HySpeed® HT2000LHF®

200 Volt Plasma Arc Cutting System

Instruction Manual
803040 – Revision 7

Hypertherm®

The world leader in plasma cutting technology™

Changed Page	Description	Rev 5 to 6	8/31/03

6.2	Item # 7 changed from 041560 to 041764. Item # 8 081031 (firmware) was removed.
Section 7	Wiring diagram revision changed from H to K (all pages)

Changed Page	Description	IM304 Rev 4 to 5	9/27/99

0.01	Uprevved because of ECNs 10483, 10484, 10639m, 10145, 10670
0.02	Added plumbing and electrical codes statement to warranty
1.0-1a.06	New safety sections
3.18	New graphic of valve cluster
3.19	Modified graphic of torch
5.17	Changed graphic of coolant reservoir
5.18	New graphic of coolant reservoir
6.08	New coolant reservoir #, new level switch SA #
6.15	New Torch mounting sleeve #
6.18	Added new level switch SA # to recommended spare parts
7.05-7.13	Uprevved wiring diagrams to G

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Changed Page	Description	IM304 Rev 3 to 4	5/26/99

0.01	Uprevved because of request to add cut quality info and ECNs 10228, 10308, 10344, 10417
0.03-.08	Updated TOC
2.03	Added 440V power supplies
3.03	Changed spec. on coolant
3.04	Added power specs for 440V
3.11	Added note referencing DC relay kit part number
4.10	Added line referencing cutting techniques
4.33-4.36	Adding cutting techniques
6.04	Added 440V control xfrmr
6.05	Added 440V power xfrmr
6.09	Changed p/n of items 6 and 7 for new pressure switch
6.13	Added 015049 to parts list
6.16	Changed figure title to HT2000 Consumable Parts
6.17	Added HT2000 Beveling Consumable Parts Kit
6.18	Bumped page - also changed p/n for pressure switch in gas console recommended spare parts
7.01-7.13	Wiring diagram change to reflect new 440V power supply rev E to rev F
a.01-a.14	Added argon-hydrogen cutting and installation
i.01-i.06	Updated index

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Changed Page	Description	IM304 Rev 2 to 3 1/18/99
0.01	Uprevved because of ECNs 10078, 10079, 10070, 9753, 10012, 9864, 10020, 9926	
0.06	Changed TOC to reference HT2000LHF Torches	
0.08	Changed TOC to reference HT2000LHF Torches	
2.01	Added line in spec description to specify recommended production cutting thickness	
2.02	Added note to Water Muffler description stating that it cannot be used with the stainless torch	
2.03	Added dimension on torch diameter and referenced an additional drawing in Section 6	
2.06	Added note to Water Muffler description stating that it cannot be used with the stainless torch	
3.07	Added note to Water Muffler description stating that it cannot be used with the stainless torch	
3.11	Updated signal labels for I/O cable	
3.13	Added note to Water Muffler cable stating that it cannot be used with the stainless torch	
4.11	Changed index to cut chart and consumables to include new electrode and swirl ring	
4.12-4.29	Updated cut charts with new electrode, swirl ring, and clearer cutting capacities	
5.02	Removed old style pump clamp from drawing	
6.05	New part number for valve SV7	
6.08	Added kits for pump and motor replacement	
6.09	New part number for valves SV1-3	
6.15	Added new stainless steel torch	
6.16	Added new electrode to parts kit	
6.17	New part numbers for valves, pump	

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Changed Page	Description	IM304 Rev 1 to 2 8/21/98
0.01	Uprevved because of ECNs 9763, 9758, 9803	
0.08	Added figure of coolant flow diagram to TOC	
3.08	New graphic of rear panel	
5.17	Added figure of coolant flow diagram	
6.08	New graphic of rear panel, new p/ns for valve assembly, water pump assembly	
7.04	Added coolant flow diagram to wiring diagrams	

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0.01	Uprevved because of ECNs 9523, 9483, grounding appendix, serial # jump to 2LHF-000150
0.07	Added System Grounding to TOC
0.08	Added System Grounding to TOC
3.03	Referenced new grounding appendix
4.15	Added a sentence to Mild Steel 100A cutting cut chart
4.16	Added a sentence to Mild Steel 100A cutting cut chart
5.05	New power distribution PCB graphic, added fuse
5.14	Added error code for phase loss
6.02	New firmware rev
6.06	New graphic of chopper with phase loss board, new phase loss board #
6.16	Changed some quantities in consumable parts kit
7.01	Uprevved wiring diagrams to E
i.02	Added j1 to grounding requirements in index
i.04	Added phase loss to index
j.01	New system grounding appendix
j.02	New system grounding appendix
j.03	New system grounding appendix
j.04	New system grounding appendix
j.05	New system grounding appendix

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HySpeed HT2000LHF

200 Volt

Instruction Manual

(P/N 803040)

Revision 7 – November, 2013

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EMC INTRODUCTION

Hypertherm's CE-marked equipment is built in compliance with standard EN50199. The equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

The limits required by EN50199 may not be adequate to completely eliminate interference when the af fected equipment is in close proximity or has a high degree of sensitivity. In such cases it may be necessary to use other measures to further reduce interference.

This plasma equipment is designed for use only in an industrial environment.

INSTALLATION AND USE

The user is responsible for installing and using the plasma equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user to resolve the situation with the technical assistance of the manufacturer . In some cases this remedial action may be as simple as earthing the cutting circuit, see *Earthing of Workpiece*. In other cases it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

ASSESSMENT OF AREA

Before installing the equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

a. Other supply cables, control cables, signalling and telephone cables; above, below and adjacent to the cutting equipment.
b. Radio and television transmitters and receivers.
c. Computer and other control equipment.
d. Safety critical equipment, for example guarding of industrial equipment.
e. Health of the people around, for example the use of pacemakers and hearing aids.
f. Equipment used for calibration or measurement.
g. Immunity of other equipment in the environment. User shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures.
h. Time of day that cutting or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

METHODS OF REDUCING EMISSIONS

Mains Supply

Cutting equipment must be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. Consideration should be given to shielding the supply cable of permanently installed cutting equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the cutting mains supply so that good electrical contact is maintained between the conduit and the cutting power source enclosure

Maintenance of Cutting Equipment

The cutting equipment must be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the cutting equipment is in operation. The cutting equipment should not be modified in any way except for those changes and adjustments covered in the manufacturer's instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Cutting Cables

The cutting cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

Equipotential Bonding

Bonding of all metallic components in the cutting installation and adjacent to it should be considered. However , metallic components bonded to the workpiece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of Workpiece

Where the workpiece is not bonded to earth for electrical safety , nor connected to earth because of its size and position, for example, ship's hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary , the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitances selected according to national regulations.

Note. The cutting circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury , for example, by allowing parallel cutting current return paths which may damage the earth circuits of other equipment. Further guidance is given in IEC TC26 (sec)94 and IEC TC26/108A/CD Arc Welding Equipment Installation and Use.

Screening and Shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire plasma cutting installation may be considered for special applications

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

You are responsible for the safe use of the Product. Hypertherm does not and cannot make any guarantee or warranty regarding the safe use of the Product in your environment.

GENERAL

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, with the exception of G3 Series power supplies, which shall be within a period of three (3) years from the date of 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.

PATENT INDEMNITY

Except only in cases of products not manufactured by Hypertherm or manufactured by a person other than Hypertherm not in strict conformity with Hypertherm' s specifications and in cases of designs, processes, formulae, or combinations not developed or purported to be developed by Hypertherm, Hypertherm will defend or settle, at its own expense, any suit or proceeding brought against you alleging that the use of the Hypertherm product, alone and not in combination with any other product not supplied by Hypertherm, infringes any patent of any third party . You shall notify Hypertherm promptly upon learning of any action or threatened action in connection with any such alleged infringement, and Hypertherm's obligation to indemnify shall be conditioned upon Hypertherm' s sole control of, and the indemnified party's cooperation and assistance in, the defense of the claim.

LIMITATION OF LIABILITY

In no event shall Hypertherm be liable to any person or entity for any incidental, consequential, indirect, or punitive damages (including but not limited to lost profits) regardless of whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise and even if advised of the possibility of such damages.

LIABILITY CAP

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.

INSURANCE

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

NATIONAL AND LOCAL CODES

National and Local codes governing plumbing and electrical installation shall take precedent over any instructions contained in this manual. **In no event** shall Hypertherm be liable for injury to persons or property damage by reason of an code violation or poor work practices.

TRANSFER OF RIGHTS

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

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Section 1

SAFETY

In this section:

RECOGNIZE SAFETY INFORMATION

The symbols shown in this section are used to identify potential hazards. When you see a safety symbol in this manual or on your machine, understand the potential for personal injury, and follow the related instructions to avoid the hazard.

FOLLOW SAFETY INSTRUCTIONS

Read carefully all safety messages in this manual and safety labels on your machine.

- Keep the safety labels on your machine in good condition. Replace missing or damaged labels immediately.
- Learn how to operate the machine and how to use the controls properly. Do not let anyone operate it without instruction.
- Keep your machine in proper working condition. Unauthorized modifications to the machine may affect safety and machine service life.

DANGER WARNING CAUTION

A signal word DANGER or WARNING is used with a safety symbol. DANGER identifies the most serious hazards.

- DANGER and WARNING safety labels are located on your machine near specific hazards.
- WARNING safety messages precede related instructions in this manual that may result in injury or death if not followed correctly.
- CAUTION safety messages precede related instructions in this manual that may result in damage to equipment if not followed correctly.

CUTTING CAN CAUSE FIRE OR EXPLOSION

Fire Prevention

- Be sure the area is safe before doing any cutting. Keep a fire extinguisher nearby.
- Remove all flammables within 35 feet (10 m) of the cutting area.
- Quench hot metal or allow it to cool before handling or before letting it touch combustible materials.
- Never cut containers with potentially flammable materials inside – they must be emptied and properly cleaned first.
- Ventilate potentially flammable atmospheres before cutting.
- When cutting with oxygen as the plasma gas, an exhaust ventilation system is required.

Explosion Prevention

- Do not use the plasma system if explosive dust or vapors may be present.
- Do not cut pressurized cylinders, pipes, or any closed container.
- Do not cut containers that have held combustible materials.

WARNING

Explosion Hazard
Argon-Hydrogen and Methane

Hydrogen and methane are flammable gases that present an explosion hazard. Keep flames away from cylinders and hoses that contain methane or hydrogen mixtures. Keep flames and sparks away from the torch when using methane or argon-hydrogen plasma.

WARNING

Hydrogen Detonation with Aluminum Cutting

- When cutting aluminum underwater, or with the water touching the underside of the aluminum, free hydrogen gas may collect under the workpiece and detonate during plasma cutting operations.
- Install an aeration manifold on the floor of the water table to eliminate the possibility of hydrogen detonation. Refer to the Appendix section of this manual for aeration manifold details.


ELECTRIC SHOCK CAN KILL

Touching live electrical parts can cause a fatal shock or severe burn.

- Operating the plasma system completes an electrical circuit between the torch and the workpiece. The workpiece and anything touching the workpiece are part of the electrical circuit.
- Never touch the torch body, workpiece or the water in a water table when the plasma system is operating.

Electric Shock Prevention

All Hypertherm plasma systems use high voltage in the cutting process (200 to 400 VDC are common). Take the following precautions when operating this system:

- Wear insulated gloves and boots, and keep your body and clothing dry.
- Do not stand, sit or lie on – or touch – any wet surface when using the plasma system.
- Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground. If you must work in or near a damp area, use extreme caution.
- Provide a disconnect switch close to the power supply with properly sized fuses. This switch allows the operator to turn off the power supply quickly in an emergency situation.
- When using a water table, be sure that it is correctly connected to earth ground.
- Install and ground this equipment according to the instruction manual and in accordance with national and local codes.
- Inspect the input power cord frequently for damage or cracking of the cover. Replace a damaged power cord immediately. **Bare wiring can kill.**
- Inspect and replace any worn or damaged torch leads.
- 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 during the cutting process.
- Before checking, cleaning or changing torch parts, disconnect the main power or unplug the power supply.
- Never bypass or shortcut the safety interlocks.
- Before removing any power supply or system enclosure cover, disconnect electrical input power. Wait 5 minutes after disconnecting the main power to allow capacitors to discharge.
- Never operate the plasma system unless the power supply covers are in place. Exposed power supply connections present a severe electrical hazard.
- When making input connections, attach proper grounding conductor first.
- 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 safety hazard.

CUTTING CAN PRODUCE TOXIC FUMES

Cutting can produce toxic fumes and gases that deplete oxygen and cause injury or death.

- Keep the cutting area well ventilated or use an approved air-supplied respirator.
- Do not cut in locations near degreasing, cleaning or spraying operations. The vapors from certain chlorinated solvents decompose to form phosgene gas when exposed to ultraviolet radiation.
- Do not cut metal coated or containing toxic materials, such as zinc (galvanized), lead, cadmium or beryllium, unless the area is well ventilated and the operator wears an air-supplied respirator. The coatings and any metals containing these elements can produce toxic fumes when cut.
- Never cut containers with potentially toxic materials inside – they must be emptied and properly cleaned first.
- This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer.

A PLASMA ARC CAN CAUSE INJURY AND BURNS

Instant-On Torches
Plasma arc comes on immediately when the torch switch is activated.

The plasma arc will cut quickly through gloves and skin.
- Keep away from the torch tip.
- Do not hold metal near the cutting path.
- Never point the torch toward yourself or others.

ARC RAYS CAN BURN EYES AND SKIN

Eye Protection Plasma arc rays produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.
- Use eye protection in accordance with applicable national or local codes.
- Wear eye protection (safety glasses or goggles with side shields, and a welding helmet) with appropriate lens shading to protect your eyes from the arc's ultraviolet and infrared rays.

Arc Current	Lens Shade AWS (USA)	Lens Shade ISO 4850
Up to 100 A	No. 8	No. 11
100-200 A	No. 10	No. 11-12
200-400 A	No. 12	No. 13
Over 400 A	No. 14	No. 14

Skin Protection Wear protective clothing to protect against burns caused by ultraviolet light, sparks and hot metal.
- Gauntlet gloves, safety shoes and hat.
- Flame-retardant clothing to cover all exposed areas.
- Cuffless trousers to prevent entry of sparks and slag.
- Remove any combustibles, such as a butane lighter or matches, from your pockets before cutting.

Cutting Area Prepare the cutting area to reduce reflection and transmission of ultraviolet light:
- Paint walls and other surfaces with dark colors to reduce reflection.
- Use protective screens or barriers to protect others from flash and glare.
- Warn others not to watch the arc. Use placards or signs.

GROUNDING SAFETY

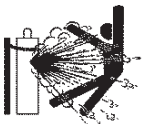
Work Cable Attach the work cable securely to the workpiece or the work table with good metal-to-metal contact. Do not connect it to the piece that will fall away when the cut is complete.

Work Table Connect the work table to an earth ground, in accordance with appropriate national or local electrical codes.

Input Power
- Be sure to connect the power cord ground wire to the ground in the disconnect box.
- If installation of the plasma system involves connecting the power cord to the power supply, be sure to connect the power cord ground wire properly.
- Place the power cord's ground wire on the stud first, then place any other ground wires on top of the power cord ground. Fasten the retaining nut tightly.
- Tighten all electrical connections to avoid excessive heating.

COMPRESSED GAS EQUIPMENT SAFETY

- Never lubricate cylinder valves or regulators with oil or grease.
- Use only correct gas cylinders, regulators, hoses and fittings designed for the specific application.
- Maintain all compressed gas equipment and associated parts in good condition.
- Label and color-code all gas hoses to identify the type of gas in each hose. Consult applicable national or local codes.



GAS CYLINDERS CAN EXPLODE IF DAMAGED

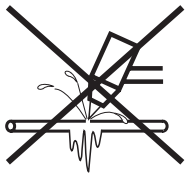
Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.

- Handle and use compressed gas cylinders in accordance with applicable national or local codes.
- Never use a cylinder that is not upright and secured in place.
- Keep the protective cap in place over valve except when the cylinder is in use or connected for use.
- Never allow electrical contact between the plasma arc and a cylinder.
- Never expose cylinders to excessive heat, sparks, slag or open flame.
- Never use a hammer, wrench or other tool to open a stuck cylinder valve.

NOISE CAN DAMAGE HEARING

Prolonged exposure to noise from cutting or gouging can damage hearing.

- Use approved ear protection when using plasma system.
- Warn others nearby about the noise hazard.



A PLASMA ARC CAN DAMAGE FROZEN PIPES

Frozen pipes may be damaged or can burst if you attempt to thaw them with a plasma torch.

PACEMAKER AND HEARING AID OPERATION

Pacemaker and hearing aid operation can be affected by magnetic fields from high currents.
Pacemaker and hearing aid wearers should consult a doctor before going near any plasma arc cutting and gouging operations.

To reduce magnetic field hazards:

- Keep both the work cable and the torch lead to one side, away from your body.
- Route the torch leads as close as possible to the work cable.
- Do not wrap or drape the torch lead or work cable around your body.
- Keep as far away from the power supply as possible.

ADDITIONAL SAFETY INFORMATION

1. ANSI Standard Z49.1, *Safety in Welding and Cutting,* American Welding Society, 550 LeJeune Road P.O. Box 351020, Miami, FL 33135
2. ANSI Standard Z49.2, *Fire Prevention in the Use of Cutting and Welding Processes,* American National Standards Institute 1430 Broadway, New York, NY 10018
3. ANSI Standard Z87.1, *Safe Practices for Occupation and Educational Eye and Face Protection,* American National Standards Institute, 1430 Broadway, New York, NY 10018
4. AWS F4.1, *Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances,* American Welding Society 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
5. AWS F5.2, *Recommended Safe Practices for Plasma Arc Cutting,* American Welding Society 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
6. CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Cylinders,* Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202
7. CSA Standard W117.2, *Code for Safety in Welding and Cutting,* Canadian Standards Association Standard Sales 178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3, Canada
8. NFPA Standard 51B, *Cutting and Welding Processes,* National Fire Protection Association 470 Atlantic Avenue, Boston, MA 02210
9. NFPA Standard 70–1978, *National Electrical Code,* National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210
10. OSHA, *Safety and Health Standards,* 29FR 1910 U.S. Government Printing Office, Washington, D.C. 20402

WARNING LABEL

This warning label is affixed to some power supplies. It is important that the operator and maintenance technician understand the intent of these warning symbols as described. The numbered text corresponds to the numbered boxes on the label.

1. Cutting sparks can cause explosion or fire.

1.1 Keep flammables away from cutting.

1.2 Keep a fire extinguisher nearby, and have a watchperson ready to use it.

1.3 Do not cut on any closed containers.

2. The plasma arc can cause injury and burns.

2.1 Turn off power before disassembling torch.

2.2 Do not hold the material near cutting path.

2.3 Wear complete body protection.

3. Electric shock from torch or wiring can kill. Protect yourself from electric shock.

3.1 Wear insulating gloves. Do not wear wet or damaged gloves.

3.2 Insulate yourself from work and ground.

3.3 Disconnect input plug or power before working on machine.

4. Breathing cutting fumes can be hazardous to your health.

4.1 Keep your head out of the fumes.

4.2 Use forced ventilation or local exhaust to remove the fumes.

4.3 Use ventilating fan to remove the fumes.

5. Arc rays can burn eyes and injure skin.

5.1 Wear hat and safety glasses. Use ear protection and button shirt collar. Use welding helmet with correct shade of filter. Wear complete body protection.

6. Become trained and read the instructions before working on the machine or cutting.

7. Do not remove or paint over (cover) warning labels.

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Section 1a

SÉCURITÉ

Dans cette section :

IDENTIFIER LES CONSIGNES DE SÉCURITÉ

Les symboles indiqués dans cette section sont utilisés pour identifier les risques éventuels. Si vous trouvez un symbole de sécurité, que ce soit dans ce manuel ou sur l'équipement, soyez conscient des risques de blessures et suivez les instructions correspondantes afin d'éviter ces risques.

SUIVRE LES INSTRUCTIONS DE SÉCURITÉ

Lire attentivement toutes les consignes de sécurité dans le présent manuel et sur les étiquettes de sécurité se trouvant sur la machine.

- Les étiquettes de sécurité doivent rester lisibles. Remplacer immédiatement les étiquettes manquantes ou abîmées.
- Apprendre à faire fonctionner la machine et à utiliser correctement les commandes. Ne laisser personne utiliser la machine sans connaître son fonctionnement.
- Garder la machine en bon état. Des modifications non autorisées sur la machine peuvent engendrer des problèmes de sécurité et raccourcir la durée d'utilisation de l'équipement.

DANGER AVERTISSEMENT PRÉCAUTION

Les signaux DANGER ou AVERTISSEMENT sont utilisés avec un symbole de sécurité, DANGER correspondant aux risques les plus sérieux.

- Les étiquettes de sécurité DANGER et AVERTISSEMENT sont situées sur la machine pour signaler certains dangers spécifiques.
- Les messages d'AVERTISSEMENT précèdent les instructions d'utilisation expliquées dans ce manuel et signalent les risques de blessures ou de mort au cas où ces instructions ne seraient pas suivies correctement.
- Les messages de PRÉCAUTION précèdent les instructions d'utilisation contenues dans ce manuel et signalent que le matériel risque d'être endommagé si les instructions ne sont pas suivies correctement.

LE COUPAGE PEUT PROVOQUER UN INCENDIE OU UNE EXPLOSION

Prévention des incendies

- Avant de commencer, s'assurer que la zone de coupage ne présente aucun danger. Conserver un extincteur à proximité.
- Éloigner toute matière inflammable à une distance d'au moins 10 m du poste de coupage.
- Tremper le métal chaud ou le laisser refroidir avant de le manipuler ou avant de le mettre en contact avec des matériaux combustibles.
- Ne jamais couper des récipients pouvant contenir des matières inflammables avant de les avoir vidés et nettoyés correctement.
- Aérer toute atmosphère potentiellement inflammable avant d'utiliser un système plasma.
- Lors de l'utilisation d'oxygène comme gaz plasma, un système de ventilation par aspiration est nécessaire.

Prévention des explosions

- Ne pas couper en présence de poussière ou de vapeurs.
- Ne pas couper de bouteilles, de tuyaux ou autres récipients fermés et pressurisés.
- Ne pas couper de récipients contenant des matières combustibles.

AVERTISSEMENT

Risque d'explosion argon-hydrogène et méthane

L'hydrogène et le méthane sont des gaz inflammables et potentiellement explosifs. Conserver à l'écart de toute flamme les bouteilles et tuyaux contenant des mélanges à base d'hydrogène ou de méthane. Maintenir toute flamme et étincelle à l'écart de la torche lors de l'utilisation d'un plasma d'argon-hydrogène ou de méthane.

