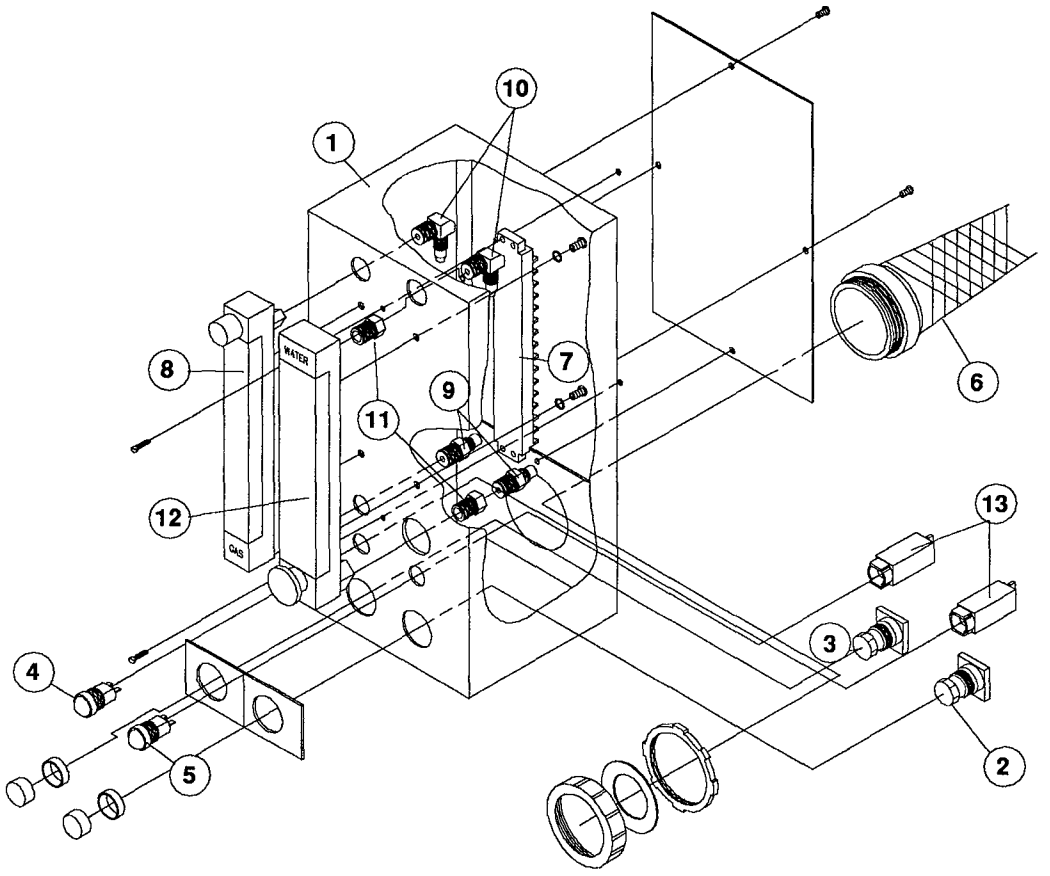


Figure 4-4 Operator's Panel - 1 Torch

OPERATOR'S PANEL - 1 TORCH (028739) - USED WITH PAC-500 SYSTEM

Item	Part Number	Description	Designator	Qty.
	028739	**Operator's Panel, 1-Torch**		
1	001448	Enclosure, 1 Torch		1
2	005017	Switch, ON/OFF	1SS	1
3	005018	Switch, TEST/RUN	2SS	1
4	109009	Plt Lt: Wht 6VDC	1LT	1
5	109008	Plt Lt: Grn 6VDC	2LT	1
6	008052	Strain Relief, Basket Weave		1
7	008073	Terminal Strip (16)	4TB	1
8	011005	Flow meter:0-10 SC/BT-8 Float w/Valve		1
	011013	Adapter Clip		
	011012	Control Knob		
	011008	Shield		
	011006	Meter Tube		
	011007	Float, Tungsten		
	011009	Wide spacer clip, SS		
9	015005	Adapter, 1/4 NPT X #4		2
10	015014	Adapter, 90°, 1/4 NPT X #4		2
11	015571	3/8 X 1/4 Reducer Bushing		2
12	011068	Flow meter 1.9 SCFM/SF-11 Float w/Valve		1
13	014182	Xfmr:AC Adapter		2