AVERTISSEMENT

Détonation de l'hydrogène lors du coupage de l'aluminium

- Lors du coupage de l'aluminium sous l'eau, ou si l'eau touche la partie inférieure de la pièce d'aluminium, de l'hydrogène libre peut s'accumuler sous la pièce à couper et détonner lors du coupage plasma.
- Installer un collecteur d'aération au fond de la table à eau afin d'éliminer les risques de détonation de l'hydrogène. Se référer à l'annexe du manuel pour plus de renseignements sur les collecteurs d'aération.


LES CHOCS ÉLECTRIQUES PEUVENT ÊTRE FATALS

Toucher une pièce électrique sous tension peut provoquer un choc électrique fatal ou des brûlures graves.

- La mise en fonctionnement du système plasma ferme un circuit électrique entre la torche et la pièce à couper. La pièce à couper et tout autre élément en contact avec cette pièce font partie du circuit électrique.
- Ne jamais toucher le corps de la torche, la pièce à couper ou l'eau de la table à eau pendant le fonctionnement du système plasma.

Prévention des chocs électriques

Tous les systèmes plasma Hypertherm utilisent des hautes tensions pour le coupage (souvent de 200 à 400 V). On doit prendre les précautions suivantes quand on utilise le système plasma :

- Porter des bottes et des gants isolants et garder le corps et les vêtements au sec.
- Ne pas se tenir, s'asseoir ou se coucher sur une surface mouillée, ni la toucher quand on utilise le système plasma.
- S'isoler de la surface de travail et du sol en utilisant des tapis isolants secs ou des couvertures assez grandes pour éviter tout contact physique avec le travail ou le sol. S'il s'avère nécessaire de travailler dans ou près d'un endroit humide, procéder avec une extrême prudence.
- Installer un sectionneur avec fusibles appropriés, à proximité de la source de courant. Ce dispositif permet à l'opérateur d'arrêter rapidement la source de courant en cas d'urgence.
- En cas d'utilisation d'une table à eau, s'assurer que cette dernière est correctement mise à la terre.
- Installer et mettre à la terre l'équipement selon les instructions du présent manuel et conformément aux codes électriques locaux et nationaux.
- Inspecter fréquemment le cordon d'alimentation primaire pour s'assurer qu'il n'est ni endommagé, ni fendu. Remplacer immédiatement un cordon endommagé. **Un câble dénudé peut tuer**.
- Inspecter et remplacer les câbles de la torche qui sont usés ou endommagés.
- Ne pas saisir la pièce à couper ni les chutes lors du coupage. Laisser la pièce à couper en place ou sur la table de travail, le câble de retour connecté lors du coupage.
- Avant de vérifier, de nettoyer ou de remplacer les pièces de la torche, couper l'alimentation ou débrancher la prise de courant.
- Ne jamais contourner ou court-circuiter les verrouillages de sécurité.
- Avant d'enlever le capot du système ou de la source de courant, couper l'alimentation électrique. Attendre ensuite 5 minutes pour que les condensateurs se déchargent.
- Ne jamais faire fonctionner le système plasma sans que les capots de la source de courant ne soient en place. Les raccords exposés de la source de courant sont extrêmement dangereux.
- Lors de l'installation des connexions, attacher tout d'abord la prise de terre appropriée.
- Chaque système plasma Hypertherm est conçu pour être utilisé uniquement avec des torches Hypertherm spécifiques. Ne pas utiliser des torches inappropriées qui pourraient surchauffer et présenter des risques pour la sécurité.

LE COUPAGE PEUT PRODUIRE DES VAPEURS TOXIQUES

Le coupage peut produire des vapeurs et des gaz toxiques qui réduisent le niveau d'oxygène dans l'air et peuvent provoquer des blessures, voire la mort.

- Conserver le poste de coupage bien aéré ou utiliser un masque respiratoire homologué.
- Ne pas procéder au coupage près d'endroits où s'effectuent le dégraissage, le nettoyage ou la vaporisation. Certains solvants chlorés se décomposent sous l'effet des rayons ultraviolets et forment du phosgène.
- Ne pas couper des métaux peints ou contenant des matières toxiques comme le zinc (galvanisé), le plomb, le cadmium ou le béryllium, à moins que la zone de travail soit très bien ventilée et que l'opérateur porte un masque respiratoire. Les revêtements et métaux contenant ces matières peuvent produire des vapeurs toxiques lors du coupage.
- Ne jamais couper de récipients pouvant contenir des matières inflammables avant de les avoir vidés et nettoyés correctement.
- Quand on utilise ce produit pour le soudage ou le coupage, il dégage des fumées et des gaz qui contiennent des produits chimiques qui, selon l'État de Californie, provoquent des anomalies congénitales et, dans certains cas, le cancer.

L'ARC PLASMA PEUT PROVOQUER DES BLESSURES OU DES BRÛLURES

Torches à allumage instantané

L'arc plasma s'allume immédiatement après que la torche soit mise en marche.

L'arc plasma coupe facilement les gants et la peau.

- Rester éloigné de l'extrémité de la torche.
- Ne pas tenir de métal près de la trajectoire de coupe.
- Ne jamais pointer la torche vers soi ou d'autres personnes.

LES RAYONS DE L'ARC PEUVENT BRÛLER LES YEUX ET LA PEAU

Protection des yeux Les rayons de l'arc plasma produisent de puissants rayons visibles ou invisibles (ultraviolets et infrarouges) qui peuvent brûler les yeux et la peau.

- Utiliser des lunettes de sécurité conformément aux codes locaux ou nationaux en vigueur.
- Porter des lunettes de protection (lunettes ou masque muni d'écrans latéraux et encore masque de soudure) avec des verres teintés appropriés pour protéger les yeux des rayons ultraviolets et infrarouges de l'arc.

Courant de l'arc	Puissance des verres teintés AWS (É.-U.)	ISO 4850
Jusqu'à 100 A	N° 8	N° 11
100-200 A	N° 10	N° 11-12
200-400 A	N° 12	N° 13
Plus de 400 A	N° 14	N° 14

Protection de la peau Porter des vêtements de sécurité pour se protéger contre les brûlures que peuvent causer les rayons ultraviolets, les étincelles et le métal brûlant :

- Gants à crispin, chaussures et casque de sécurité.
- Vêtements ignifuges couvrant toutes les parties exposées du corps.
- Pantalon sans revers pour éviter que des étincelles ou des scories puissent s'y loger.
- Avant le coupage, retirer de ses poches tout objet combustible comme les briquets au butane ou les allumettes.

Zone de coupage Préparer la zone de coupage afin de réduire la réverbération et la transmission de la lumière ultraviolette :

- Peindre les murs et autres surfaces de couleur sombre pour réduire la réflexion de la lumière.
- Utiliser des écrans et autres dispositifs de protection afin de protéger les autres personnes de la lumière et de la réverbération.
- Prévenir les autres personnes de ne pas regarder l'arc. Utiliser des affiches ou des panneaux.

MISE À LA MASSE ET À LA TERRE

Câble de retour Bien fixer le câble de retour (ou de masse) à la pièce à couper ou à la table de travail de façon à assurer un bon contact métal-métal. Ne pas fixer le câble de retour à la partie de la pièce qui doit se détacher.

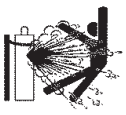
Table de travail Raccorder la table de travail à la terre, conformément aux codes de sécurité locaux ou nationaux appropriés.

Alimentation

- S'assurer que le fil de terre du cordon d'alimentation est connecté à la terre dans le coffret du sectionneur.
- S'il est nécessaire de brancher le cordon d'alimentation à la source de courant lors de l'installation du système, s'assurer que le fil de terre est correctement branché.
- Placer tout d'abord le fil de terre du cordon d'alimentation sur le plot de mise à la terre puis placer les autres fils de terre par-dessus. Bien serrer l'écrou de retenue.
- S'assurer que toutes les connexions sont bien serrées pour éviter la surchauffe.

SÉCURITÉ DES BOUTEILLES DE GAZ COMPRIMÉ

- Ne jamais lubrifier les robinets des bouteilles ou les régulateurs avec de l'huile ou de la graisse.
- Utiliser uniquement les bouteilles, régulateurs, tuyaux et accessoires appropriés et conçus pour chaque application spécifique.
- Entretenir l'équipement et les pièces d'équipement à gaz comprimé afin de les garder en bon état.
- Étiqueter et coder avec des couleurs tous les tuyaux de gaz afin d'identifier le type de gaz contenu dans chaque tuyau. Se référer aux codes locaux ou nationaux en vigueur.



LES BOUTEILLES DE GAZ COMPRIMÉ PEUVENT EXPLOSER EN CAS DE DOMMAGES

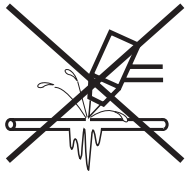
Les bouteilles de gaz contiennent du gaz à haute pression. Si une bouteille est endommagée, elle peut exploser.

- Manipuler et utiliser les bouteilles de gaz comprimé conformément aux codes locaux ou nationaux.
- Ne jamais utiliser une bouteille qui n'est pas placée à la verticale et bien assujettie.
- Le capuchon de protection doit être placé sur le robinet sauf si la bouteille est en cours d'utilisation ou connectée pour utilisation.
- Éviter à tout prix le contact électrique entre l'arc plasma et une bouteille.
- Ne jamais exposer des bouteilles à une chaleur excessive, aux étincelles, aux scories ou aux flammes nues.
- Ne jamais utiliser des marteaux, des clés ou d'autres outils pour débloquer le robinet des bouteilles.

LE BRUIT PEUT PROVOQUER DES PROBLÈMES AUDITIFS

Une exposition prolongée au bruit du coupage ou du gougeage peut provoquer des problèmes auditifs.

- Utiliser un casque de protection homologué lors de l'utilisation du système plasma.
- Prévenir les personnes aux alentours des risques encourus en cas d'exposition au bruit.



UN ARC PLASMA PEUT ENDOMMAGER LES TUYAUX GELÉS

Les tuyaux gelés peuvent être endommagés ou éclater si l'on essaie de les dégeler avec une torche plasma.

PACEMAKERS ET PROTHÈSES AUDITIVES

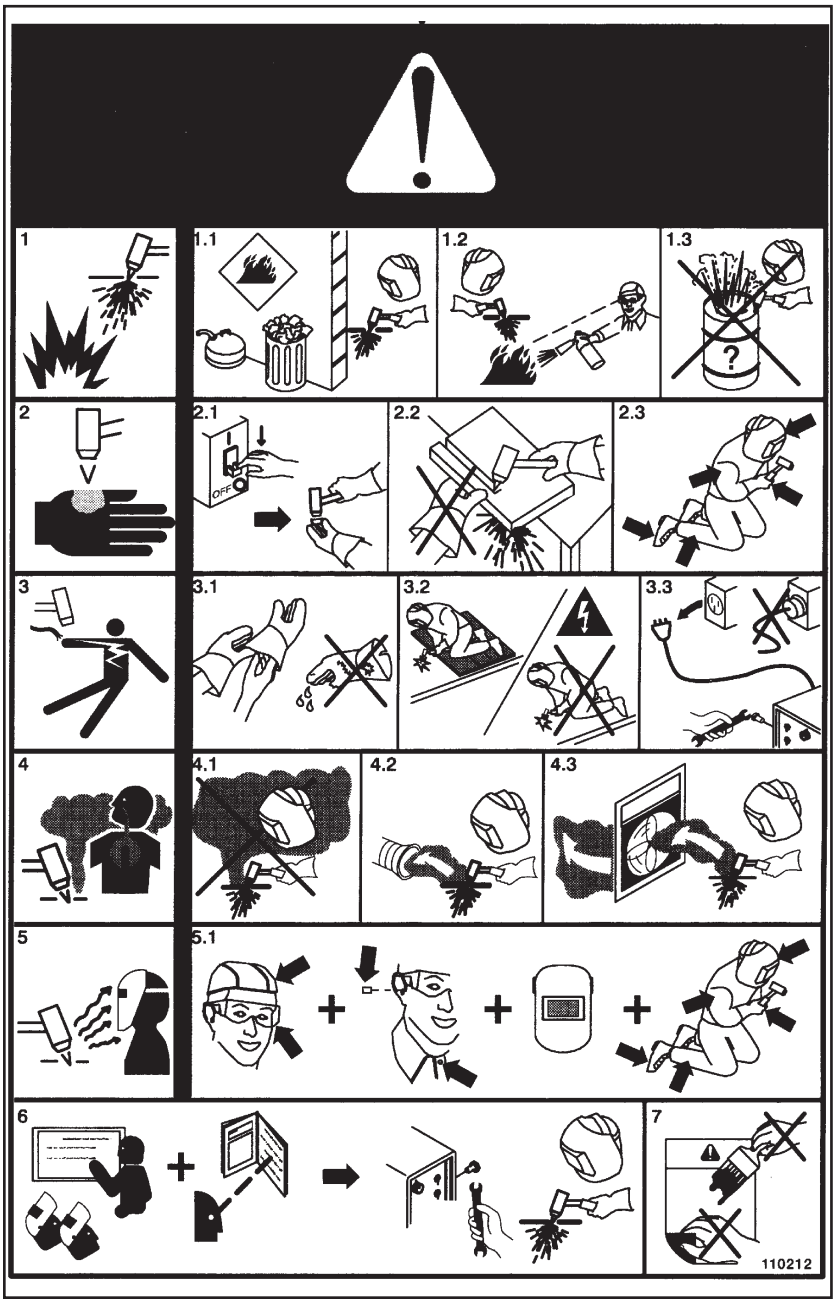
Les champs magnétiques produits par les courants à haute tension peuvent affecter le fonctionnement des prothèses auditives et des pacemakers. Les personnes portant ce type d'appareil doivent consulter un médecin avant de s'approcher d'un lieu où s'effectue le coupage ou le gougeage plasma.

Pour réduire les risques associés aux champs magnétiques :

- Garder loin de soi et du même côté du corps le câble de retour et le faisceau de la torche.
- Faire passer le faisceau de la torche le plus près possible du câble de retour.
- Ne pas s'enrouler le faisceau de la torche ou le câble de retour autour du corps.
- Se tenir le plus loin possible de la source de courant.

Étiquette de sécurité

Cette étiquette est affichée sur la source de courant. Il est important que l'utilisateur et le technicien de maintenance comprennent la signification des symboles de sécurité. Les numéros de la liste correspondent aux numéros des images.



1. Les étincelles produites par le coupage peuvent provoquer une explosion ou un incendie.

1.1 Pendant le coupage, éloigner toute matière inflammable.

1.2 Conserver un extincteur à proximité et s'assurer qu'une personne soit prête à l'utiliser.

1.3 Ne jamais couper de récipients fermés.

2. L'arc plasma peut provoquer des blessures et des brûlures.

2.1 Couper l'alimentation avant de démonter la torche.

2.2 Ne pas tenir la surface à couper près de la trajectoire de coupe.

2.3 Porter des vêtements de protection couvrant tout le corps.

3. Un choc électrique causé par la torche ou les câbles peut être fatal. Se protéger contre les risques de chocs électriques.

3.1 Porter des gants isolants. Ne pas porter de gants mouillés ou abîmés.

3.2 S'isoler de la surface de travail et du sol.

3.3 Débrancher la prise ou la source de courant avant de manipuler l'équipement.

4. L'inhalation des vapeurs produites par le coupage peut être dangereuse pour la santé.

4.1 Garder le visage à l'écart des vapeurs.

4.2 Utiliser un système de ventilation par aspiration ou d'échappement localisé pour dissiper les vapeurs.

4.3 Utiliser un ventilateur pour dissiper les vapeurs.

5. Les rayons de l'arc peuvent brûler les yeux et provoquer des lésions de la peau.

5.1 Porter un casque et des lunettes de sécurité. Se protéger les oreilles et porter une chemise dont le col peut être déboutonné. Porter un casque de soudure dont la protection filtrante est suffisante. Porter des vêtements protecteurs couvrant la totalité du corps.

6. Se former à la technique du coupage et lire les instructions avant de manipuler l'équipement ou de procéder au coupage.

7. Ne pas retirer ou peindre (recouvrir) les étiquettes de sécurité.

Section 2

SPECIFICATIONS

HySpeed HT2000LHF System Components

See Figure 3-2 in Section 3 for details of the system interconnections.

Power Supply

The LHF power supply houses two 100-amp, 15 kHz choppers, the torch's high-frequency starting circuit and an optional internal Torch Height Control (THC).

HySpeed LHF Machine Torch

The LHF machine torch is liquid-cooled and capable of cutting most metals from gauge to 2-inch (50 mm) thickness and from gauge to 1-inch (25 mm) thickness for production cutting. **To achieve consumable long life, all cuts must begin and end on the plate surface**.

Gas Console

This unit houses metering and solenoid valves for shield and plasma gases, flow meters, pressure gauges for plasma gases, and a pressure gauge for the shield gas supply.

Argon-Hydrogen Manifold – Optional

This unit houses a flowmeter for argon-hydrogen, a metering valve, a plasma gas outlet switch and a plasma-off valve.

Digital Remote Voltage & Current Control Console

This unit includes LED displays that indicate the setpoints for volts and amperes prior to starting the arc. The displays then automatically display the actual values of the voltage and current while cutting. The digital remote has potentiometers to set and adjust the voltage and current.

Programmable Remote Voltage & Current Control Console

This unit includes LED displays that indicate the setpoints for volts and amperes prior to starting the arc. The displays then automatically display the actual values of the voltage and current while cutting. The programmable remote functions are controlled by the CNC.

Remote Current Control Console

This unit contains a manually adjustable thumbwheel to set arc current only.

Initial Height Sensing - Optional

This unit, used with 2 inductive probes, is designed to automatically detect the workpiece surface and move the torch to the pierce position. This system can be used for underwater cutting, cutting at the water line, or cutting above water.

Timer/Counter – Optional

The timer/counter allows the operator to monitor the number of arc starts and the cumulative time that the arc is on in hours. The arc starts can be reset.

Water Muffler – Optional

The water muffler for the LHF system is an option which greatly improves cutting safety and pollution control capabilities. The water muffler can be used to cut above, below and at the water line. Refer to the Water Muffler instruction manual 802050 for more detailed information. The water muffler cannot be used with the stainless steel torch.

CommandTHC – Optional

The CommandTHC is an external torch height control and initial height sensing system designed for plasma cutting applications on an x-y cutting table. Refer to the CommandTHC instruction manual 802780 for more detailed information.

Specifications

System Requirements

Power Requirements:
Refer to LHF power supply specifications below:

Gas Requirements:

Plasma Gas Types	Oxygen, Nitrogen, Air, Argon-Hydrogen (H35 = 35% Hydrogen/ 65% Argon)
Shield Gas Types	Air, Nitrogen, Carbon Dioxide

Gas Quality:

Oxygen	99.5% pure (liquid gas recommended)
Nitrogen	99.995% pure (liquid gas recommended)
Air	Clean, dry, oil-free (compressed or liquid gas recommended)
Carbon Dioxide	99.5% pure (compressed or liquid gas recommended)

Plasma Gas Inlet Pressures and Flow Rates:

Air	90 psi +/- 10 psi (6.2 bar +/- 0.7 bar) at 82 scfh (2322 l/h)
Oxygen	120 psi +/- 10 psi (8.3 bar +/- 0.7 bar) at 90 scfh (2549 l/h)
Nitrogen	120 psi +/- 10 psi (8.3 bar +/- 0.7 bar) at 80 scfh (2265 l/h)
Argon-Hydrogen	120 psi +/- 10 psi (8.3 bar +/- 0.7 bar) at 105 scfh (2973 l/h)

Shield Gas Inlet Pressures and Flow Rates:

Air	90 psi +/- 10 psi (6.2 bar +/- 0.7 bar) at 280 scfh (7929 l/h)
Carbon Dioxide	90 psi +/- 10 psi (6.2 bar +/- 0.7 bar) at 220 scfh (6230 l/h)
Nitrogen	90 psi +/- 10 psi (6.2 bar +/- 0.7 bar) at 275 scfh (7787 l/h)
Oxygen	120 psi +/- 10 psi (8.3 bar +/- 0.7 bar) at 35 scfh (991 l/h)

Power Supply

Maximum OCV (U_0) .....280 VDC
Output Current (I_2) .....40 – 200 amps
Output Voltage (U_2) .....150 VDC
Duty Cycle Rating (X) .....100% up to 30 kW. Beyond 30 kW, Duty Cycle (X) = (30 kW/Actual Power)^2 Eg: If Actual Power = 32 kW, then Duty Cycle (X) = (30 kW/32 kW)^2 = 88%
Ambient Temperatures/Duty Cycle .....Power supplies will operate between +14° and 104° F (-10° and +40° C). Power supplies operated in an ambient temperature above 86° F (30° C) may show some decrease in duty cycle.
Power Factor (cosφ) 0.86

Input Power (Input Voltage (U_1) x Input Current (I_1))**:**

073227 with THC; **073228** without THC .....200 VAC, 3PH, 50 Hz, 108 amps
073229 with THC; **073230** without THC .....208 VAC, 3PH, 60 Hz, 104 amps
073231 with THC; **073232** without THC .....240 VAC, 3PH, 60 Hz, 90 amps
073235 with THC; **073236** without THC .....400 VAC, CE, 3PH, 50 Hz, 56 amps
073262 with THC; **073263** without THC .....440 VAC, 3PH, 50-60 Hz, 49 amps
073233 with THC; **073234** without THC .....480 VAC, 3PH, 60 Hz, 45 amps
073237 with THC; **073238** without THC .....600 VAC, 3PH, 60 Hz, 36 amps

Dimensions and Weight:
Width.....28-1/4" (710 mm)
Height .....35-1/2" (900 mm); 40-3/4" (1035 mm) on CE units
Depth .....41-1/4" (1045 mm)
Weight.....780 lbs (351 kg); 800 lbs (363 kg) on CE units
Cooling.....Forced Air (Class F)
Coolant Tank Capacity.....2.9 gallons (11 liters)

HySpeed LHF Machine Torch

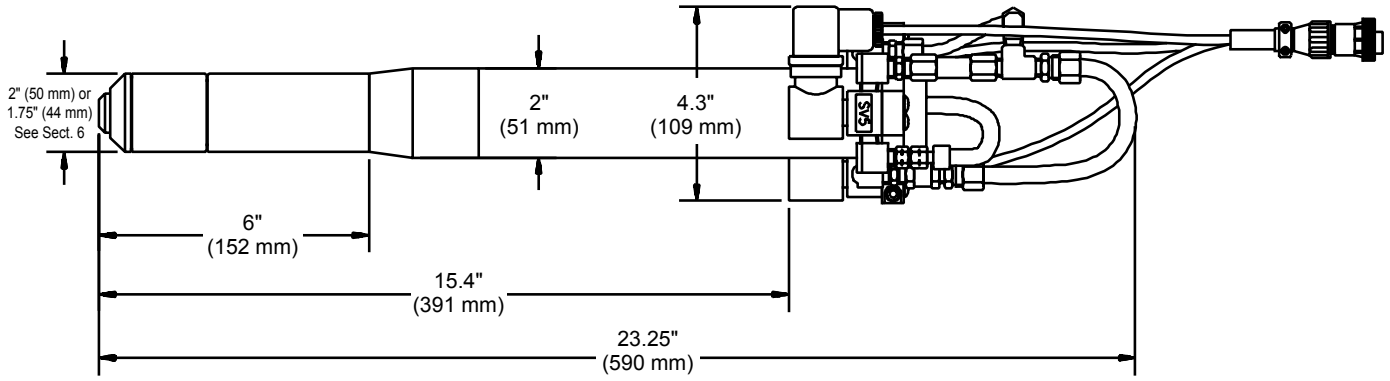


Figure 2-1 LHF Machine Torch (standard torch shown. See Section 6 for figure of stainless steel torch)

Maximum cutting thickness.....2" (50 mm)
Maximum current at 100% duty cycle.....200 amps

Plasma and Shield Gas Flow.....Refer to the *Cut Charts* in the **Operation** section for specific gas requirements.

Water coolant flow rate .....0.8 gpm (3.0 l/min)
Weight.....3 lbs (1.36 kg)

Gas Console

Dimensions and Weight:

Width .....11.5" (290 mm)
Height.....14.5" (370 mm)
Depth.....4" (100 mm)
Weight .....23 lbs (10.4 kg)

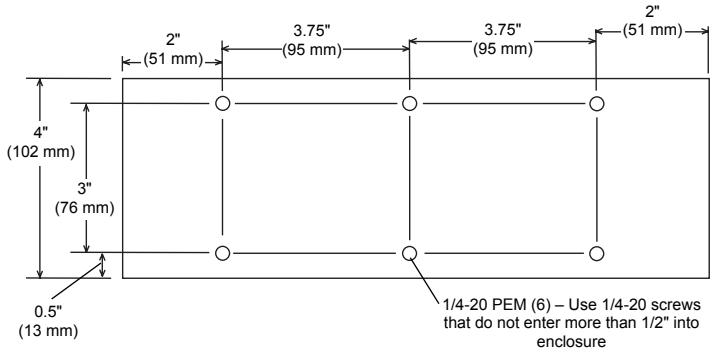


Figure 2-2 Mounting Dimensions – Gas Console

Argon-Hydrogen Manifold – Optional

Dimensions and Weight:

Width .....5" (127 mm)
Height.....10" (254 mm)
Depth.....5" (127 mm)
Weight .....5.75 lbs (2.6 kg)

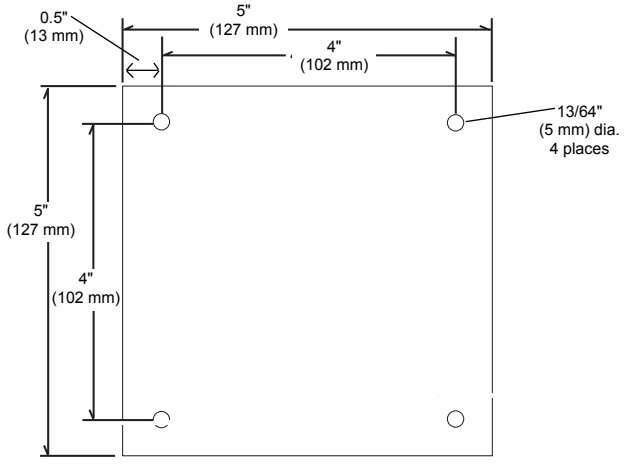


Figure 2-3 Mounting Dimensions – Argon-Hydrogen Manifold

Digital Remote Voltage & Current Control Console

Controls.....Voltage adjust potentiometer: Adjusts arc cutting voltage and displays value on LEDs. Current adjust potentiometer: Adjusts arc current and displays value on LEDs.
Control range .....Current: 40-200 amps/Voltage: 100-200 volts
Control resolution.....Current: 10 amps/ Voltage: 5 volts

Dimensions and Weight:
Width .....11.4" (290 mm)
Height.....3" (76 mm)
Depth.....13.4" (340 mm)
Weight .....5.3 lbs (2.4 kg)

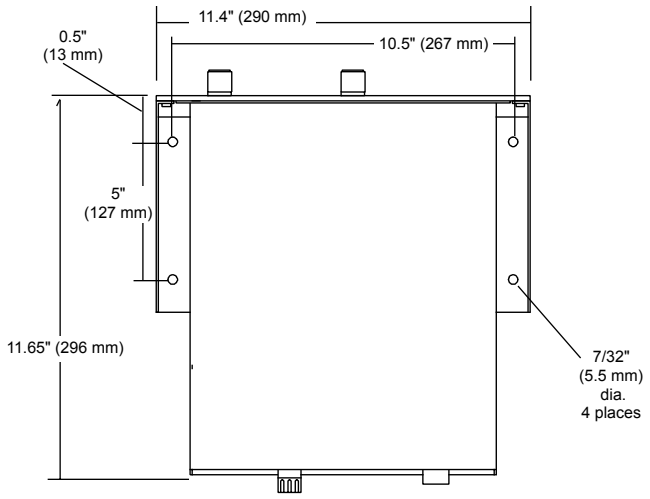


Figure 2-4 Mounting Dimensions – Digital Remote Voltage & Current Control Console

Programmable Remote Voltage & Current Control Console

Controls.....None. Controlled through guidance CNC.
Control range .....Current: 40-200 amps/Voltage: 100-200 volts
Control resolution.....Current: 10 amps/ Voltage: 5 volts

Dimensions and Weight:
Width .....11.4" (290 mm)
Height.....3" (76 mm)
Depth.....12.5" (318 mm)
Weight .....5.3 lbs (2.4 kg)

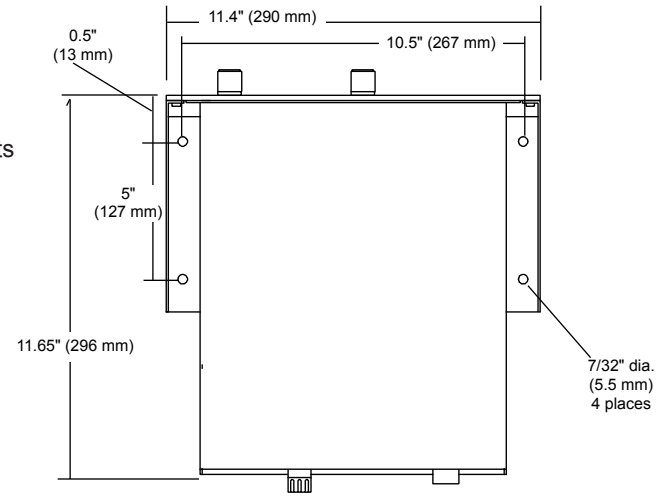


Figure 2-5 Mounting Dimensions – Programmable Remote Voltage & Current Control Console

Remote Current Control Console

Dimensions and Weight:
Width .....6-1/2" (165 mm)
Height.....2-1/2" (64 mm)
Depth.....8-5/8" (219 mm)
Weight .....3 lbs (1 kg)

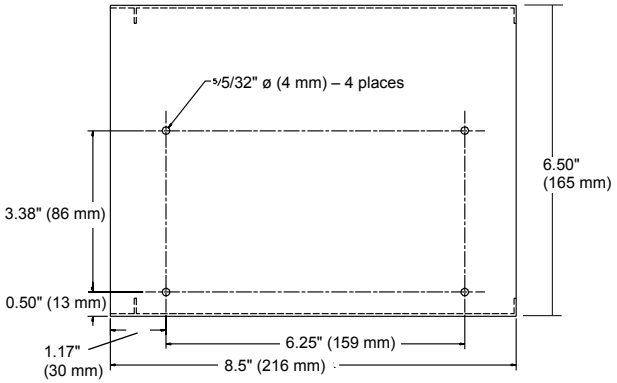


Figure 2-6 Mounting Dimensions – Remote Current Control Console

Initial Height Sensing (IHS) – Optional

Input power .....120VAC from power supply
Air pressure.....20 psi (1.4 bar) regulated shop air input to solenoid

Dimensions and Weight:
Width .....9" (229 mm)
Height.....4.5" (114 mm)
Depth.....11.5" (292 mm)
Weight .....13 lbs (6 kg)

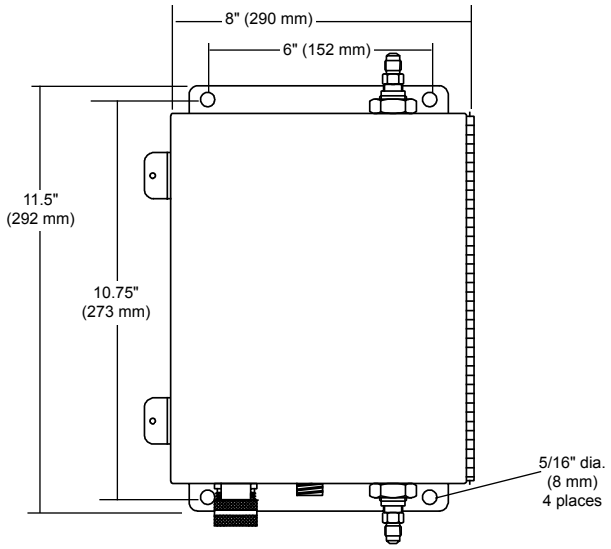


Figure 2-7 Mounting Dimensions – IHS

Timer/Counter – Optional

Dimensions and Weight:
Width .....6-1/2" (165 mm)
Height.....2-1/2" (64 mm)
Depth.....8-5/8" (219 mm)
Weight .....3 lbs (1 kg)

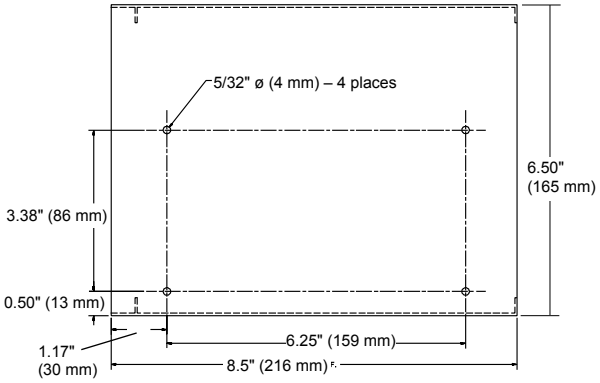


Figure 2-8 Mounting Dimensions – Timer/Counter

Water Muffler – Optional

Refer to the Water Muffler Instruction Manual 802050. The water muffler cannot be used with the stainless steel torch.

CommandTHC – Optional

Refer to the CommandTHC Instruction Manual 802780.

Hypertherm

Section 3

INSTALLATION

Upon Receipt

- Verify that all system components on your order have been received. Contact your supplier if any items are missing.
- Inspect the system components for any physical damage that may have occurred during shipping. If there is evidence of damage, refer to *Claims.* All communications regarding claims must include the model number and serial number located on the back of the power supply.

Claims

Claims for damage during shipment – If your unit was damaged during shipment, you must file a claim with the carrier. Hypertherm will furnish you with a copy of the bill of lading upon request. If you need additional assistance, call Customer Service listed in the front of this manual, or your authorized Hypertherm distributor.

Claims for defective or missing merchandise – If any of the merchandise is defective or missing, contact your supplier. If you need additional assistance, call Customer Service listed in the front of this manual, or your authorized Hypertherm distributor.

Installation Requirements

All installation and service of the electrical and plumbing systems must conform to national or local electrical and plumbing codes. This work should be performed only by qualified, licensed personnel.

Direct any technical questions to the nearest Hypertherm Technical Service Department listed in the front of this manual, or your authorized Hypertherm distributor.

Gas Requirements

All gases are provided by the customer**.** Refer to **Section 2** for specifications.

Caution: Gas supply pressures not within the parameters outlined in Section 2 can cause poor cut quality, poor consumable life, and operational problems.

If the purity level of the gas is too low or if there are leaks in the supply hoses or connections,

- **Cut speeds can decrease**
- **Cut quality can deteriorate**
- **Cutting thickness capability can decrease**
- **Parts life can shorten**

The LHF system can cut with air, oxygen, nitrogen or argon-hydrogen as the plasma gas, and use air, nitrogen or carbon dioxide as the shield gas.

Air may be supplied from cylinders, a liquid supply, or from an on-site compressor. Hypertherm recommends a three-stage coalescing filtration system when using air as a supply gas. See the appendix section for suggested filtration.

Other gases may be supplied from cylinders or liquid storage tanks.

Gas Supply Plumbing

If making hard plumbing connections, avoid using iron pipe. Never use PTFE tape on any joint preparation. After installation, pressurize the entire system and check for leaks.

For flexible-hose systems, use a hose designed for inert gas to carry air, nitrogen, argon-hydrogen or carbon-dioxide.

Caution: Only hose designed to carry oxygen may be used for oxygen lines.

Note: When cutting with oxygen as the plasma gas, nitrogen must also be connected to the gas console to achieve the proper oxygen/nitrogen mixtures in the preflow and cut flow conditions.

WARNING

Cutting with oxygen as the plasma gas can cause a potential fire hazard due to the oxygen-enriched atmosphere that it creates. As a precaution, Hypertherm recommends that an exhaust ventilation system be installed when cutting with oxygen.

Torch Coolant Requirements

The power supply is shipped to the customer without any coolant in the tank. Hypertherm recommends a mixture of 30% propylene glycol, 69.9% purified water, and 0.1% benzotriazole. This mixture resists freezing to +10° F (-12° C) and protects copper surfaces in the coolant loop.

Caution: For operating temperatures colder than +10° F (-12° C), the percentage of propylene glycol must be increased to avoid the risk of a cracked torch head, hoses, or other damage to the torch coolant system due to the freezing of the torch coolant.

Caution: Always use propylene glycol in the coolant. Do not substitute automotive antifreeze which will damage the torch cooling system.

Caution: Always use purified water in the coolant mixture in order to prevent corrosion in the cooling system. The hardness of the purified water should be between 0.2 and 8.5 ppm. If using a conductivity meter to measure water purity, the recommended level is between 0.5 and 18 µSiemens/cm at 77° F (25° C).

See the chart in the appendix section to determine if a stronger propylene glycol/purified water solution is needed for your particular application. The standard coolant mixture is available in 1-gallon containers by ordering 028872. 100% propylene glycol is available by ordering 028873.

Refer to the Material Safety Data Sheets in the appendix section for data on safety, handling, and storage of propylene glycol and benzotriazole.

WARNING

Propylene glycol and benzotriazole are irritating to skin and eyes, and harmful or fatal if swallowed. Upon contact, flush skin or eyes with water. If swallowed, drink water and call a physician immediately. Do not induce vomiting.

Grounding Requirements

Proper grounding is essential for personal safety and to prevent emission of high-frequency interference.

See Appendix for system grounding requirements.

Connect the worktable to a high-quality earth ground, not more than 20 feet (6 m) from the table. A suitable ground consists of a solid copper rod of at least 1/2" (12 mm) diameter driven to a depth of at least 8 feet (2.5 m) into the earth, below the permanent moisture level. Ensure that all grounding connections are tight to avoid excessive heating. The power supply enclosure is grounded through the incoming AC conductor and does not require an additional ground. See also *Grounding* in the **Safety** section. For additional information consult national or local electric codes.

Caution: All accessory modules in the system must be grounded to earth. Use a minimum of 8 AWG wire connected from the stud on the side of each module enclosure to the worktable ground.

Noise levels

This plasma system may produce noise that is harmful to the operator or to those close to the cutting table. See *Noise Protection* in the **Safety** section.

Power Requirements

All switches, slow-blow fuses and power cables are customer supplied and must be chosen as outlined by applicable national and/or local electrical codes. Installation must be performed by qualified personnel. Use a separate primary line disconnect switch for the power supply.

Input Voltage	Phase	Rated Input Current @ 30 kw Output	Recommended Slow-Blow Fuse Size	Recommended Cable Size (AWG)
200 VAC	3	108 amps	150 amps	1
208 VAC	3	104 amps	150 amps	1
240 VAC	3	90 amps	150 amps	1
400 VAC	3	56 amps	80 amps	4
440 VAC	3	49 amps	70 amps	6
480 VAC	3	45 amps	60 amps	6
600 VAC	3	36 amps	50 amps	8

Line Disconnect Switch

The line disconnect switch serves as the supply voltage disconnecting (isolating) device. Install this switch on a wall near the power supply for easy accessibility by the operator. **The line disconnect switch must be installed by qualified personnel following all applicable local and national codes. The switch should:**

- isolate the electrical equipment and disconnect all live conductors from the supply voltage when in the “OFF” position
- have one “OFF” and one “ON” position clearly marked with “0” (OFF) and “1” (ON)
- have an external operating handle capable of being locked in the “OFF” position
- contain a power operated mechanism that serves as an emergency stop
- have slow-blow fuses installed for the proper breaking capacity (see table above)

Power Cable

Wire sizes vary based on the distance of the receptacle from the main box. The wire sizes listed in the table above were taken from the National Electric Code 1990 handbook, table 310.16. Use a 4-conductor Type SO input power cable with a conductor temperature rating of 140°F (60°C). The cable should be installed only by a licensed electrician.

Positioning the Power Supply

WARNING

Remove all electrical connections to power supply before moving or positioning. Transporting unit can cause personal injury and equipment damage.

Note**:** A lifting eye is provided for moving the power supply into place with a crane or hoist. It may also be moved by forklift if the forks are long enough to extend the entire length of the base. Take care when lifting with the forks so that the underside of the power supply is not damaged.

- Place the power supply in an area that is free of excessive moisture, has proper ventilation, and is relatively clean. Allow room for accessing the sides of the power supply for servicing.
- Cooling air is drawn in through the front panel grating, and is exhausted through the rear of the unit by a cooling fan. Do not place any filter device over the air intake locations. This reduces cooling efficiency and VOIDS THE WARRANTY.

Connecting the Power

WARNING

The line disconnect switch must be in the OFF position before making the power cable connections! In the U.S., use a "lock-out/tag-out" procedure until installation is complete. In other countries, follow appropriate local or national safety procedures.

Connecting the Power (continued)

1. Insert the power cable through the strain relief at the lower left rear of the power supply. Connect the power cable leads to **TB1** located at the center wall, right side.

2. Connect the power leads to the **L1**, **L2**, and **L3** terminals of **TB1.** See Fig. 3-1.

3. Connect the ground lead as shown.

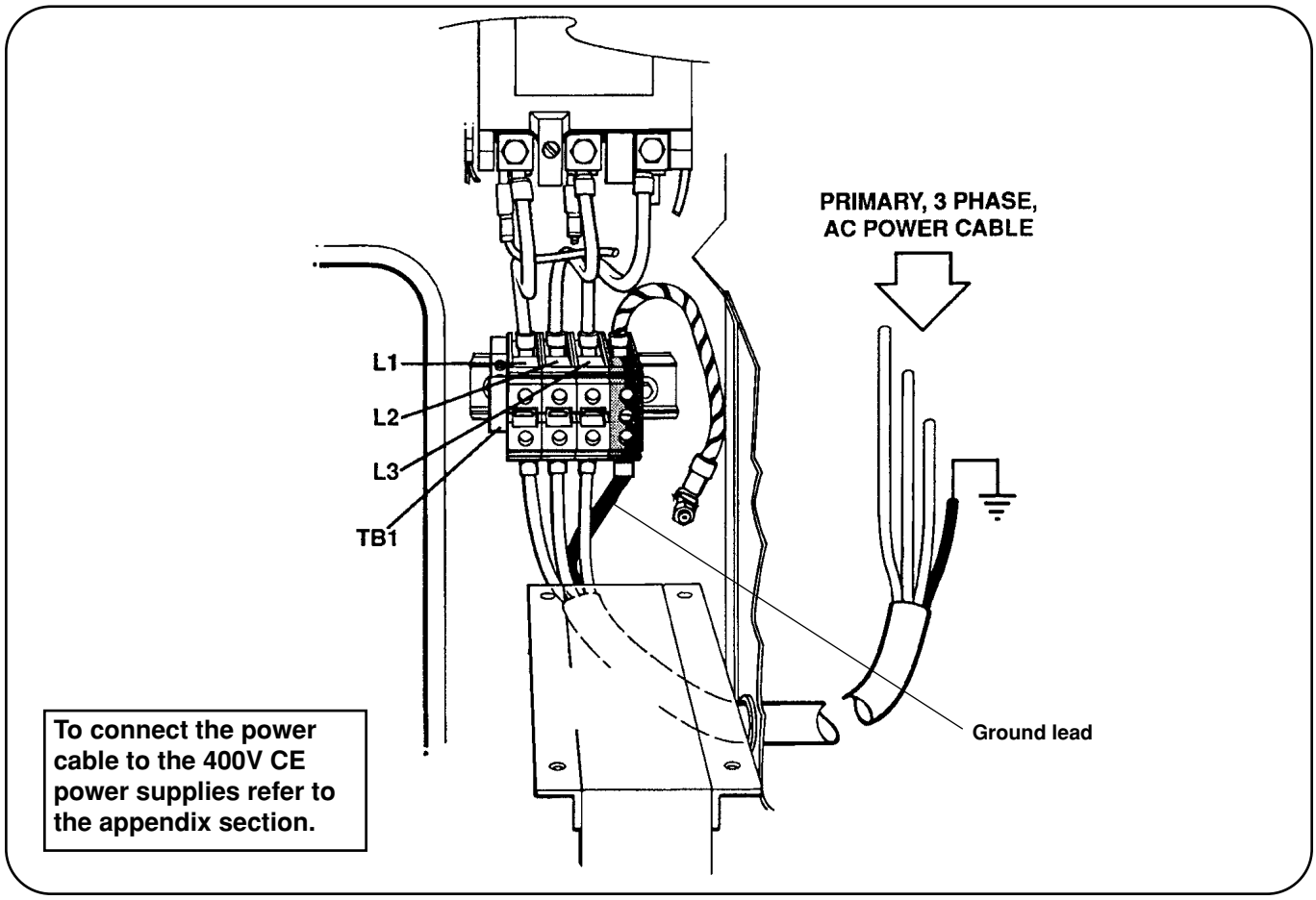


Figure 3-1 Power Cable Connections

WARNING

There is line voltage at the contactor if the line disconnect switch is in the ON position, even if the ON (1) pushbutton on the power supply has not been pressed. As a common safety practice, ALWAYS verify that the line disconnect switch is in the OFF position before installing, disconnecting or servicing in this area.

Power Cable from LHF Power Supply to Power Source.

1. **Be certain that the line disconnect switch is in the OFF position and remains in the OFF position for the remainder of the installation of the LHF system.**

2. Connect the power cord leads to the line disconnect switch following local and applicable electrical codes.

Torch Lifter Requirements

The LHF system requires a high-quality, motorized torch lifter with sufficient travel to cover all cutting thickness requirements. The lifter must provide **10 inches (254 mm) of vertical travel**. The unit should have a constant speed of at least **20 ipm (508 mm/min)** with positive braking. A unit which drifts through the stop point is not acceptable.