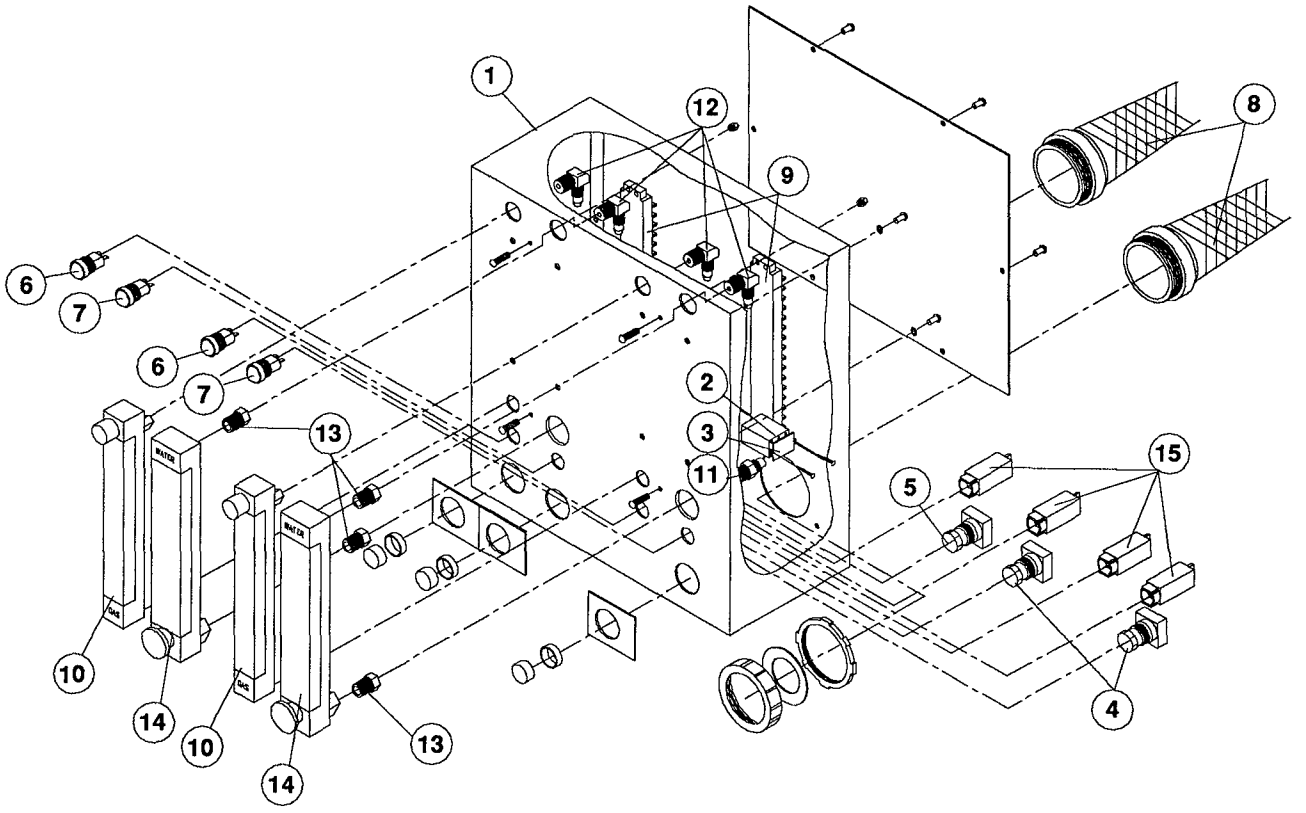


Figure 4-5 Operator's Panel - 2 Torch

OPERATOR'S PANEL - 2 TORCH (028740) - USED WITH PAC-500 SYSTEM

Item	Part Number	Description	Designator	Qty.
	028740	**Operator's Panel, 2-Torch**		
1	001449	Enclosure, 2 Torch		1
2	003040	Relay, 3PDT, 120 VAC		1
3	003026	Socket, Relay		1
4	005017	Switch, ON/OFF	1SS	2
5	005018	Switch, TEST/RUN	2SS	1
6	109009	Plt Lt: Wht 6VDC	1LT	2
7	109008	Plt Lt: Grn 6VDC	2LT	2
8	008052	Strain Relief, Basket Weave		2
9	008073	Terminal Strip (16)	4TB	2
10	011005	Flow meter:0-10 SC/BT-8 Float w/Valve		2
	011013	Adapter Clip		1
	011012	Control Knob		1
	011008	Shield		1
	011006	Meter Tube		1
	011007	Float, Tungsten		1
	011009	Wide spacer clip, SS		1
11	015005	Adapter, 1/4 NPT X #4		4
12	015014	Adapter, 90°, 1/4 NPT X #4		4
13	015571	3/8 X 1/4 Reducer Bushing		4
14	011068	Flow meter 1.9 SCFM/SF-11 Float w/Valve		2
15	014182	Xfmr:AC Adapter		4