Optional Equipment

Water Muffler

Refer to Water Muffler instruction manual 802050. A power cable for the Water Muffler pump must be provided by the customer. The pumps provided by Hypertherm take a three-phase input. Part numbers and corresponding voltages are listed in the Water Muffler manual. Input current information is provided on the motor data plate. Present pump systems all draw less than 20 amps and cable sizes should be selected accordingly.

The water muffler cannot be used with the stainless steel torch.

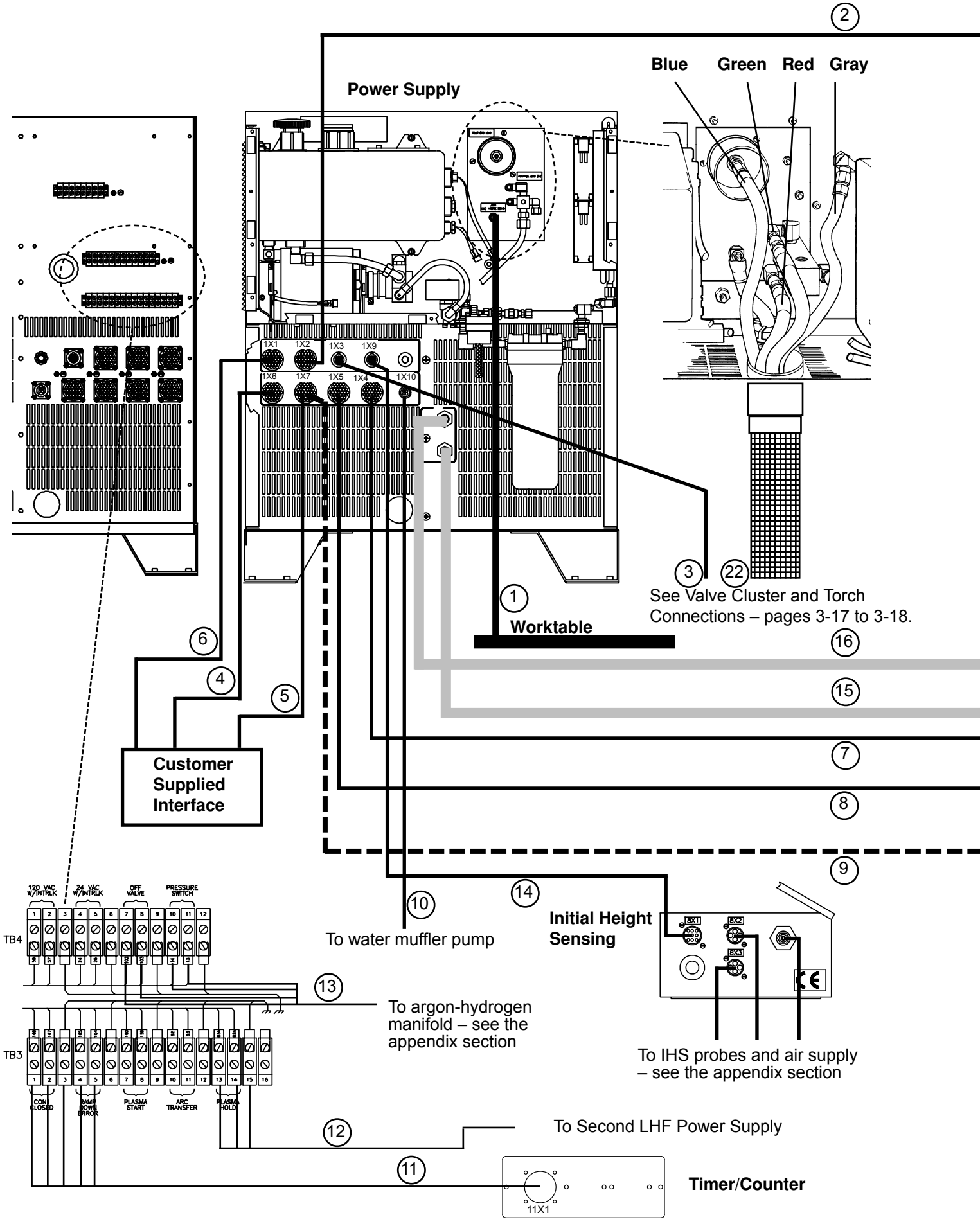
System Units Placement

- Position all required units prior to making electrical, gas and interface connections.
- Ground all external modules in the LHF system to earth.
- To prevent leaks in the system, tighten all gas and water connections to the following specifications:

Gas or water hose size	Torque Specification		
	lbf-in	lbf-ft	kgf-cm
up to 3/8"	75-85	6.25-7	86-98
1/2"	360-480	30-40	415-550

Use 2 wrenches when tightening to prevent damage to the mating component.

Use the diagram on the following 2 pages to make system interconnections. Follow the number guide on the diagram to find out specific information on each cable, hose or connection. The numbered items are detailed on the pages following the interconnection diagram.


2
Blue
Green
Red
Gray
Power Supply
1X1
1X2
1X3
1X9
1X6
1X7
1X5
1X4
1X10
3
22
See Valve Cluster and Torch Connections – pages 3-17 to 3-18.
1
Worktable
6
4
5
16
15
7
8
9
Customer Supplied Interface
10
To water muffler pump
14
Initial Height Sensing
8X1
8X2
8X3
13
To argon-hydrogen manifold – see the appendix section
To IHS probes and air supply – see the appendix section
TB4
120 VAC W/INTRLK
24 VAC W/INTRLK
OFF VALVE
PRESSURE SWITCH
TB3
CONT CLOSED
RAMP DOWN ERROR
PLASMA START
ARC TRANSFER
PLASMA HOLD
12
To Second LHF Power Supply
11
11X1
Timer/Counter

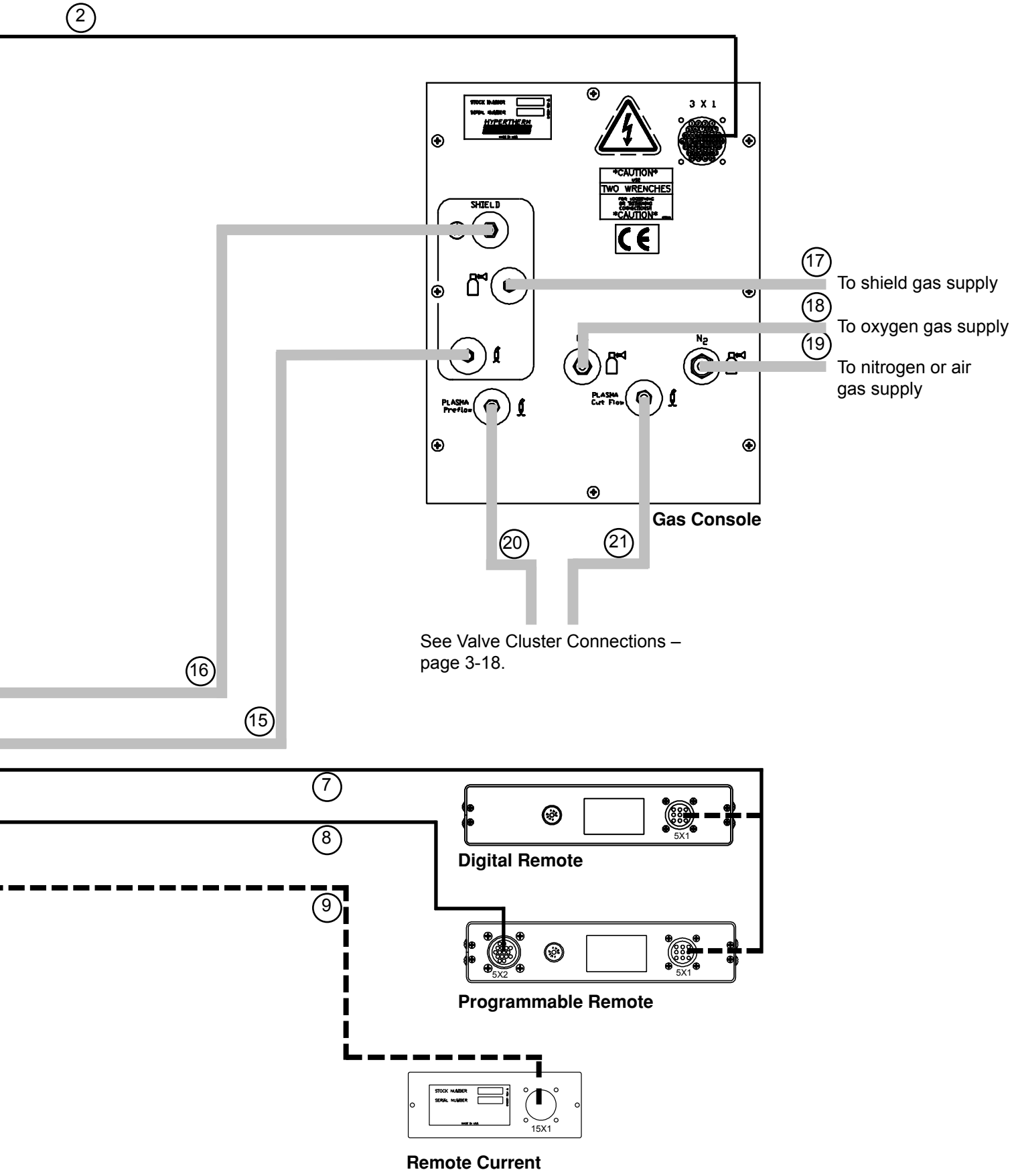


Figure 3-2 System Interconnections

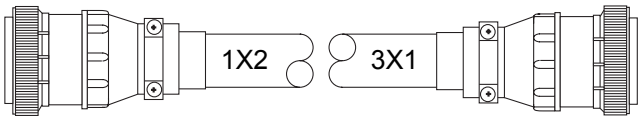
Power Supply Connections

(1) *Positive Lead – Power Supply to Worktable*

(1)

Part No.	Length
023755	4 ft (1.2 m)
023920	8 ft (2.4 m)
023508	10 ft (3 m)
023403	15 ft (4.6 m)
023404	25 ft (7.6 m)
023968	30 ft (9.2 m)
023986	35 ft (10.7 m)
023405	50 ft (15 m)

(2) *Gas Console Cable – Power Supply to Gas Console*



(2)

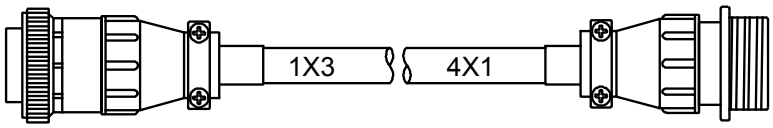
Part No.	Length
023989	10 ft (3 m)
023549	15 ft (4.6 m)
023605	25 ft (7.6 m)
023757	38 ft (11.6 m)
023606	50 ft (15 m)
123044	60 ft (18.3 m)
023607	75 ft (23 m)
123077	85 ft (25.9 m)
023608	100 ft (30.5)
023963	115 ft (35.1 m)
123147	120 ft (36.6 m)
023743	125 ft (38.1 m)
023609	150 ft (46 m)
023953	200 ft (62 m)

1x2	3x1	Color	Signal
2	2	Black	LT1 / DC ON
3	3	Green	LT1 / DC ON
7	7		Shield
8	8	Black	SV1B / O2 / N2
9	9	Blue	SV1B / O2 / N2
4	4		Shield
16	16	Black	SV2 / O2 / N2
17	17	Yellow	SV2 / O2 / N2
10	10		Shield
27	27	Red	SV1A / O2 / N2
28	28	Brown	SV1A / O2 / N2
22	22		Shield
11	11	Black	SV3 / Preflow Trap
12	12	Brown	SV3 / Preflow Trap
18	18		Shield

1x2	3x1	Color	Signal
19	19	Black	S1 / N2 / O2
20	20	Orange	S1 / N2 / O2
13	13		Shield
14	14	Red	S2 / Test / Preflow
15	15	White	S2 / Test / Common
21	21		Shield
35	35	Red	S2 / Test / Operate
36	36	Green	S2 / Test / Common
31	31		Shield
32	32	Red	PS1&PS2
33	33	Blue	PS1&PS2
37	37		Shield

(3) *Off-Valve Cable – Power Supply to Valve Cluster Cable*

See valve cluster connections on page 3-18.

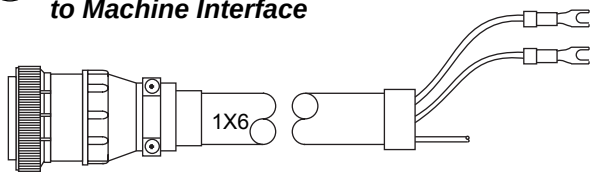


(3)

Part No.	Length
123283	15 ft (4.6 m)
123284	20 ft (6 m)
123285	25 ft (7.6 m)
123286	30 ft (9.2 m)
123287	35 ft (10.7 m)
123288	40 ft (12.2 m)
123289	50 ft (15 m)

1x3	4x1	Color	Signal
1	1	Red	SV4A Cutflow
2	2	White	SV4A Cutflow
3	3	Green	Shield
5	5	Orange	SV4B Preflow
6	6	White	SV4B Preflow
4	4	White	Shield
7	7	Black	SV5 Plasma OFF
8	8	White	SV5 Plasma OFF
9	9	Yellow	Shield

(4) *Machine I/O Interface Cable – Power Supply to Machine Interface*



(4)

Part No.	Length	Part No.	Length
023841	6 ft (1.8 m)	123080	85 ft (25.9 m)
023842	15 ft (4.6 m)	023847	100 ft (30.5)
023843	25 ft (7.6 m)	023962	115 ft (35.1 m)
023844	35 ft (10.7 m)	123148	120 ft (36.6 m)
023845	50 ft (15 m)	023848	125 ft (38.1 m)
123047	60 ft (18.3 m)	023849	150 ft (46 m)
023846	75 ft (23 m)	023850	200 ft (62 m)

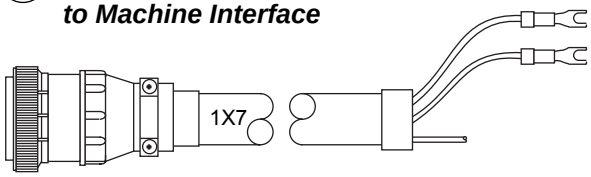
1x6	Color	Signal	1x6	Color	Signal
2	Yellow	Initial Height Sig. (OFF=Closed)	9	Blue	Plasma START (START=Closed)
6	Black	Initial Height Com.	15	Black	Plasma START
11		Shield	14		Shield
4	Orange	Auto Height Sig. (OFF=Closed)	37	Red	†Arc Transfer (TRANSFER=Closed)
8	Black	Auto Height Com.	32	Green	†Arc Transfer
13		Shield	26		Shield
34	Red	*†Lifter DOWN Load (DOWN=Closed)	1	White	Hold Ignition Sig. (HOLD=Closed)
29	Black	Lifter DOWN Line	5	Black	Hold Ignition Com.
23		Shield	10		Shield
35	Green	*†Lifter UP Load (UP=Closed)	3	Brown	Ramp Down Error
30	Black	Lifter UP Line	7	Black	Ramp Down Error
24		Shield	12		Shield
36	Red	Upper Limit Switch (OFF=Closed)			
31	Blue	Upper Limit Switch			
25		Shield			

* Signals are AC relays. DC relays are available as an option from Hypertherm by ordering kit: 128404

WARNING

When installing or servicing the power supply, AC or DC line voltages may be present on the UP, DOWN and TRANSFER signals even if the power supply line disconnect switch is OFF. Make certain that <u>all</u> line disconnect switches relating to the system are OFF during installation and when servicing.

(5) *Machine V/C Interface Cable – Power Supply to Machine Interface*



(5)

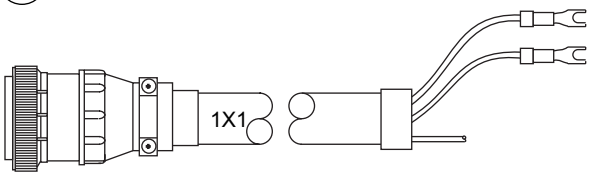
Part No.	Length	Part No.	Length
023902	6 ft (1.8 m)	023855	75 ft (23 m)
023851	15 ft (4.6 m)	023856	100 ft (30.5)
023852	25 ft (7.6 m)	023903	125 ft (38.1 m)
023853	35 ft (10.7 m)	023857	150 ft (46 m)
023854	50 ft (15 m)	023858	200 ft (62 m)

Note: If you are using a remote V/C to set voltage and current, skip this step.

Before connecting the machine V/C interface cable, see the wiring diagrams in this manual and verify that the correct plug is attached to the µP control PCB REC6 receptacle.

1x7	Color	Signal	1x7	Color	Signal
2	White	Current 10	16	Black/Red	Voltage V5
3	Red	Current 20	17	White/Red	Voltage V10
4	Green	Current 40	18	Orange/Red	Voltage V20
5	Orange	Current 80	19	Blue/Red	Voltage V40
6	Blue	Current 100	20	Red/Green	Voltage V80
7	White/Black	Current 200	21	Orange/Green	Voltage V100
10	Shld	Shield	22	Black/White/Red	Voltage V200
11	Blue/Black	Current Common	23	White/Black/Red	Voltage VCommon

6 *Remote I/O Cable – Power Supply to Remote Interface*

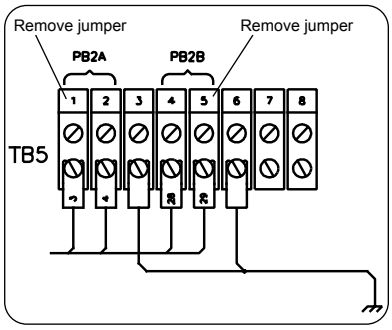


6

Part No.	Length	Part No.	Length
123294	6 ft (1.8 m)	123301	85 ft (25.9 m)
123295	15 ft (4.6 m)	123302	100 ft (30.5)
123296	25 ft (7.6 m)	123303	115 ft (35.1 m)
123297	35 ft (10.7 m)	123304	120 ft (36.6 m)
123298	50 ft (15.3 m)	123305	125 ft (38.1 m)
123299	60 ft (18.3 m)	123306	150 ft (46 m)
123300	75 ft (23 m)	123307	200 ft (62 m)

1x1	Color	Signal	1x1	Color	Signal
2	Yellow	PB1 LT1 24VAC	19	White	FS1 Interlock
3	Black	PB1 LT1 24VAC	20	Red	FS1 Interlock
7	Shield	Ground	13	Shield	Ground
5	Orange	TS1 Interlock	**23**	**Blue**	**LT1 120 VAC**
6	Black	TS1 Interlock	**24**	**Black**	**LT1 120 VAC**
1	Shield	Ground	25	Shield	Ground
8	Red	LS1 Interlock	26	Red	PB2A 24 VAC
9	Black	LS1 Interlock	27	Green	PB2A 24 VAC
4	Shield	Ground	28	Shield	Ground
11	Green	PS3 Interlock	**29**	**White**	**PB2B 120 VAC**
12	Black	PS3 Interlock	**30**	**Black**	**PB2B 120 VAC**
18	Shield	Ground	34	Shield	Ground
14	Red	PS1,PS2 Interlock	32	Brown	PB1A 24 VAC
15	Blue	PS1,PS2 Interlock	33	Black	PB1A 24 VAC
21	Shield	Ground	37	Shield	Ground
16	Red	TS2 Interlock	**35**	**Red**	**PB1B 120 VAC**
17	Yellow	TS2 Interlock	**36**	**Brown**	**PB1B 120 VAC**
10	Shield	Ground	31	Shield	Ground

Notes:
- **If using this Remote I/O Cable, remove jumpers from power supply TB5 terminals 1&2 and 4&5 and terminate Remote I/O Cable wires for PB2A and PB2B to a normally closed switch.**
- Terminate wires for PB1A and PB1B to a normally open switch.
- Input requirements for interlocks: DC current between 15 and 20 mA; DC voltage between 12 and 15 V.
- Refer also to pages 3 and 6 of the wiring diagrams in Section 7.

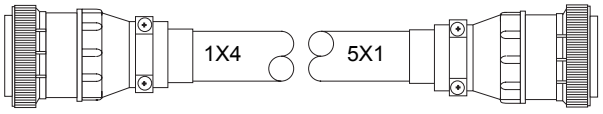


WARNING

- **Be certain to properly terminate 120 VAC wire connections!**
- **Provide proper strain relief for remote I/O cable at customer interface.**

7 *Remote Voltage and Current Cable – Power Supply to Digital Remote or Programmable Remote*

Note: If you are using a machine computer interface to set voltage and current and do not want the programmable voltage current readout, skip references 7-9.



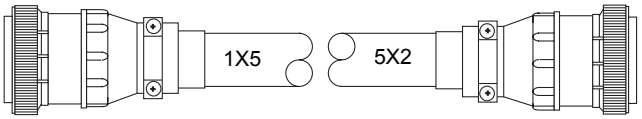
1x4	5x1	Color	Signal
4	1	Green	SID Data
8	2	Black	SID Common
13		Grn/Blk	Shield
9	3	Red	SOD Data
15	6	Black	SOD Common
14		Red/Blk	Shield
35	7	White	AC Power
36	8	Black	AC Power
31		Wht/Blk	Shield
	5		Key
22			Key

7

Part No.	Length	Part No.	Length
023990	7 ft (2.1 m)	123188	120 ft (36.6 m)
023911	15 ft (4.6 m)	023882	125 ft (38.1 m)
023878	25 ft (7.6 m)	023883	150 ft (45.8 m)
023879	50 ft (15.3 m)	023884	200 ft (61 m)
123040	60 ft (18.3 m)	023885	250 ft (76.3 m)
023880	75 ft (22.9 m)	023886	275 ft (83.9 m)
123073	85 ft (25.9 m)	023887	300 ft (91.5 m)
023881	100 ft (30.5 m)		

(8) *Programmable Remote Voltage and Current Cable – Power Supply to Programmable Remote*

Note: If you are using the digital remote to set voltage and current, skip this reference.



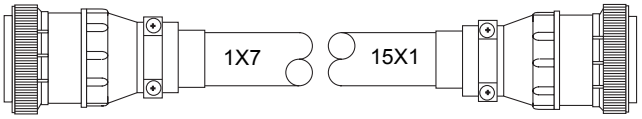
(8)

Part No.	Length	Part No.	Length
023834	15 ft (4.6 m)	023898	125 ft (38.1 m)
023835	25 ft (7.6 m)	023839	150 ft (45.8 m)
023836	50 ft (15.3 m)	023840	200 ft (61 m)
023837	75 ft (22.9 m)	023899	250 ft (76.3 m)
023838	100 ft (30.5 m)	023900	275 ft (83.9 m)
		023901	300 ft (91.5 m)

1x5	5x2	Color	Signal	1x5	5x2	Color	Signal
1	1	Black	Current 20	10	10	Black/Green	Voltage 20
2	2	Blue	Current 40	11	11	Black/Orange	Voltage 40
3	3	Green	Current 80	12	12	Black/Red	Voltage 80
4	4	White	Current 100	13	13	White/Green	Voltage 100
5	5	Orange	Current 200	14	14	White/Red	Voltage 200
7	7	White/Black	Common	15	15	Black/White	Spare
8	8	White/Blue	Voltage 5	16	16	Shld	Shield
9	9	Black/Blue	Voltage 10				

(9) *Current Control Cable – Power Supply to Remote Current Control*

Note: If you are using the digital remote, programmable remote or machine computer to set current, skip this reference.