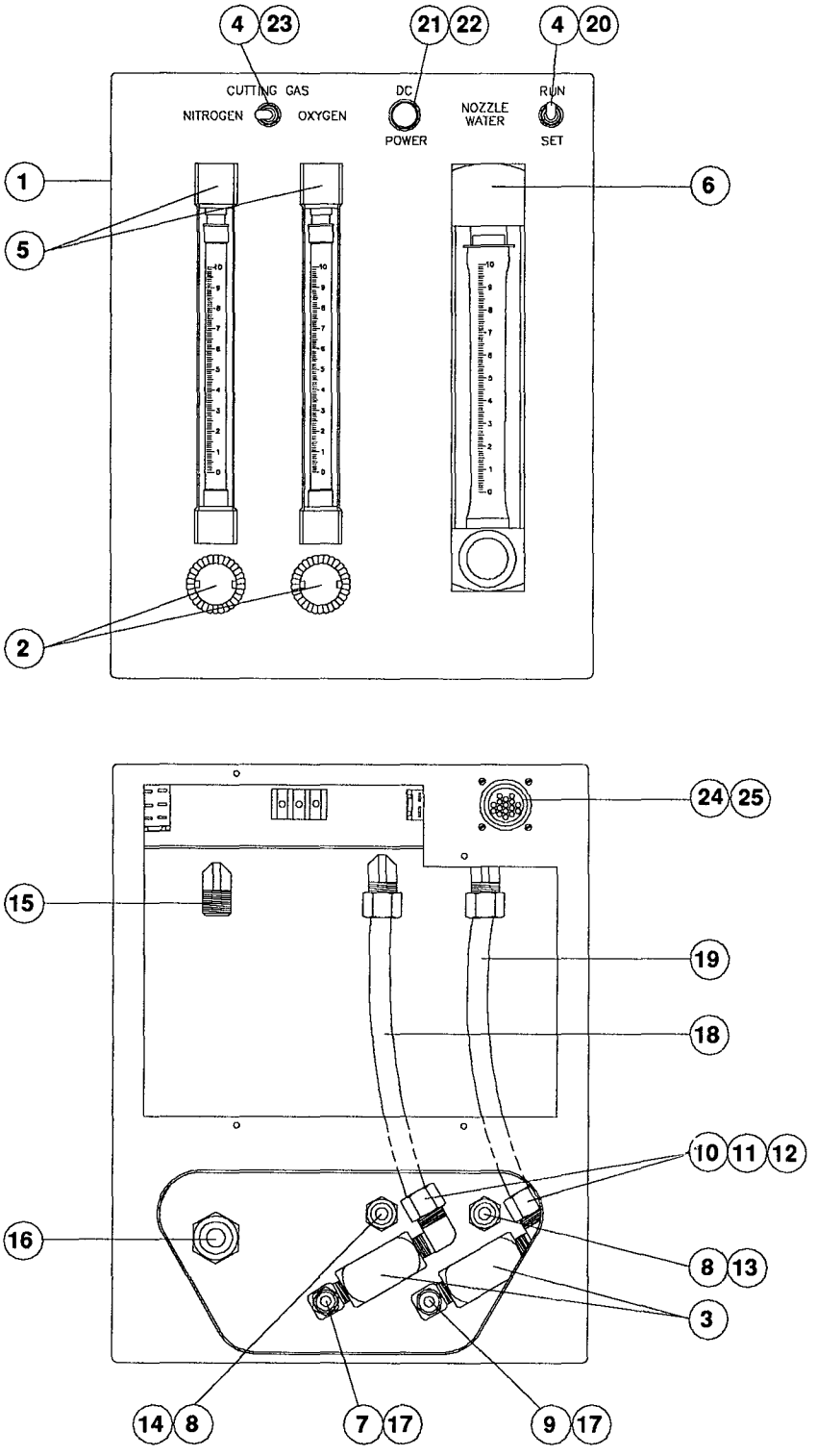


Figure 4-6 Flow Console - HT400E

FLOW CONSOLE (055026) - USED WITH HT400E/2XHT400E SYSTEMS

Item	Part Number	Description	Designator	Qty.
	055026	**HT400E Bev Flow Console**		
1	001465	Enclosure: HT400E Bev Fl Csl		1
2	004117	Cap: Needle Valve		2
3	006027	Needle Valve: 1/4 FPT .125 Orf		2
4	008106	Nut, Sw Dress		2
5	011015	Flow meter:0-10 SC/BT-8 Flt, No Vlv		2
6	011068	Flow meter 1.9 SCFM/SF-11 Flt w/Vlv		1
7	015009	Adptr:1/4NPT X RH'B' Male Brs		1
8	015073	Adptr:1/4NPT X 1/4FPT Brs		2
9	015103	Adptr:1/4NPTX RH'B'Inrt Fem Brs		1
10	015120	Adptr:1/4NPT X 1/2CPRSN 90 Brs		4
11	015125	Sleeve:1/2Plastic Tube CPRSN Delrin		4
12	015126	Insr:1/2 Plastic Tube Brs		4
13	015145	Adptr:1/4NPT X G-1/4-BSPP Brs		1
14	015146	Adptr:1/4NPT X G-3/8-BSPP Brs		2
15	015257	Adptr:3/8 NPT X #6 Male 90 Brs		1
16	015258	Adptr:3/8 NPT X #6 Male Brs		1
17	015532	Street Elbow:1/4 90 Brs		2
18	046042	Tubing:1/2"OD .063W Blue Nylon		.875'
19	046043	Tubing:1/2"OD .063W Black Nylon		.875'
	029212	**Harness:HT400E Flow Console**		1
20	005041	Toggle SW:DP Maint ON/ON	S1	1
21	109008	Plt Lt: Grn 6VDC	L1	1
22	014182	Xfmr:AC Adapter		1
23	005109	SW:DPDT 5A Lever Lock	S2	1
24	008193	Rcpt Shell:CPC 17-16 Std Sex		1
25	008205	Pin:18-16 AWG Type III + CRP		10

PARTS LIST

TORCH LEAD ASSEMBLIES

Part No.	Description	Length
028137	Shielded Torch Leads,	10 Ft
028138	Shielded Torch Leads,	15 Ft
028139	Shielded Torch Leads,	20 Ft
028140	Shielded Torch Leads,	25 Ft
028141	Shielded Torch Leads,	30 Ft