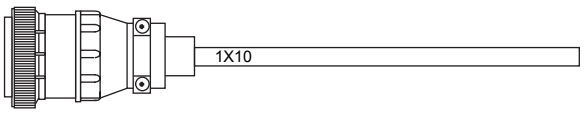
1X7	15X1	Color	Current Signal (I)
2	8	Black	I-10
3	7	White	I-20
4	10	Black	I-40
5	9	Green	I-80
6	15	Black	I-100
7	16	Red	I-200
11	3		I-Com

(9)

Part No.	Length
123150	10 ft (3 m)
023871	25 ft (7.6 m)
023872	38 ft (11.6 m)
023873	50 ft (15 m)
023874	75 ft (23 m)
023875	100 ft (30.5 m)
123068	110 ft (33.6 m)
123277	120 ft (36.6 m)
123088	125 ft (38.1 m)
023876	150 ft (46 m)
123032	170 ft (51.9 m)
023877	200 ft (61 m)

(10) *Water Muffler Pump Cable – Power Supply to Water Muffler Pump*

See water muffler instruction manual 802050 to connect cable to pump motor, and to make remaining water muffler connections. The water muffler cannot be used with the stainless steel torch.

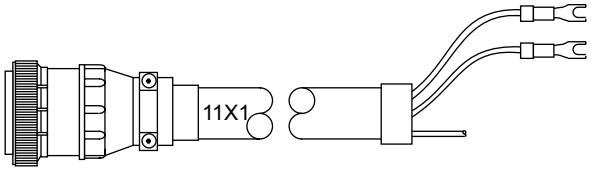


From 1X10	Color	To WM Pump Contactor
2	Black	Coil
4	White	AC Neut.
3	Green	Ground

(10)

Part No.	Length
023866	50 ft (15 m)
023867	75 ft (23 m)
023868	100 ft (30.5)

(11) *Timer/Counter Cable – Power Supply to Timer/Counter*

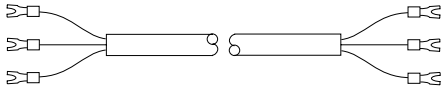


11x1	TB3	Color	Signal
1	2	White	Starts and Arc time (CON1 Closed)
2	1	Black	Starts and Arc time (CON1 Closed)
3	3	Drain	Drain
15	5	Red	Error Counter (Ramp Down Error)
16	4	Black	Error Counter (Ramp Down Error)
12	6	Drain	Drain

(11)

Part No.	Length
023687	10 ft (3 m)
023692	25 ft (7.6 m)
023758	38 ft (11.6 m)
023693	50 ft (15 m)
123046	60 ft (18.3 m)
023694	75 ft (23 m)
123079	85 ft (25.9 m)
023695	100 ft (30.5)
023993	115 ft (35.1 m)
123189	120 ft (36.6 m)
023696	150 ft (46 m)
023954	200 ft (62 m)

(12) *Hold Cable – Power Supply 1 to Power Supply 2*



Color	TB3	Signal
Black	13	Hold Signal
Red	14	Hold Common
Shield	15	Hold Shield

(12)

Part No.	Length
023340	15 ft (4.6 m)
023341	25 ft (7.6 m)
023342	50 ft (15 m)
023343	100 ft (30.5)
023344	150 ft (46 m)

(13) *Argon-Hydrogen Cable – Power Supply to Argon-Hydrogen Manifold*

See the appendix section for Argon-Hydrogen installation and operation.

(14) *Initial Height Sensing Cable – Power Supply to Initial Height Sensing Console*

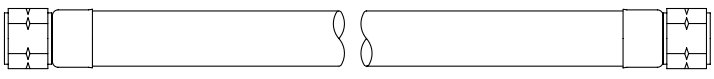
See the appendix section for Initial Height Sensing connections.

Gas Console Connections

See page 3-9 for gas console connection to power supply.

(15) *Shield Gas Hose – Gas Console to Power Supply*

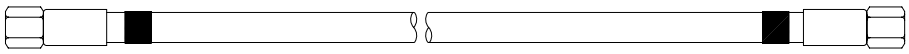
Note: Turn counterclockwise to tighten



(15)

Part No.	Length
024348	5 ft (1.5 m)
024313	10 ft (3 m)
024302	15 ft (4.6 m)
024349	20 ft (6.1 m)
024303	25 ft (7.6 m)
024350	30 ft (9.1 m)
024351	35 ft (10.7 m)
024352	40 ft (12.2 m)
024353	45 ft (13.7 m)
024304	50 ft (15 m)
024305	75 ft (23 m)
024306	100 ft (30.5 m)
024312	150 ft (46 m)

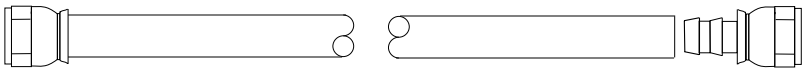
(16) *Shield Gas Sense Hose – Gas Console to Power Supply*



(16) Part No.	Length
024061	5 ft (1.5 m)
024063	10 ft (3 m)
024065	15 ft (4.6 m)
024067	20 ft (6.1 m)
024069	25 ft (7.6 m)
024071	30 ft (9.1 m)
024356	35 ft (10.7 m)
024092	40 ft (12.2 m)
024403	45 ft (13.7 m)
024096	50 ft (15 m)
024174	60 ft (18.3 m)
024468	75 ft (23 m)
024523	100 ft (30.5 m)

(17) *Shield Gas Supply Hose – Shield Supply to Gas Console*

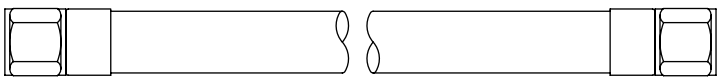
Any supply gases that will be used for the shield gas, attach to the same point on the gas console.



(17) Part No.	Length
024043	4 ft (1.2 m)
024341	10 ft (3 m)
024200	15 ft (4.6 m)
024342	20 ft (6 m)
024133	25 ft (7.6 m)
024448	35 ft (10.7 m)
024407	45 ft (13.7 m)
024012	50 ft (15 m)
024472	60 ft (18.3 m)
024147	75 ft (23 m)
024486	85 ft (25.9 m)
024115	100 ft (30 m)
024452	110 ft (33.6 m)
024449	115 ft (35.1 m)
024515	120 ft (36.6 m)
024395	125 ft (38.1 m)
024119	150 ft (46 m)
024480	170 ft (51.9 m)
024184	180 ft (55 m)
024123	200 ft (61 m)

(18) *Oxygen Plasma Supply Hose – Oxygen Supply to Gas Console*

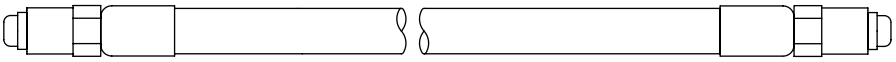
Note: If cutting with oxygen as the plasma gas, nitrogen must also be connected to the gas console to achieve the proper oxygen/nitrogen mixtures in the preflow and cut flow conditions.



(18) Part No.	Length
024204	15 ft (4.6 m)
024205	25 ft (7.6 m)
024155	50 ft (15 m)
024398	75 ft (22.9 m)
024487	85 ft (25.9 m)
024206	100 ft (30 m)
024481	110 ft (33.6 m)
024450	115 ft (35.1 m)
024516	120 ft (36.6 m)
024490	125 ft (38.1 m)
024159	150 ft (46 m)
024470	180 ft (54.9 m)
024333	200 ft (61 m)

Gas Console Connections (continued)

(19) ***Nitrogen Plasma Supply Hose – Nitrogen Supply to Gas Console***

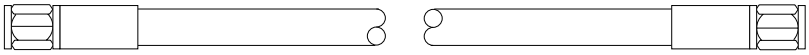


(19)

Part No.	Length
024505	6 ft (1.8 m)
024210	10 ft (3 m)
024203	15 ft (4.6 m)
024232	20 ft (6 m)
024134	25 ft (7.6 m)
024211	35 ft (10.6 m)
024112	50 ft (15 m)
024148	75 ft (23 m)
024488	85 ft (25.9 m)
024116	100 ft (30 m)
024482	110 ft (33.6 m)
024451	115 ft (35.1 m)
024517	120 ft (36.6 m)
024491	125 ft (38.1 m)
024120	150 ft (46 m)
024185	180 ft (55 m)
024124	200 ft (61 m)

(19) ***Air Plasma Supply Hose (Customer Supplied) – Air Supply to Gas Console***

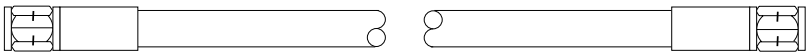
(20) ***Plasma Preflow Gas Hose – Gas Console to Valve Cluster***
See valve cluster connections on page 3-18.



(20)

Part No.	Length
024317	5 ft (1.5 m)
024026	10 ft (3 m)
024027	15 ft (4.6 m)
024017	20 ft (6.1 m)
024028	25 ft (7.6 m)
024029	30 ft (9.1 m)
024030	35 ft (10.7 m)
024031	40 ft (12.2 m)
024207	45 ft (13.7 m)
024340	50 ft (15 m)
024419	56 ft (17.1 m)
024127	60 ft (18.3 m)
024343	75 ft (23 m)
024344	100 ft (30.5 m)

(21) ***Plasma Cut Flow Gas Hose – Gas Console to Valve Cluster***
See valve cluster connections on page 3-18.



Note: Turn counterclockwise to tighten

(21)

Part No.	Length
024316	5 ft (1.5 m)
024307	10 ft (3 m)
024320	15 ft (4.6 m)
024308	20 ft (6.1 m)
024321	25 ft (7.6 m)
024309	30 ft (9.1 m)
024322	35 ft (10.7 m)
024310	40 ft (12.2 m)
024323	45 ft (13.7 m)
024311	50 ft (15 m)
024420	56 ft (17.1 m)
024367	60 ft (18.3 m)
024357	75 ft (23 m)
024358	100 ft (30.5 m)

Valve Cluster and Torch Connections

Routing the Torch Leads

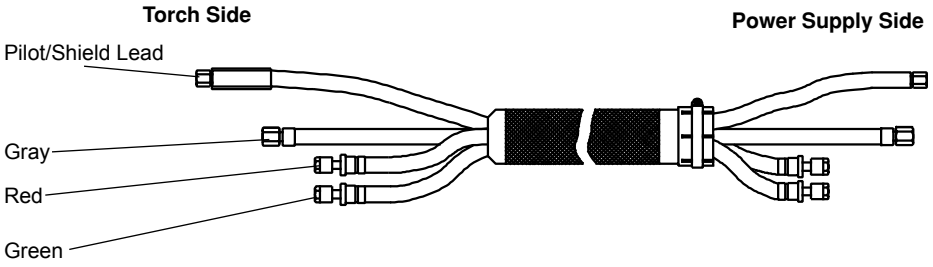
Caution: Before routing the leads, make sure that the torch is removed from the torch leads.

Route the torch leads from the power supply to the torch through a festoon or a power track.

Connecting the Torch Leads to the Torch

See page 3-8 for torch lead connections to the power supply.
See page 3-7 for torque specifications.

(22) ***Torch Leads – Power Supply to Torch*** **(22)**



Part No.	Length
028657	10 ft (3 m)
028658	15 ft (4.6 m)
028659	20 ft (6.1 m)
028546	25 ft (7.6 m)
028660	30 ft (9.1 m)
028661	35 ft (10.7 m)
028662	40 ft (12.2 m)
028663	45 ft (13.7 m)
028547	50 ft (15 m)

1. If the 12" off-valve hose is connected from the torch to the valve cluster, disconnect it at the valve cluster. Note that the fitting is left-hand threaded and turns in a clockwise direction to remove.

2. Slide the torch sleeve over the torch leads and out of the way.

3. Attach the red and green torch leads to the red and green tubes of the torch main body using a 3/8" wrench to hold the torch fittings, and a 1/2" wrench to tighten the torch lead fittings.

4. Attach the pilot/shield lead to the shortest tube on the torch main body. Use a 5/16" wrench to hold the torch body fitting and a 7/16" wrench to tighten the torch lead fitting.

5. Attach the gray torch lead to the remaining torch fitting. Use a 5/16" wrench to hold the torch body fitting and a 7/16" wrench to tighten the torch lead fitting.

Note: If the 12" off-valve hose is not connected to the torch, make the left-hand threaded connection at this time. Use the same wrenches as in steps 4 and 5.

6. Slide the torch sleeve over the torch main body and screw together.

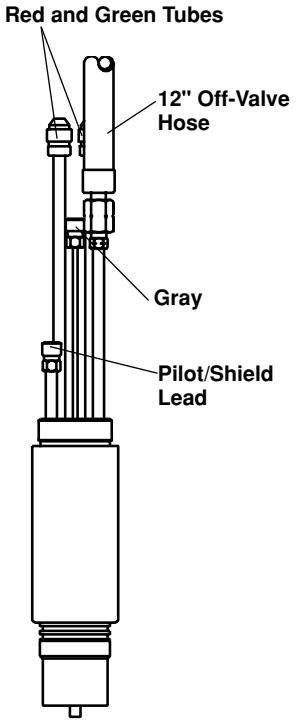


Figure 3-3 Torch Lead Connections to Torch

Valve Cluster Connections

See page 3-9 for plasma preflow and cutflow hose connections to the gas console.
See page 3-16 for plasma preflow and cutflow hose part numbers.
See page 3-7 for torque specifications.

1. Loosen the valve cluster screw and slide the valve cluster up the torch sleeve. Secure in place approximately as shown in Figure 3-5.

2. Attach the plasma preflow hose from the gas console to SV4B.

3. Attach the plasma cut flow hose from the gas console to SV4A. Note that this connection is left-hand threaded.

4. Attach the 12" plasma hose from the torch to off-valve SV5. Note that this connection is left-hand threaded.

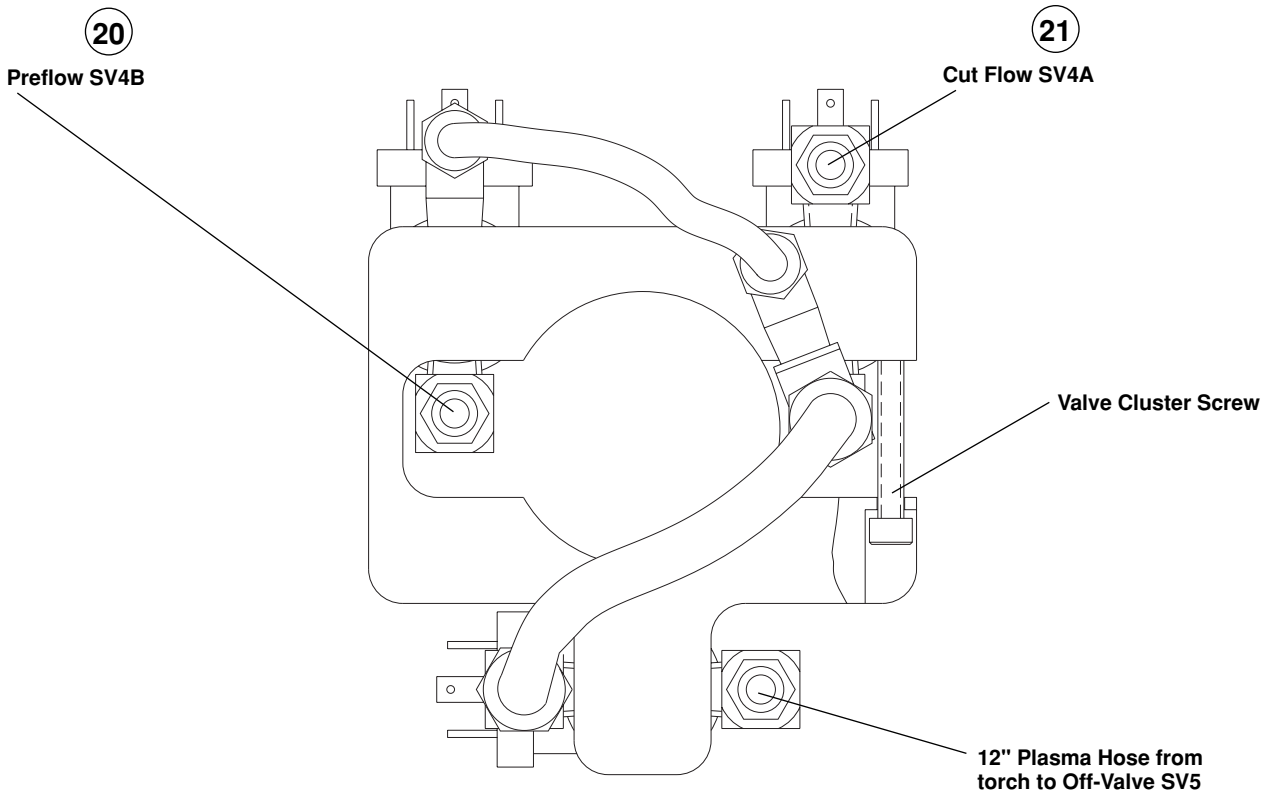
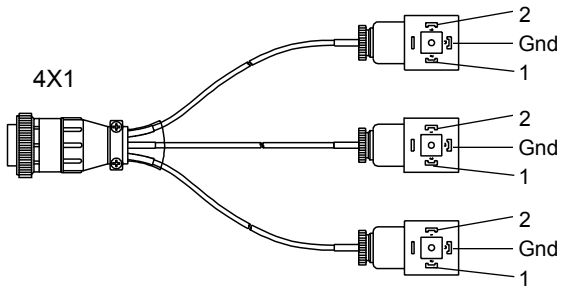


Figure 3-4 Valve Cluster Connections – Top View

(23) *Valve Cluster Cable – Valve Cluster to Power Supply Off-Valve Cable*

(23) Part No.	Length
123282	10" (254 mm)
123321	24" (610 mm)



4x1	SV Socket	Color	Signal
1	SV4A-1	Red	SV4A
2	SV4A-2	Black	SV4A
3	SV4A-Gnd	Clear	Ground
4	SV4B-Gnd	Clear	Ground
5	SV4B-1	Red	SV4B
6	SV4B-2	Black	SV4B
7	SV5-1	Red	SV5
8	SV5-2	Black	SV5
9	SV5-Gnd	Clear	Ground

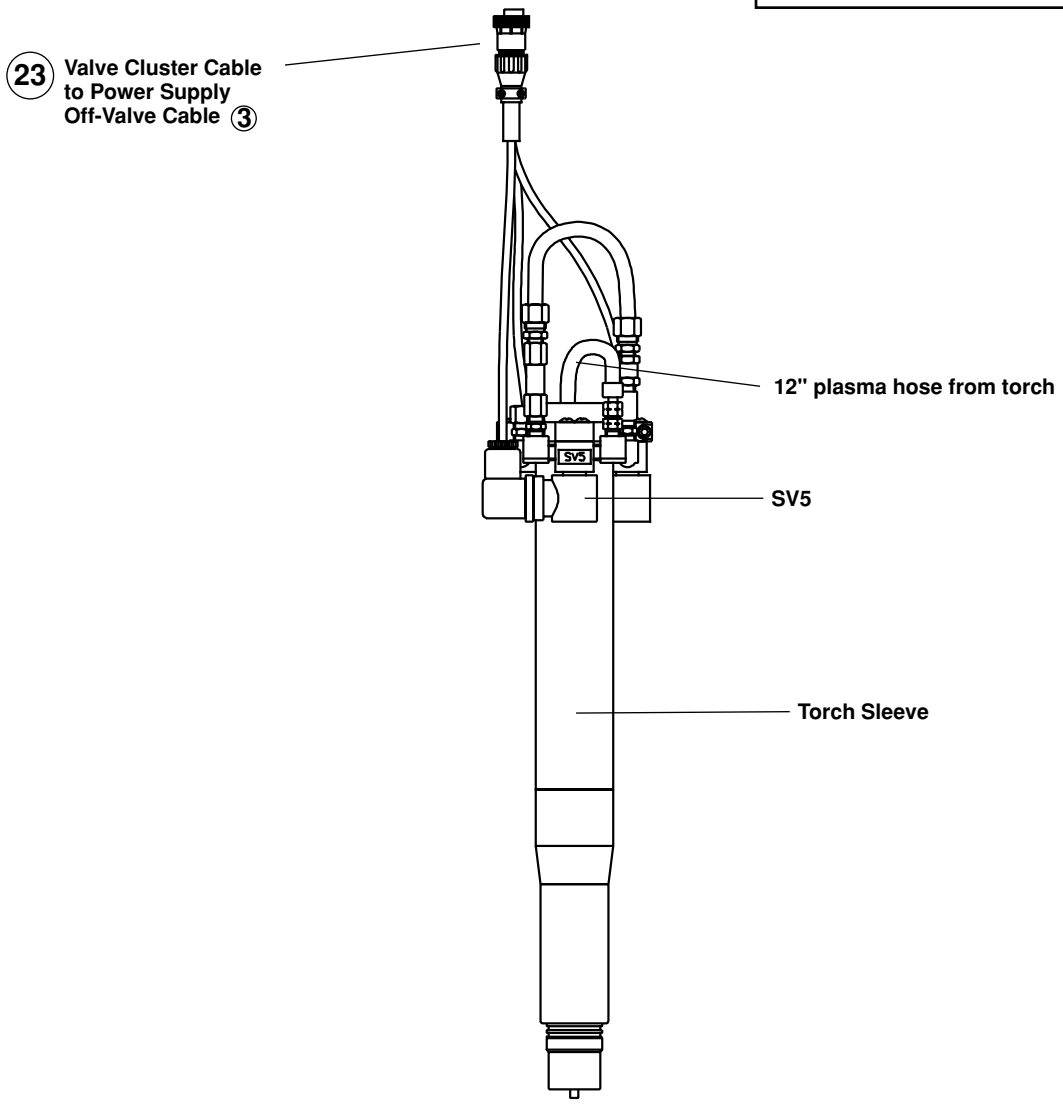


Figure 3-5 Torch with Valve Cluster and Cable Attached

Mounting the Machine Torch

1. Loosen the securing screws and install the machine torch (with torch leads attached) in the torch mounting bracket. See Figure 3-6.

2. Position the torch until the torch body extends all the way through the bracket, so that the bracket is now around the plastic torch sleeve and not touching the stainless steel torch body. Position the torch approximately 0.25" (6 mm) from the work surface.

3. Tighten the securing screws.

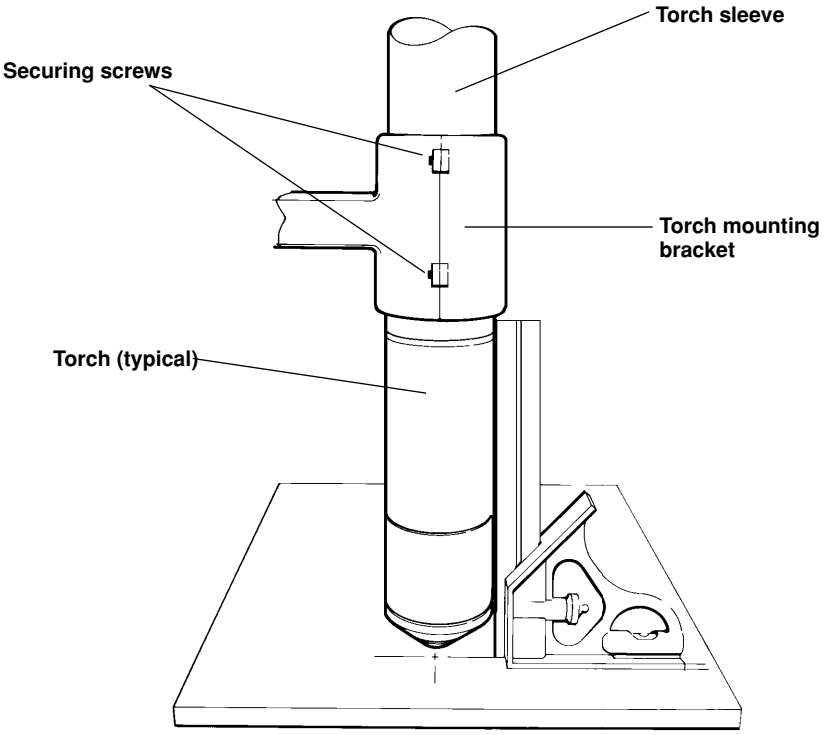


Figure 3-6 Torch Alignment

Torch Alignment

Prior to cutting with the machine torch, ensure that the torch is at right angles to the workpiece to get a clean, vertical cut. Use a square to align the torch. The torch should be aligned at 0° and 90°. See Figure 3-6.

Hypertherm

Section 4

OPERATION

Front Panel Controls and Indicators

Status Indicators Before Startup

When power is applied from the line disconnect switch and before the POWER ON (I) button is pushed, the coolant flow LED will always be illuminated. Once the POWER ON button is pushed and held for a few seconds, this LED will extinguish if the system is in proper working condition.

Other fault conditions may also be indicated when the line power is switched on. Be sure to press and hold the power supply POWER ON (I) button (in some cases up to 1 minute) to extinguish all status indicators. If any LEDs remain illuminated, shut down the system and correct the problem. See *Status LED Troubleshooting* in **Section 5**, if necessary.

Power Supply

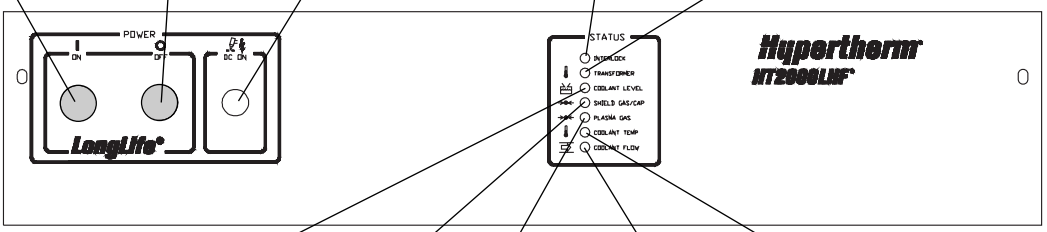
ON (I)
Activates the power supply and its control circuits. Indicator illuminates when power up is complete and status indicators are satisfied.

OFF (O)
Shuts the power supply down.

DC ON
Illuminates when main contactor closes, indicating DC power is being supplied to the torch.

INTERLOCK LED
Spare. This LED is always extinguished.

TRANSFORMER LED
When illuminated, indicates that either the power supply main transformer or one of the choppers is operating above the proper temperature range.



COOLANT LEVEL LED
When illuminated, indicates that the coolant level is inadequate.

PLASMA GAS LED
When illuminated, indicates that the plasma gas pressure is inadequate.

COOLANT TEMP LED
When illuminated, indicates that the torch coolant temperature is too hot.

SHIELD GAS/CAP LED
When illuminated, indicates that either the shield gas pressure is inadequate, or that the retaining cap is installed improperly on the torch.

COOLANT FLOW LED
When illuminated, indicates that the coolant flow from the torch is inadequate.

Figure 4-1 Power Supply Front Panel Controls and Indicators

Gas Console

FM1
Indicates the flow rate % of nitrogen or air plasma gas. Percentages are specified in the *Cut Charts*.

S1
Selects the use of either nitrogen, air or oxygen as the plasma cutting gas.

PG1
Indicates the nitrogen or air plasma inlet pressure. Gas inlet pressures are specified in the *Cut Charts*.

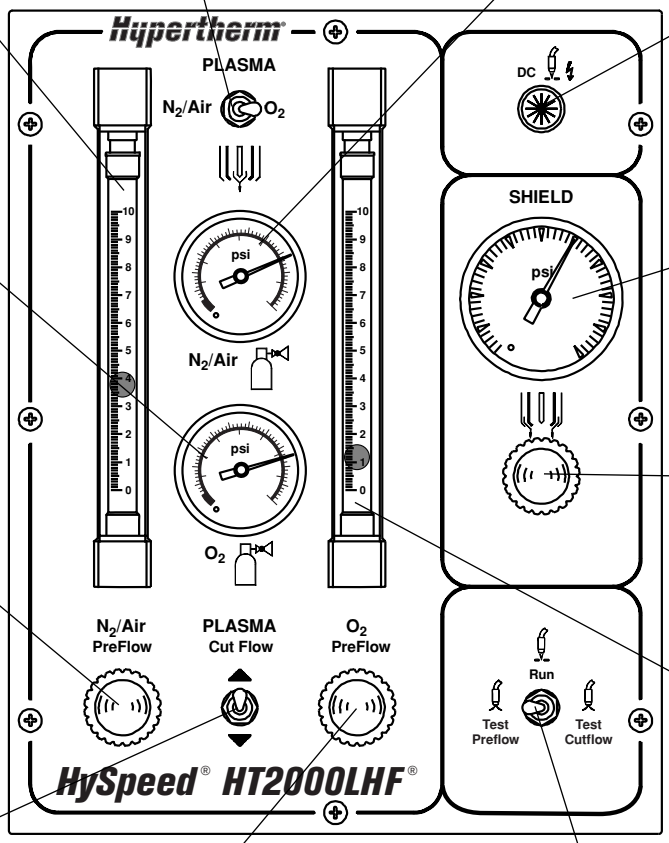
LT1
Illuminates when the main contactor closes, indicating that DC power is being supplied to the torch.

PG2
Indicates the oxygen plasma inlet pressure. Gas inlet pressures are specified in the *Cut Charts*.

PG3
Indicates the shield gas pressure at the torch.

MV2
Adjusts flow rate % of nitrogen, or air plasma gas while in the **Test Preflow** mode. Preflow plasma gas flow rate percentages are specified in the *Cut Charts*.

MV4
Adjusts shield gas pressure to the torch.



MV1
Adjusts flow rate % of nitrogen, air or oxygen plasma gas while in **Test Cut Flow** mode. Cut Flow plasma gas flow rate percentages are specified in the *Cut Charts*.

FM2
Indicates the flow rate % of oxygen plasma gas. Oxygen flow rate percentage is specified in the *Cut Charts*.

MV3
Adjusts flow rate % of oxygen plasma gas while in **Test Preflow** mode. Preflow plasma gas flow rate percentages are specified in the *Cut Charts*.

S2
Test Preflow – Used when setting the plasma preflow flow rate on the flowmeter. In this position the contactor is disabled.
Test Cut Flow – Allows the selected plasma gas flow rate to be adjusted on the flowmeter for cutting conditions. In this position the contactor is disabled.
Run – Enables the contactor and the subsequent firing of the arc after the gas rates have been set in the **Test Preflow** and **Test Cut Flow** positions.

Designations
FM1-FM2 — Flowmeters
LT1 — Indicator Lamp
MV1-MV3 — Motor Valve
PG1-PG3 — Pressure Gauges
S1-S2 — Toggle Switch

Figure 4-2 LHF Gas Console Front Panel Controls and Indicators

Digital Remote Voltage & Current Control Console

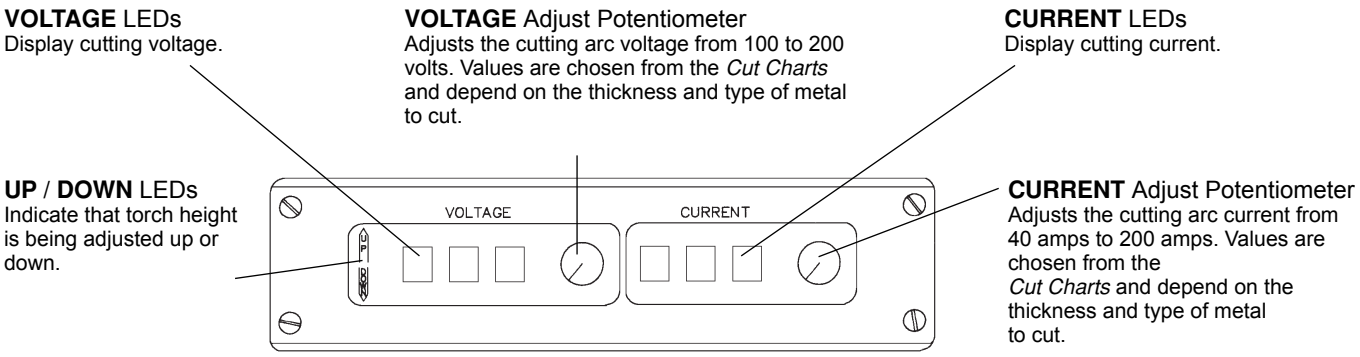


Figure 4-3 Digital Remote Voltage & Current Control Console Front Panel Controls and Indicators

Programmable Remote Voltage & Current Control Console

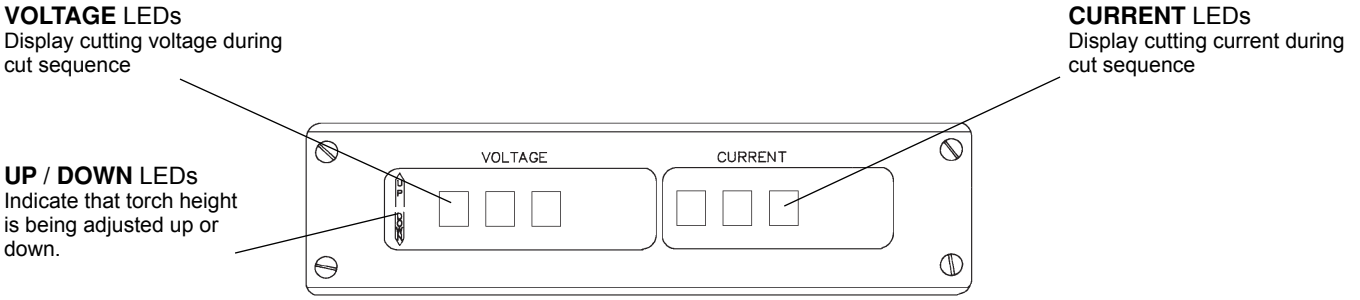


Figure 4-4 Programmable Remote Voltage & Current Control Console Front Panel Indicators

Remote Current Control Console

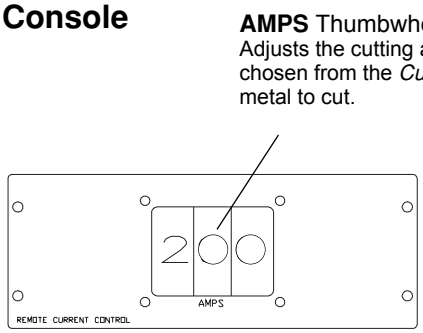


Figure 4-5 Remote Current Control Console Front Panel Controls

Timer/Counter

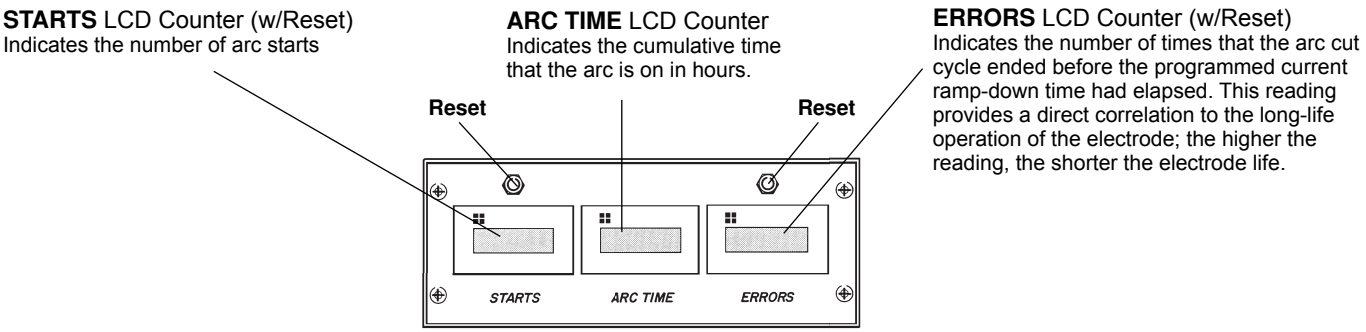


Figure 4-6 Timer/Counter Front Panel Controls

System Checkout

The following procedure assumes the plasma system includes an IHS system, a Digital Remote (DR) Voltage & Current Control Console, and the optional internal THC.

Set Switches and Check Torch

1. Ensure that the switches listed below are positioned as follows:

   The main disconnect switch for the power supply is set to Off.

   S2 toggle switch on the gas console is set to Run**.**

2. Ensure that the proper consumables are installed in the torch. Refer to the *Cut Charts* to choose the correct consumables for your cutting needs. See also *Changing Consumable Parts* at the end of this section.

3. Ensure that the torch is squared to the material. Refer to **Section 3** for the torch alignment procedure.

Turn Gases On

4. Set S1 toggle switch on the gas console to N_2/Air or O_2.

5. Turn the required supply gases On.

   - When using oxygen, or nitrogen as the plasma gas, adjust supply regulator to read 120 psi +/- 10 psi (8.3 bar +/- 0.7 bar).

     When using air as the plasma gas, adjust supply regulator to read 90 psi +/- 10 psi (6.2 bar +/- 0.7 bar).

   - Adjust the supply regulator for shield gas to read 90 psi +/- 10 psi (6.2 bar +/- 0.7 bar).

Turn Power Supply On and Adjust Voltage/Current

6. Set the main disconnect switch for the power supply to the On position. See *Status Indicators Before Startup*. Depress the POWER ON (I) button on the power supply. Ensure that the green POWER ON indicator on the power supply illuminates.

7. Set the VOLTAGE and CURRENT on the Digital Remote. Select the arc current and arc voltage from the *Cut Charts* for the type and thickness of metal to test cut.

Adjust Preflow Gases

8. Set S2 toggle switch to Test Preflow . Verify that the plasma gas pressure gauges on the gas console both read 120 psi (8.3 bar).

9. Look at FM1 and/or FM2 and set the Preflow plasma gas flow rate. Refer to the *Cut Charts* for flow rate percentage.

10. Look at PG3 on the gas console, and set the Shield gas flow rate. Refer to the *Cut Charts* for flow rate percentage.

Adjust Cut Flow Gases and Check Initial Height Sensing (IHS)

11. Set S2 toggle switch to Test Cut Flow.

12. Look at FM1 and/or FM2 and set the Cut Flow plasma gas flow rate. Refer to the *Cut Charts* for flow rate percentage.

13. Set S2 to Run after setting the preflow and plasma flow rates.

14. Check the pilot arc operation by positioning the torch a minimum of 3 inches (75 mm) above the work.

15. Depress the START button. After 2 seconds of gas preflow, the primary contactor will close and the pilot arc will start. The pilot arc should emit a steady, hissing sound and a cone of light should appear at the face of the torch nozzle. The pilot arc will continue for approximately 300ms (O_2) and 600 ms (Air/N_2) and then extinguish automatically.

16. Place the workpiece on the work table to make a test pierce. With manual starting, no machine motion will occur.

    Note: The cutting machine must retract the torch at least 1 inch (25.4 mm) from the work before the start cycle, or probes may hit the workpiece when the START button is depressed.

17. Depress the START button. The IHS probes will immediately descend and approximately 0.5 seconds later, the torch will move toward the workpiece. The DOWN indicator lamp on the Digital Remote should be illuminated. When the torch nears the workpiece, the probes will inductively detect the work surface and the down motion should stop. The DOWN indicator lamp on the Digital Remote will extinguish and the probes will retract.

At this point, depress the STOP button and disable the IHS system. You are now ready for the Final Torch Adjustment.

Final Torch Adjustment

18. Make a reference mark on the top and bottom of the torch sleeve where it meets the torch mounting bracket.

19. Loosen the securing screw on the torch mounting bracket and position the torch higher in the mounting bracket until the arc will not transfer when the START button is depressed.

20. Slowly lower the torch in 1/16" (1.6 mm) increments until the arc transfers after the START button is depressed. Tighten the securing screw at this position.

21. Enable the IHS system and press the START button. Once the arc transfers and the machine delay time has elapsed, the metal should be pierced. Press the STOP button to terminate the plasma arc. Observe that the UP indicator illuminates and the torch retracts to the upper limit switch.

22. Disable the IHS system.

Check Torch Height Control (THC) and Digital Remote Voltage & Current Console

23. Position the workpiece on the work table with one end higher than the other end to check the auto height (torch height control) mode. Position the torch at the highest point on the workpiece. Program a square cut pattern into the controller. (See controller instruction manual.)

24. Enable the Auto Height Control for the THC.

25. Manually lower the torch to approximately .25 inches (6 mm) above the workpiece.

26. Start the arc transfer from the controller.

27. When the arc transfers and the machine delay time has elapsed, the workpiece should be pierced and machine motion will start. As the torch travels from a high point to a low point on the workpiece, note that the torch stand-off distance from the workpiece should remain constant, and that the DOWN indicator illuminates on the Digital Remote.

    As the torch travels from a low point to a high point on the workpiece, note that the torch stand-off distance from the workpiece should remain constant and that the UP indicator illuminates on the Digital Remote.

    As the torch makes a corner cut, the machine motion speed should remain constant and the UP and DOWN indicators do not illuminate. Machine motion and plasma arc will automatically stop when the cut is complete.

The system is now operational.

If the system does not function as outlined in this procedure, recheck the installation requirements and directions in this manual. If all installation directives have been followed and you are still experiencing difficulty with the system, call the Hypertherm Technical Service number listed in the front of this manual.

Noise Levels

Acceptable noise levels as defined by national or local codes may be exceeded by this plasma system. Always wear proper ear protection when cutting or gouging with the plasma system. See also *Noise Protection* in the **Safety** section of this manual.

Daily Startup

Prior to startup, ensure that your cutting environment and that your clothing meet the safety requirements outlined in the **Safety** section of this manual.

	WARNING
Before operating this system, you must read the Safety section thoroughly! Turn main disconnect switch to the power supply OFF before proceeding with the following steps.	

Note: For operation with argon-hydrogen manifold, see the appendix section of this manual.

Check Torch

1. Remove the consumables from the torch and check for worn or damaged parts. **Always place the consumables on a clean, dry, oil-free surface after removing. Dirty consumables can cause the torch to malfunction.**

   - Check the pit depth of the electrode using the electrode gauge assembly. A standard electrode should be replaced when the depth exceeds .044 inch (1.1 mm). The SilverPlus electrode may be replaced when the pit depth exceeds approximately double the recommended depth of a standard electrode.
   - Wipe the current ring in the torch with a clean paper towel or cotton swab (see Figure 4-7).
   - Refer to the *Cut Charts* to choose the correct consumables for your cutting needs.

2. Replace consumable parts. Refer to *Changing Consumable Parts* later in this section for detailed information on replacing consumables.

3. Ensure that the torch is perpendicular to the material. Refer to **Section 3** for the torch alignment procedure.

Turn Gases On

4. Set S2 toggle switch on the gas console to Run**.**

5. Set S1 on the gas console to N_2/Air (for nitrogen or air as plasma gas), or O_2 (for oxygen as plasma gas).

6. Turn the required supply gases On**.**

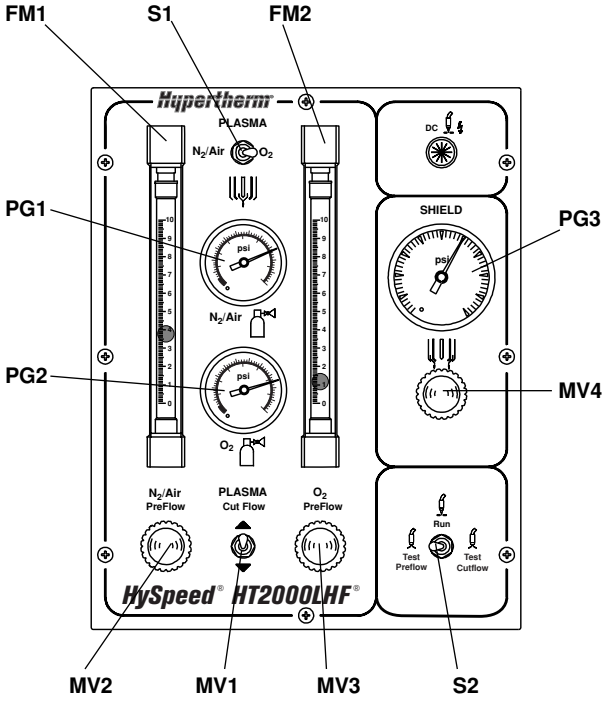
Note: See the *Cut Charts* to set the plasma and shield gas inlet pressures.

Turn Power Supply On and Adjust Voltage & Current

7. Turn the main disconnect switch ON. See *Status Indicators Before Startup* earlier in this section.

8. Turn on the power supply by depressing and holding down the POWER ON (I) button (PB1) on the power supply. Ensure that the green POWER ON indicator illuminates. Hold PB1 down until all of the status indicators extinguish.

9. Set the voltage and current from the Digital Remote Voltage and Current Console or from the machine computer interface. Select the arc current and arc voltage from the *Cut Charts* for the type and thickness of metal to cut.



Adjust Preflow Gases

10. Set S2 on the gas console to Test Preflow. Verify the plasma gas inlet pressure reading on the plasma pressure gauges (PG1, PG2) on the gas console. Refer to the *Cut Charts* for the proper pressure setting.