028142	Shielded Torch Leads,	35 Ft
028143	Shielded Torch Leads,	40 Ft

OPERATOR'S PANEL LEADS (STNDRD CNTRL CSL - PAC-500)

Part No.	Description	Length
028144	Leads, Operator's Panel/Std Csl	5 Ft
028145	Leads, Operator's Panel/Std Csl	10 Ft
028146	Leads, Operator's Panel/Std Csl	15 Ft
028147	Leads, Operator's Panel/Std Csl	20 Ft
028148	Leads, Operator's Panel/Std Csl	25 Ft
028149	Leads, Operator's Panel/Std Csl	30 Ft

OPERATOR'S PANEL LEADS (UL CNTRL CSL - PAC-500L)

Part No.	Description	Length
028186	Leads, Operator's Panel/UL Csl	5 Ft
028187	Leads, Operator's Panel/UL Csl	10 Ft
028188	Leads, Operator's Panel/UL Csl	15 Ft
028189	Leads, Operator's Panel/UL Csl	20 Ft
028190	Leads, Operator's Panel/UL Csl	25 Ft
028191	Leads, Operator's Panel/UL Csl	30 Ft

BEVELING FLOW CONSOLE HOSES (FLOW CSL/HF CSL - HT400E)

Part No.	Description	Length
028753	Hoses, 400E Bev Fl Csl/HF Csl	25 Ft
028754	Hoses, 400E Bev Fl Csl/HF Csl	50 Ft
028755	Hoses, 400E Bev Fl Csl/HF Csl	75 Ft
028756	Hoses, 400E Bev Fl Csl/HF Csl	100 Ft
028757	Hoses, 400E Bev Fl Csl/HF Csl	150 Ft
028758	Hoses, 400E Bev Fl Csl/HF Csl	200 Ft

APPENDIX A

AERATION MANIFOLD FOR PLASMA CUTTING ALUMINUM

Introduction

When plasma arc cutting aluminum, free hydrogen gas may be generated by the cutting process. The high temperature of the plasma process causes disassociation of oxygen and hydrogen from the water in the water table. The hot aluminum, which has a high affinity for oxygen, then combines with the oxygen leaving free hydrogen.