11. Look at the oxygen (FM2) and/or nitrogen-air (FM1) flowmeters on the gas console and set the Preflow plasma gas flow rate % by referring to the *Cut Charts* and turning the oxygen (MV3) and/or nitrogen / air (MV2) preflow metering valves.

12. Look at the shield gas pressure gauge (PG3) on the gas console, and set to the *Cut Chart* specifications by turning the shield gas metering valve (MV4).

Note: If you have changed consumable parts or if the power supply has been off for more than 1 hour, purge gas lines by leaving system in Test Preflow for 1 minute.

Adjust Cut Flow Gases and Prepare for Cutting

13. Set S2 on the gas console to Test Cut Flow.

14. Look at the oxygen (FM2) and/or nitrogen / air (FM1) flowmeters on the gas console and set the Cut Flow plasma gas flow rate % by referring to the *Cut Charts* and adjusting the Plasma Cut Flow metering valve (MV1).

Note: If you have changed consumable parts or if the power supply has been off for more than 1 hour, purge gas lines by leaving the system in Test Cut Flow for one minute.

15. Set S2 to Run after the test preflow and test operate flow rates have been set.

The system is now ready for operation.

Common Cutting Faults

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

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

  2. Malfunction in the system. See **Section 5**.

- 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 *Cut Chart* information).

  2. Cut speed is too high (check *Cut 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 *Cut Chart* information).

  2. Arc current is set too low (check *Cut Chart* information).

  3. Torch parts are worn (see *Changing Consumable Parts*).

- Cut angle is not square. Causes can be:

  1. Wrong direction of machine travel.

     High quality side is on the right with respect to the forward motion of the torch.

  2. Torch-to-work distance is not correct (check *Cut Chart* information).

  3. Cutting speed is not correct (check *Cut Chart* information).

  4. Arc current is not correct (check *Cut Chart* information).

5. Damaged consumable parts (see *Changing Consumable Parts*).

- Short consumable life. Causes can be:

1. Arc current, arc voltage, travel speed, motion delay, gas flow rates, or initial torch height not set as specified in the *Cut Charts*.

2. Attempting to cut highly magnetic metal plate (some metals such as armor plate with a high nickel content) will shorten consumable life. Long consumable life is difficult to achieve when cutting plate that is magnetized or becomes magnetized easily.

3. Not beginning or ending the cut on the plate surface. **To achieve consumable long life, all cuts must begin and end on the plate surface**.

Also see *Cutting Techniques* later in this section for methods to improve cutting performance.

Technical Questions

If your system does not function correctly:

1. Recheck all pre-installation and installation requirements and connections.

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

3. If you need assistance, call the Hypertherm Technical Service number listed in the front of this manual.

Cut Charts

The Cut Charts on the following pages provide the necessary information for the operator using the system to be successful in plasma arc cutting. The system 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 drop cuts with minimal dross.

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

Conversions

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

CUT CHART AND CONSUMABLE PARTS INDEX

Metal	Amps	Plasma Gas/ Shield Gas	Shield	Retaining Cap	Nozzle	Swirl Ring	Electrode	Page
Mild Steel	200	HySpeed O_2 / Air	220239	220242	220237	220236	220235	4-12
	200	O_2 / Air	020424	120837	020605	120833	120667	4-13
	200	Air / Air	020424	120837	020608	020679	120667	4-14
	200	N_2 / CO_2	020424	120837	020608	020607	020415	4-15
	100	Air / Air	020448	120837	020611	020607	120547	4-16
	100	O_2 / Air	020424	120837	020690	020613	120547	4-17
	50	O_2 / O_2	120186	120185	120182	120179	120178	4-18
Stainless Steel CUTTING	200	Air / Air	020424	120837	020608	020679	120667	4-19
	200	N_2 / Air	020424	120837	020608	020607	020415	4-20
	200	N_2 / CO_2	020424	120837	020608	020607	020415	4-21
	200	H35 / N_2*	020602	120837	020608	020607	020415	Ap-A
	100	Air / Air	020448	120837	020611	020607	120547	4-22
	100	H35 / N_2*	020448	120837	020611	020607	020415	Ap-A
	40	Air / Air	020688	020423	020689	020613	120667	4-23
Aluminum	200	Air / Air	020424	120837	020608	020679	120667	4-24
	200	N_2 / Air	020424	120837	020608	020607	020415	4-25
	200	N_2 / CO_2	020424	120837	020608	020607	020415	4-26
	200	H35 / N_2*	020602	120837	020608	020607	020415	Ap-A
	100	Air / Air	020448	120837	020611	020607	120547	4-27
	100	H35 / N_2*	020448	120837	020611	020607	020415	Ap-A
	40	Air / Air	020688	020423	020689	020613	120667	4-28
BEVEL CUTTING Mild Steel	200	O_2/Air	120260	120837	120259	120833	120258	4-29
Mild Steel GOUGING	200	Air / Air	020485	120837	020615	020607	120667	4-30
Stainless Steel	200	H35 / N_2*	020485	120837	020615	020607	020415	Ap-A
Aluminum	200	H35 / N_2*	020485	120837	020615	020607	020415	Ap-A

*** Argon-Hydrogen Manifold required. See appendix for installation and operation with argon-hydrogen manifold.**

Consumables used with Hyspeed HT2000LHF Water Muffler**	200	HySpeed O_2 / Air	220239	220238	220237	220236	220235
	200	O_2 / Air	020566	020423	020605	120833	120667
	100	O_2 / Air	020566	020423	020690	020613	120547
	200	Air / Air	020566	020423	020608	020679	120667
	100	Air / Air	020618	020423	020611	020607	120547
	200	N_2 / CO_2	020566	020423	020608	020607	020415
	200	N_2 / Air	020566	020423	020608	020607	020415

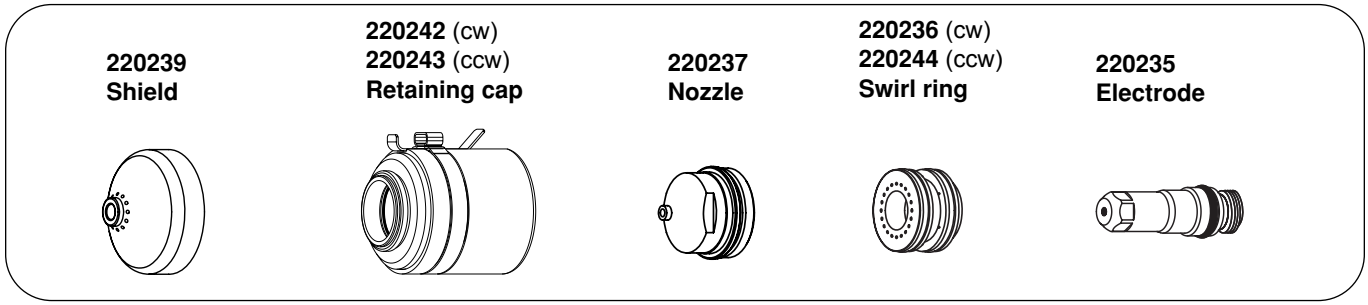
**** Do not use the water muffler when cutting with argon-hydrogen (H35)!**
Water Muffler cannot be used with the stainless steel torch

Note: If the Command THC or other ohmic contact sensing device is NOT in use, retaining caps with no IHS tab: **020423** clockwise**; 020955** counterclockwise can be used for all cutting currents except 50A**; 120185** for 50A cutting only**.** For Hyspeed 200A O_2 cutting only; use retaining cap part # 220238 (clockwise cutting) & 220241 (counter-clockwise cutting).

Mild Steel

HySpeed 200 amps • O_2 Plasma / Air Shield

This gas combination gives superior cut speed, minimum dross, minimum surface nitriding and excellent weldability.



Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (O_2 % N_2 %)	Plasma Gas Flow Rate % Cutflow (O_2 % N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/4	6	**12 38**	**76 0**	**60**	1/16	1.5	1/8	3	145	230	5800	0.3
5/16	8	(12 / 50	(90 / 0	(275	1/8	3	1/4	6	151	165	4200	0.3
3/8	10	SCFH)	SCFH)	SCFH)	5/32	4	5/16	8	155	140	3500	0.3
1/2	12				1/8	3	1/4	6	155	120	3000	0.3
5/8	15				1/8	3	1/4	6	155	100	2500	0.5
3/4	20				1/8	3	1/4	6	155	75	1900	0.6
7/8	22				1/8	3	1/4	6	159	60	1500	0.7
1	25				1/8	3	1/4	6	160	50	1300	0.7
1 1/4	32				1/8	3	5/16	8	168	30	760	2.6
1-1/2	38				1/8	3	5/16	8	175	20	500	4.0
1-3/4	44				1/8	3	N/A	N/A	180	15	380	N/A
2	50				1/8	3	N/A	N/A	188	10	250	N/A

3" Under Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (O_2 % N_2 %)	Plasma Gas Flow Rate % Cutflow (O_2 % N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/4	6	**12 38**	**76 0**	**60**	1/16	1.5	1/8	3	149	230	5800	0.3
5/16	8	(12 / 50	(90 / 0	(275	1/8	3	1/4	6	151	165	4200	0.3
3/8	10	SCFH)	SCFH)	SCFH)	5/32	4	5/16	8	159	140	3500	0.3
1/2	12				1/8	3	1/4	6	155	105	2700	0.3
5/8	15				1/8	3	1/4	6	161	90	2300	0.5
3/4	20				1/8	3	1/4	6	161	65	1600	0.6
7/8	22				1/8	3	1/4	6	161	55	1400	0.7
1	25				1/8	3	1/4	6	164	45	1100	0.7

Notes: **Set oxygen plasma gas inlet pressure to 120 psi (8.3 bar).**
Set nitrogen plasma gas inlet pressure to 120 psi (8.3 bar)
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 1" (25 mm) not recommended.
Drop cutting above 1-1/2" (38 mm) not recommended

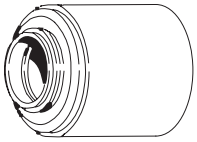
Mild Steel

200 amps • O_2 Plasma / Air Shield

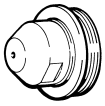
This gas combination gives superior cut speed, minimum dross, minimum surface nitriding and excellent weldability.

020424
Shield

020423 (cw)
020955 (ccw)
Retaining cap

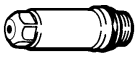


020605
Nozzle



120833* (cw)
120834 (ccw)
Swirl ring

120667 (standard)
Electrode
220084 (optional)
SilverPlus electrode+



Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (O_2 % N_2 %)	Plasma Gas Flow Rate % Cutflow (O_2 % N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/4	6	**5 45**	**64 0**	**60**	1/8	3	1/4	6	120	160	4060	0.5
.315	8	(5.3 / 62.4	(79.6 / 0	(270	1/8	3	1/4	6	125	120	3000	0.5
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	125	100	2540	1.0
1/2	12				.157	4	.314	8	125	80	2030	2.0
5/8	15				.157	4	.314	8	130	70	1780	2.0
3/4	20				3/16	5	3/8	10	135	55	1400	2.5
7/8	22				1/4	6	1/2	12	135	45	1140	2.5
1	25				1/4	6	1/2	12	140	35	890	2.5
1-1/4	32				1/4	6	1/2	12	150	22	560	3.0
1-1/2	38				1/4	6	1/2	12	155	15	380	3.0
1-3/4	44				5/16	8	5/8	12	165	10	250	3.0
2	50				5/16	8	5/8	12	170	7	180	3.0

3" Under Water

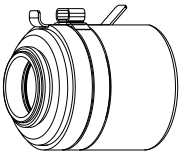
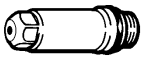
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (O_2 % N_2 %)	Plasma Gas Flow Rate % Cutflow (O_2 % N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/4	6	**5 45**	**64 0**	**70**	1/8	3	1/4	6	125	145	3700	0.5
.315	8	(5.3 / 62.4	(79.6 / 0	(280	1/8	3	1/4	6	125	110	2800	0.5
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	130	80	2000	1.0
1/2	12				1/8	3	1/4	6	130	70	1800	2.0
5/8	15				.157	4	.314	8	135	60	1500	2.0
3/4	20				3/16	5	3/8	10	140	48	1200	2.5
7/8	22				1/4	6	1/2	12	140	38	950	3.0
1	25				1/4	6	1/2	12	145	25	680	3.0

Notes: **Set oxygen plasma gas inlet pressure to 120 psi (8.3 bar).**
Set nitrogen plasma gas inlet pressure to 120 psi (8.3 bar)
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 1" (25 mm) not recommended. Drop cutting above 1-1/2" (38 mm) not recommended
*** Use 020679 swirl ring in place of 120833 swirl ring to obtain smoother cut edges on material 1/4" to 3/8" thick, but expect a 30-40% decrease in electrode life**
+ SilverPlus provides increased life to high duty cycle users in most applications. The hafnium wears to approximately twice the depth of a standard electrode (120667). Arc voltage may need to be increased by 5-10 volts throughout the electrode life to maintain proper cut height parameters.

Mild Steel

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriding can occur.

020424 Shield	120837 Retaining cap	020608 Nozzle	020679 Swirl ring	120667 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**54**	**65**	**60**	1/8	3	1/4	6	130	200	5080	
1/4	6	(62.3	(75.0	(270	1/8	3	1/4	6	130	135	3400	0.5
.315	8	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	135	115	2900	0.5
3/8	10				1/8	3	1/4	6	135	100	2540	1.0
1/2	12				.157	4	.314	8	140	80	2030	2.0
5/8	15				.157	4	.314	8	145	60	1520	2.0
3/4	20				3/16	5	3/8	10	150	45	1140	2.5
7/8	22				1/4	6	1/2	12	155	30	760	2.5
1	25				1/4	6	1/2	12	160	25	635	2.5
1-1/4	32				1/4	6			165	15	380	
1-1/2	38				1/4	6			170	10	250	
1-3/4	44				5/16	8			180	7	180	
2	50				5/16	8			185	5	130	

3" Under Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/4	6	**54**	**65**	**70**	1/8	3	1/4	6	130	130	3300	0.5
.315	8	(62.3	(75.0	(280	1/8	3	1/4	6	135	110	2700	0.5
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	135	95	2400	1.0
1/2	12				1/8	3	1/4	6	140	75	1900	2.0
5/8	15				.157	4	.314	8	145	50	1200	2.0
3/4	20				3/16	5	3/8	10	150	35	850	2.5
7/8	22				1/4	6	1/2	12	155	20	530	3.0
1	25				1/4	6	1/2	12	165	15	400	3.0

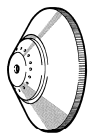
Notes: **Set plasma gas inlet pressure to 90 psi (6.2 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 1" (25 mm) not recommended
Drop cutting above 1-1/2" (38 mm) not recommended

Mild Steel

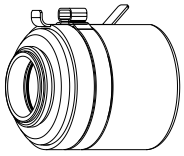
200 amps • N_2 Plasma / CO_2 Shield

This gas combination may be used when cut edge quality and surface nitriding are less important. Electrode life is extended when using this combination.

020424
Shield



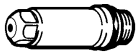
120837
Retaining cap



020608
Nozzle

020607
Swirl ring

020415
Electrode



Above Water Only

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Cutflow (N_2 %)	Shield Gas (CO_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**60/4**	1/8	3	1/4	6	120	130	3300	0.5
1/4	6	(62.3	(75.0	(270	1/8	3	1/4	6	125	110	2800	1.0
3/8	10	(SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	130	85	2160	1.5
1/2	12				1/8	3	1/4	6	130	55	1400	2.0
5/8	15				.157	4	.314	8	135	45	1140	2.0
3/4	20				3/16	5	3/8	10	145	25	635	2.5
7/8	22				1/4	6	1/2	12	150	20	510	3.0
1	25				1/4	6	1/2	12	160	15	380	3.0
1-1/4	32				1/4	6			165	10	250	
1-1/2	38				1/4	6			175	5	130	

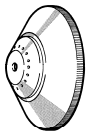
Notes: **Set plasma gas inlet pressure to 120 psi (8.3 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 1" (25 mm) not recommended

Mild Steel

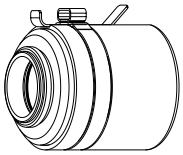
100* amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical. Some surface nitriding can occur. While this process may be used on thicker materials, optimal recommended range is to 3/8" (10mm).

020448
Shield



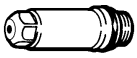
120837
Retaining cap



020611
Nozzle

020607
Swirl ring

120547
Electrode



Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
.075*	2	**48**	**39**	**60**	3/32	2.5	3/16	5	120	235	6050	
1/8	3	(55.3	(44.9	(270	3/32	2.5	3/16	5	125	185	4700	0.5
3/16	5	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	125	175	4450	0.5
1/4	6				1/8	3	1/4	6	130	125	3175	0.5
3/8	10				1/8	3	1/4	6	135	50	1270	1.0
1/2	12				1/8	3			140	35	890	
5/8	15				.157	4			145	25	635	
3/4	20				3/16	5			150	20	510	

3" Under Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**48**	**39**	**70**	5/64	2	5/32	4	130	120	3050	
3/16	5	(55.3	(44.9	(270	1/8	3	1/4	6	135	90	2300	0.5
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	140	70	1730	0.5
3/8	10				1/8	3	1/4	6	145	42	1050	0.5
1/2	12				1/8				145	28	700	

* Set arc current to **80 amps** when cutting .075" (2 mm) thick mild steel

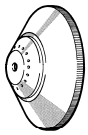
Notes: **Set plasma gas inlet pressure to 90 psi (6.2 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 3/8" (10 mm) not recommended

Mild Steel

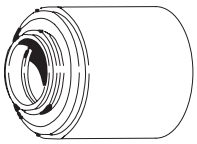
100 amps • O_2 Plasma / Air Shield

This gas combination gives good cut speed, low dross and is very economical. Some surface nitriding can occur. While this process may be used on thicker materials, optimal recommended range is to 3/8" (10mm).

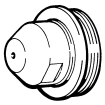
020424
Shield



020423 (cw)
020955 (ccw)
Retaining cap

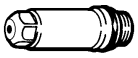


020690
Nozzle



020613 (cw)
120252 (ccw)
Swirl ring

120547*
Electrode



Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (O_2 % N_2 %)	Plasma Gas Flow Rate % Cutflow (O_2 % N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**3 32**	**36 0**	**60**	3/32	2.5	3/16	5	125	240	6100	
3/16	5	(3.3 / 39.6	(44.8 / 0	(270	1/8	3	1/4	6	125	180	4570	
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	125	120	3050	0.5
3/8	10				1/8	3	1/4	6	130	90	2280	0.5
1/2	12				1/8	3	1/4	6	130	60	1520	1.0
5/8	15				.157	4	.314	8	140	45	1140	1.0
3/4	20				3/16	5	3/8	10	145	30	760	1.5

3" Under Water

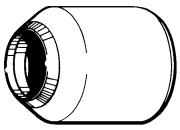
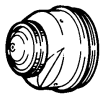
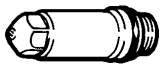
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (O_2 % N_2 %)	Plasma Gas Flow Rate % Cutflow (O_2 % N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**3 32**	**36 0**	**60**	5/64	2	5/32	4	125	220	5580	
3/16	5	(3.3 / 39.6	(44.8 / 0	(270	1/8	3	1/4	6	125	160	4060	0.5
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	125	110	2790	0.5
3/8	10				1/8	3	1/4	6	130	85	2160	0.5
1/2	12				1/8	3	1/4	6	135	60	1520	1.0

Notes: **Set oxygen plasma gas inlet pressure to 120 psi (8.3 bar)**
Set nitrogen plasma gas inlet pressure to 120 psi (8.3 bar)
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 3/8" (10 mm) not recommended

* To maximize consumable life, modify the part lead-in and lead-out to reduce ramp-down errors. For strip cutting or other applications where proper ramp-down is difficult to achieve, use electrode P/N 120667 in place of electrode P/N120547.

Mild Steel

50 amps • O_2 Plasma / O_2 Shield

120185 Retaining cap	120186 Shield	120182 Nozzle	120179 Swirl ring	120178 Electrode
				

Above Water Only

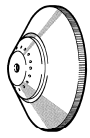
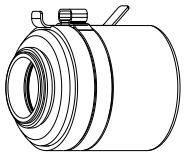
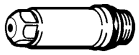
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (O_2 % N_2 %)	Cutflow (O_2 % N_2 %)	Shield Gas (O_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
.048	(18 GA.)	**3 27**	**30 0**	**18**	.060	1.50	.120	3.0	108	160	4060	0
.074	(14 GA.)	2 / 17	18 / 0	17	.060	1.50	.120	3.0	108	120	3050	0.3
.100	(12 GA.)	l/min	l/min	l/min	.070	1.75	.140	3.5	113	100	2540	0.3
.125	(10 GA.)				.080	2.00	.160	4.0	118	60	1520	0.5

Notes: **Set oxygen plasma gas inlet pressure to 120 psi (8.3 bar)**
Set nitrogen plasma gas inlet pressure to 120 psi (8.3 bar)
Set shield gas inlet pressure to 120 psi (8.3 bar)
The oxygen shield gas must be supplied from a regulator separate from the oxygen plasma gas regulator.
If using the Digital Remote (DR) or Programmable Remote (PR), set current to 60 amps.
If using a torch height control system capable of achieving the arc voltage setting on this chart, set accordingly.
If using a less sensitive torch height control system, round off the arc voltage numbers to the nearest achievable setting.
Torch-to-work Distance tolerances are ± .010 inch (± .25 mm). When using a THC the tolerances are ± 1 volt.
Stay within travel speed ranges to produce dross-free cuts.
Due to the low gas flow rates associated with the 50 amp process, initial cut quality may be degraded while nitrogen is being purged from the gas line when changing from preflow to cut flow (up to 2 seconds). To compensate, either increase machine motion delay or increase the lead-in distance at the start of the cut.
Note that some height control systems may need to be locked out to prevent the torch from diving into the plate if the machine motion delay option is used.

Stainless Steel

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross and is very economical. Some surface nitriding and surface oxidation of alloying elements can occur.

020424 Shield	120837 Retaining cap	020608 Nozzle	020679 Swirl ring	120667 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**54**	**65**	**60**	1/8	3	1/4	5	125	220	5600	
1/4	6	(62.3	(75.0	(270	1/8	3	1/4	6	130	195	5000	0.5
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	130	145	3700	1.0
1/2	12				1/8	3	1/4	6	135	105	2700	2.0
5/8	15				.157	4	.314	8	140	75	1900	2.0
3/4	20				3/16	5	3/8	10	140	55	1400	2.5
7/8	22				1/4	6	1/2	12	145	40	1000	3.0
1	25				1/4	6			150	30	760	
1-1/4	32	`			1/4	6			160	15	380	
1-1/2	38				1/4	6			170	10	250	

3" Under Water

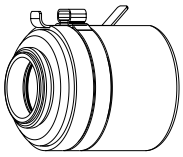
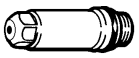
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**54**	**65**	**70**	1/8	3	1/4	6	125	210	5320	
1/4	6	(62.3	(75.0	(280	1/8	3	1/4	6	130	180	4500	0.5
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	135	125	3150	1.0
1/2	12				1/8	3	1/4	6	140	90	2300	2.0
5/8	15				.157	4	.314	8	145	60	1520	2.0
3/4	20				3/16	5	3/8	10	145	45	1150	2.5
7/8	22				1/4	6	1/2	12	150	30	750	3.0
1	25				1/4	6			155	22	570	

Notes: **Set air plasma gas inlet pressure to 90 psi (6.2 bar)**
Set air shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 7/8" (22 mm) not recommended

Stainless Steel

200 amps • N_2 Plasma / Air Shield

This gas combination is used when cut edge quality, surface nitriding and surface oxidation of alloying elements are less important. Electrode life is extended when this combination is used.