An effective means of avoiding free hydrogen buildup is to install an aeration manifold on the floor of the water table to replenish the oxygen content of the water.

Making an Aeration Manifold - Figure a-1

Make an **Aeration Manifold** with two-inch (50 mm) PVC tubing with one-inch (25 mm) **Distribution Lines** connected to it. Drill 1/8 inch (3 mm) holes every six inches (150 mm) in the distribution lines. Cap the ends of the distribution lines and install the lines so that oxygen is delivered to all parts of the cutting area.

Connect the manifold to a shop air line. Set a pressure regulator to obtain a steady stream of bubbles.

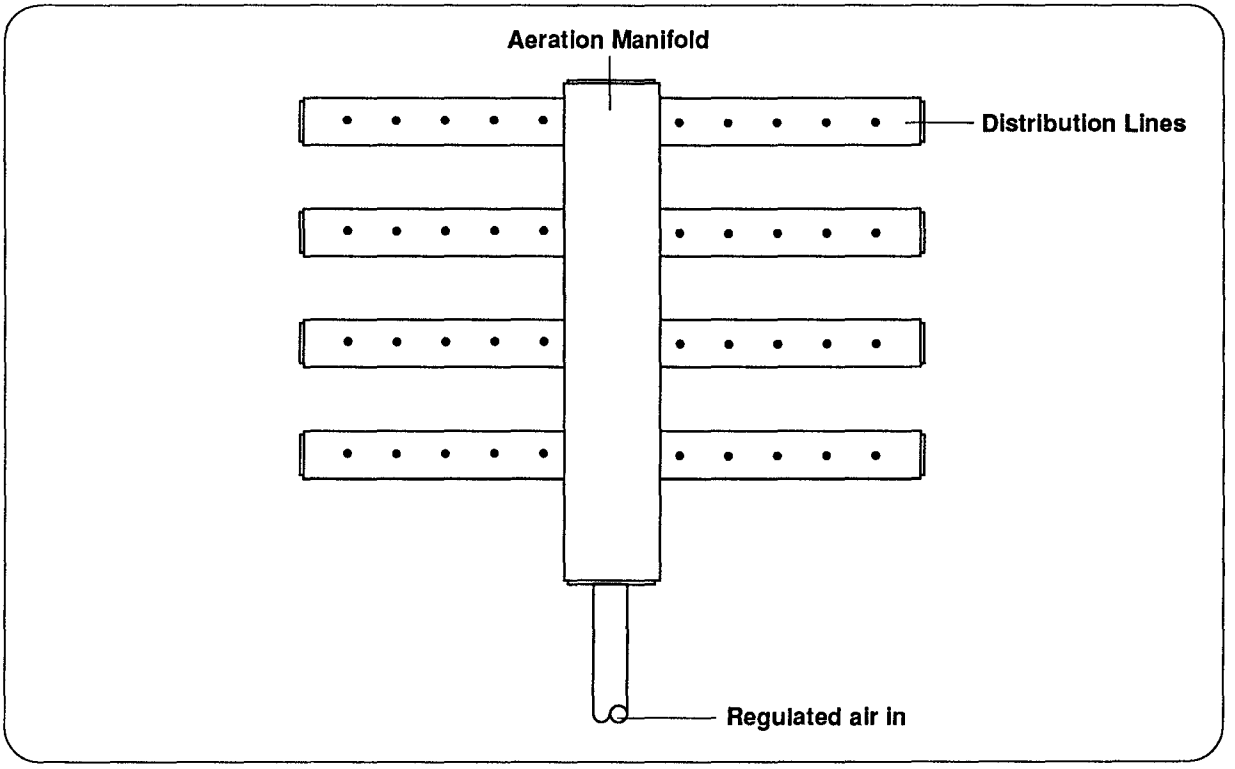


Figure a-1 Aeration Manifold