020424 Shield	120837 Retaining cap	020608 Nozzle	020607 Swirl ring	020415 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Plasma Gas Flow Rate % Cutflow (N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**60**	1/8	3	1/4	5	125	135	3430	
1/4	6	(66.4	(79.6	(270	1/8	3	1/4	6	130	120	3050	0.5
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	130	100	2540	1.0
1/2	12				1/8	3	1/4	6	135	75	1900	2.0
5/8	15				.157	4	.314	8	140	60	1520	2.0
3/4	20				3/16	5	3/8	10	140	45	1140	2.5
7/8	22				1/4	6	1/2	12	145	35	890	2.5
1	25				1/4	6			150	20	510	
1-1/4	32				1/4	6			160	15	380	
1-1/2	38				1/4	6			160	10	250	

3" Under Water

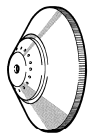
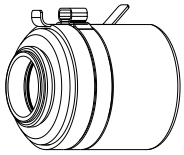
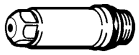
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Plasma Gas Flow Rate % Cutflow (N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**70**	1/8	3	1/4	6	125	130	3250	
1/4	6	(66.4	(79.6	(280	1/8	3	1/4	6	130	110	2750	0.5
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	135	85	2160	1.0
1/2	12				1/8	3	1/4	6	140	60	1520	2.0
5/8	15				.157	4	.314	8	145	45	1140	2.0
3/4	20				3/16	5	3/8	10	145	30	800	2.5

Notes: **Set nitrogen plasma gas inlet pressure to 120 psi (8.3 bar)**
Set air shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 7/8" (22 mm) not recommended

Stainless Steel

200 amps • N_2 Plasma / CO_2 Shield

This gas combination is used when surface nitriding and surface oxidation of alloying elements is less important. Electrode life is extended when using this gas combination.

020424 Shield	120837 Retaining cap	020608 Nozzle	020607 Swirl ring	020415 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Cutflow (N_2 %)	Shield Gas (CO_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**60**	1/8	3	1/4	6	125	190	4800	0.5
1/4	6	(66.4	(79.6	(210	1/8	3	1/4	6	130	170	4300	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	130	125	3200	1.5
1/2	12				1/8	3	1/4	6	135	95	2400	2.0
5/8	15				.157	4	.314	8	140	70	1800	2.0
3/4	20				3/16	5	3/8	10	140	50	1250	2.5
7/8	22				1/4	6	1/2	12	145	40	1000	3.0
1	25				1/4	6			150	30	760	
1-1/4	32	`			1/4	6			160	15	380	
1-1/2	38				1/4	6			170	10	250	

3" Under Water

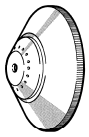
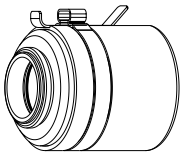
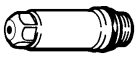
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Cutflow (N_2 %)	Shield Gas (CO_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**60**	1/8	3	1/4	6	125	180	4550	0.5
1/4	6	(66.4	(79.6	(210	1/8	3	1/4	6	130	150	3850	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	135	110	2700	1.5
1/2	12				1/8	3	1/4	6	140	75	1920	2.0
5/8	15				.157	4	.314	8	145	50	1350	2.0
3/4	20				3/16	5	3/8	10	145	38	950	2.5
7/8	22				1/4	6	1/2	12	150	28	700	3.0

Notes: **Set nitrogen plasma gas inlet pressure to 120 psi (8.3 bar)**
Set carbon dioxide shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 7/8" (22 mm) not recommended

Stainless Steel

100 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross and is very economical. Some surface nitriding and surface oxidation of alloying elements can occur.

020448 Shield	120837 Retaining cap	020611 Nozzle	020607 Swirl ring	120547 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**48**	**39**	**60**	3/32	2.5	3/16	5	125	140	3560	
3/16	5	(53.3	(44.9	(270	1/8	3	1/4	6	130	110	2800	0.5
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	130	80	2030	0.5
3/8	10				1/8	3	1/4	6	135	55	1400	0.5
1/2	12				1/8	3			140	35	890	
5/8	15				.157	4			145	25	635	
3/4	20				3/16	5			150	20	510	

3" Under Water

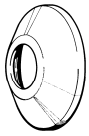
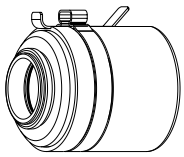
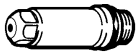
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**48**	**39**	**60**	5/64	2	5/32	4	125	135	3400	
3/16	5	(53.3	(44.9	(270	1/8	3	1/4	6	130	100	2520	0.5
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	135	65	1720	0.5
3/8	10				1/8	3	1/4	6	140	45	1120	0.5
1/2	12				1/8	3			145	25	670	

Notes: **Set air plasma gas inlet pressure to 90 psi (6.2 bar)**
Set air shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 3/8" (10 mm) not recommended

Stainless Steel

40 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross level and is very economical. Some surface nitriding and surface oxidation of alloying elements can occur.

020688 Shield	120837 Retaining cap	020689 Nozzle	020613 Swirl ring	120667 Electrode
				

Above Water Only

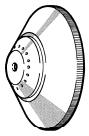
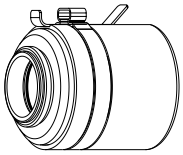
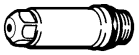
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
.050	(18 GA.)	**40**	**20**	**60**	3/32	2.5	3/16	5	120	145	3700	
1/16	1.5	(46.0	(23.1	(275	3/32	2.5	3/16	5	120	120	3050	
1/8	3	SCFH)	SCFH)	SCFH)	3/32	2.5	3/16	5	125	75	1900	0.5
1/4	6				1/8	3			135	24	610	
3/8	10				1/8	3			140	12	300	

Notes: **Set air plasma gas inlet pressure to 90 psi (6.2 bar)**
Set air shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 1/8" (3 mm) not recommended

Aluminum

200 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical.

020424 Shield	120837 Retaining cap	020608 Nozzle	020679 Swirl ring	120667 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**54**	**65**	**60**	1/8	3	1/4	6	130	220	5600	0.5
1/4	6	(62.3	(75.0	(270	1/8	3	1/4	6	140	190	4800	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	140	145	3700	2.0
1/2	12				1/8	3	1/4	6	145	110	2800	2.5
5/8	15				.157	4	.314	8	150	85	2200	2.5
3/4	20				3/16	5	3/8	10	155	65	1650	2.5
7/8	22				1/4	6	1/2	12	160	50	1300	2.5
1	25				1/4	6			165	35	900	
1-1/4	32	`			1/4	6			170	20	500	
1-1/2	38				1/4	6			175	12	300	

3" Under Water

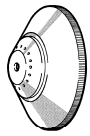
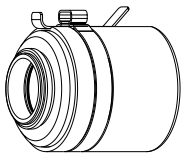
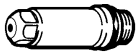
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**54**	**65**	**70**	1/8	3	1/4	6	135	210	5300	0.5
1/4	6	(62.3	(75.0	(280	1/8	3	1/4	6	140	170	4300	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	145	125	3150	2.0
1/2	12				1/8	3	1/4	6	150	90	2240	2.5
5/8	15				.157	4	.314	8	155	65	1650	3.0
3/4	20				3/16	5	3/8	10	160	45	1150	3.0

Notes: **Set plasma gas inlet pressure to 90 psi (6.2 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 7/8" (22 mm) not recommended

Aluminum

200 amps • N_2 Plasma / Air Shield

This gas combination is used when cut edge quality is less important. Electrode life is extended when this combination is used.

020424 Shield	120837 Retaining cap	020608 Nozzle	020607 Swirl ring	020415 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Cutflow (N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**60**	1/8	3	1/4	6	130	180	4570	0.5
1/4	6	(66.4	(79.6	(270	1/8	3	1/4	6	135	160	4060	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	135	120	3050	1.5
1/2	12				1/8	3	1/4	6	140	80	2030	2.0
5/8	15				.157	4	.314	8	140	70	1780	2.0
3/4	20				3/16	5	3/8	10	150	50	1270	2.5
7/8	22				1/4	6	1/2	12	160	35	890	2.5
1	25				1/4	6			165	25	635	
1-1/4	32	`			1/4	6			175	20	510	
1-1/2	38				1/4	6			185	10	250	

3" Under Water

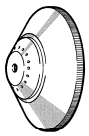
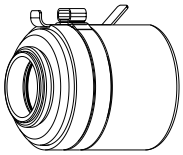
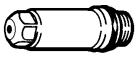
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Cutflow (N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**70**	1/8	3	1/4	6	135	170	4350	0.5
1/4	6	(66.4	(79.6	(280	1/8	3	1/4	6	140	140	3650	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	140	100	2600	1.5
1/2	12				1/8	3	1/4	6	145	65	1620	2.0
5/8	15				.157	4	.314	8	145	55	1350	2.5
3/4	20				3/16	5	3/8	10	155	35	890	3.0
7/8	22				1/4	6	1/2	12	165	25	620	3.0

Notes: **Set plasma gas inlet pressure to 120 psi (8.3 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 7/8" (22 mm) not recommended

Aluminum

200 amps • N_2 Plasma / CO_2 Shield

This gas combination is used when cut edge quality is less important. Electrode life is extended when this combination is used.

020424 Shield	120837 Retaining cap	020608 Nozzle	020607 Swirl ring	020415 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Cutflow (N_2 %)	Shield Gas (CO_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**60**	1/8	3	1/4	6	130	185	4700	0.5
1/4	6	(66.4	(79.6	(210	1/8	3	1/4	6	135	160	4050	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	135	120	3050	2.0
1/2	12				1/8	3	1/4	6	140	95	2400	2.5
5/8	15				.157	4	.314	8	140	70	1800	2.5
3/4	20				3/16	5	3/8	10	150	55	1400	3.0
7/8	22				1/4	6	1/2	12	160	42	1050	3.0
1	25				1/4	6			165	33	840	
1-1/4	32	`			1/4	6			175	20	510	
1-1/2	38				5/16	8			185	11	280	

3" Under Water

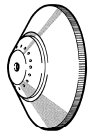
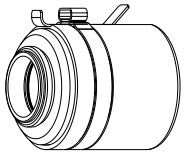
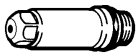
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (N_2 %)	Cutflow (N_2 %)	Shield Gas (CO_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**50**	**60**	**60**	1/8	3	1/4	6	130	175	4450	0.5
1/4	6	(66.4	(79.6	(220	1/8	3	1/4	6	135	145	3650	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	140	100	2600	2.0
1/2	12				1/8	3	1/4	6	145	75	1820	2.5
5/8	15				.157	4	.314	8	145	55	1350	2.5
3/4	20				3/16	5	3/8	10	155	40	980	3.0
7/8	22				1/4	6	1/2	12	165	30	750	3.0

Notes: **Set plasma gas inlet pressure to 120 psi (8.3 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 7/8" (22 mm) not recommended

Aluminum

100 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical.

020448 Shield	120837 Retaining cap	020611 Nozzle	020607 Swirl ring	120547 Electrode
				

Above Water

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**48**	**39**	**60**	3/32	2.5	3/16	5	135	110	2800	
3/16	5	(55.3	(44.9	(270	1/8	3	1/4	6	140	90	2290	0.5
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	145	70	1780	0.5
3/8	10				1/8	3	1/4	6	145	50	1270	0.5
1/2	12				1/8	3			150	40	1010	
5/8	15				.157	4			155	30	760	
3/4	20				3/16	5			160	25	635	

3" Under Water

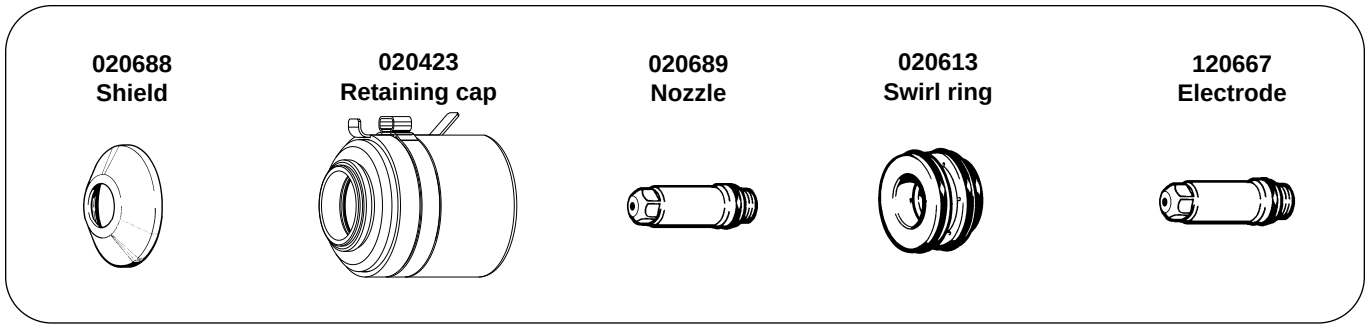
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**48**	**39**	**70**	5/64	2	5/32	4	135	100	2650	
3/16	5	(55.3	(44.9	(280	1/8	3	1/4	6	140	80	2050	0.5
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	145	60	1510	0.5
3/8	10				1/8	3	1/4	6	150	40	1000	0.5
1/2	12				1/8	3			155	30	750	

Notes: **Set plasma gas inlet pressure to 90 psi (6.2 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 3/8" (10 mm) not recommended

Aluminum

40 amps • Air Plasma / Air Shield

This gas combination gives good cut speed, low dross levels and is very economical.



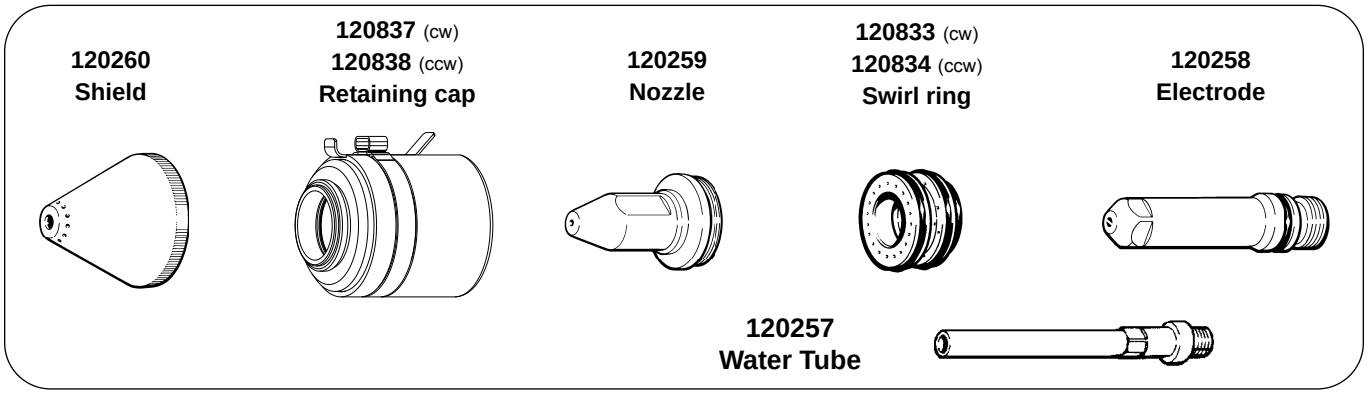
Above Water Only

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (Air %)	Cutflow (Air %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/32	2.5	**40**	**20**	**60**	3/32	2.5	3/16	5	120	140	3550	
1/8	3	(46.0	(23.1	(275	3/32	2.5	3/16	5	130	100	2550	0.5
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3			140	35	900	
3/8	10				1/8	3			150	15	350	

Notes: **Set plasma gas inlet pressure to 90 psi (6.2 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 1/8" (3 mm) not recommended

Mild Steel - Beveling Consumables

200 amps • O_2 Plasma / Air Shield



Above Water Only

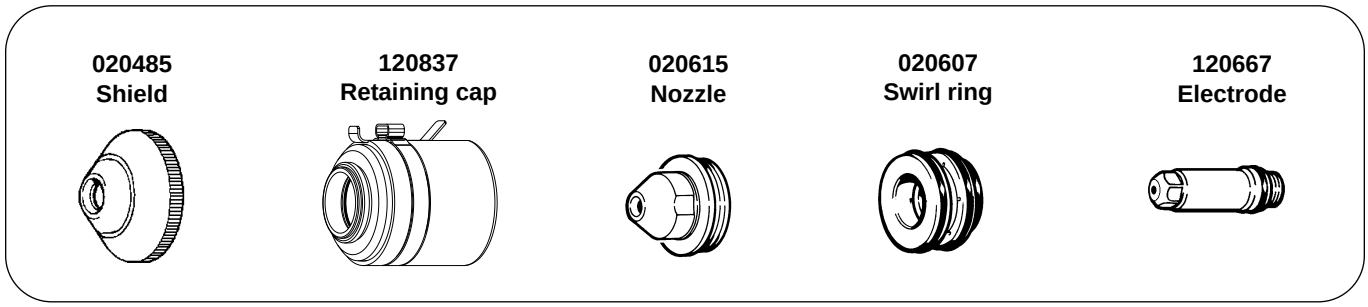
Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (O_2 % N_2 %)	Plasma Gas Flow Rate % Cutflow (O_2 % N_2 %)	Shield Gas (Air) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/4	6	**12 38**	**64 0**	**60**	1/8	3	1/4	6	115	160	4060	0.5
.315	8	(14.9 / 50.4	(79.6 / 0	(270	1/8	3	1/4	6	120	120	3000	0.5
3/8	10	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	120	100	2540	1.0
1/2	12				.157	4	.314	8	120	80	2030	2.0
5/8	15				.157	4	.314	8	125	70	1780	2.0
3/4	20				3/16	5	3/8	10	130	55	1400	2.5
7/8	22				1/4	6	1/2	12	135	45	1140	2.5
1	25				1/4	6	1/2	12	135	35	890	2.5
1 1/4	32				1/4	6			140	22	560	
1-1/2	38				1/4	6			150	15	380	
1-3/4	44				5/16	8			160	10	250	
2	50				5/16	8			170	7	180	

Notes: **Set oxygen plasma gas inlet pressure to 120 psi (8.3 bar).**
Set nitrogen plasma gas inlet pressure to 120 psi (8.3 bar).
Set shield gas inlet pressure to 90 psi (6.2 bar).
Production cutting above 1" (25 mm) not recommended

Beveling cuts should be made between 45° and 90° to the work surface.

Mild Steel Gouging

200 amps • Air Plasma / Air Shield



Plasma Gas Flow Rate %		Shield Gas (Air) Pressure (psi)	Arc Current Setting (amps)	Plasma Gas (Air) Inlet Pressure (psi)	Shield Gas (Air) Inlet Pressure (psi)
Preflow (Air %)	Cut Flow (Air %)				
71	**71**	**50**	**200**	**90**	**90**
(81.8 SCFH)					

CHANGING CONSUMABLE PARTS

WARNING

Always disconnect power to the power supply before inspecting or changing torch consumable parts.

Check the consumable parts daily for wear before cutting. Before removing parts, bring the torch to the edge of the machine, with the lifter raised to its highest point. This prevents the danger of dropping the consumables into the water of the water table.

Removal and Inspection – Refer to Figure 4-7

1. Remove the retaining cap and shield by unscrewing the retaining cap by hand.

2. Check the shield for external signs of wear. It should be clean and clear of metal debris. The gas holes along the edge of the shield should not be blocked with debris. The center hole should not have any nicks or gouges, and should show no signs of arcing activity.

3. Unscrew and remove the shield from the retaining cap. Inspect the gas holes from the inside. The holes should be clear of metal or other debris. (Debris can cause arcing.)

4. Inspect the two O-rings on the torch body. They should be lubricated and undamaged. If they are dry, lubricate them lightly with a very thin film of the lubricant provided in the consumable parts kit. If they are damaged, replace them.

5. Using the 3/4" side of the wrench supplied with the consumable parts kit, remove the nozzle. Inspect it for damage or signs of wear. You can clean the inside of the nozzle with steel wool, but be sure to remove any remnants of the steel wool afterward. The hole in the nozzle should not be worn or oval-shaped.

6. Using the 3/8" center hole in the wrench, remove the **Electrode** and inspect it. If the center of an all copper electrode has a pit more than .044" (1.1 mm) deep, replace it. A SilverPlus electrode should be replaced when the pit depth exceeds approximately double the recommended depth of a standard copper electrode. Use the electrode gauge assembly supplied in the spare parts kit to measure pit depth. If the electrode is still good, inspect its O-ring: it should be lubricated and undamaged. If it is dry, lubricate it lightly with a very thin film of lubricant provided in the spare parts kit. If it is damaged, replace it.

7. Remove the swirl ring from the electrode and inspect it. It should be clean, and the holes on the top and sides should not be plugged. Inspect its O-ring. It should be lubricated and undamaged. If it is dry, lubricate it lightly with a very thin film of the lubricant provided in the consumable parts kit. If it is damaged, replace it.

8. Inspect the inside of the torch body by using a mirror, or by looking carefully inside. The current ring inside of the torch body should be clean and undamaged. Use a clean paper towel or cotton swab to remove dirt, grease, etc. A preferred method to clean the current ring is with a clean paper towel or cotton swab dipped in water or 3% hydrogen peroxide. If the water tube is damaged at all, it may need to be replaced. See *Changing the Water Tube.*

Replacement

1. Before installing the electrode, be sure to lubricate the O-ring lightly with a very thin film of the lubricant provided in the consumable parts kit. Replace the electrode and tighten it with the wrench. **Do not overtighten**.

2. Before installing the swirl ring, be certain to lubricate the O-rings lightly with a very thin film of the lubricant provided in the consumable parts kit. Install the swirl ring with the bottom O-ring facing the inside of the torch. Push it into place. Be sure to hold the swirl ring in place until the nozzle is installed to avoid dropping it into the water of the water table.

3. Install the nozzle and tighten by hand. Finish tightening it with the wrench. **Do not overtighten**

4. Screw on the shield to the retaining cap and tighten by hand. Screw on the retaining cap to the torch and tighten by hand. Make sure that it is tightened snugly; if it is loose, it can affect the shield gas flow.

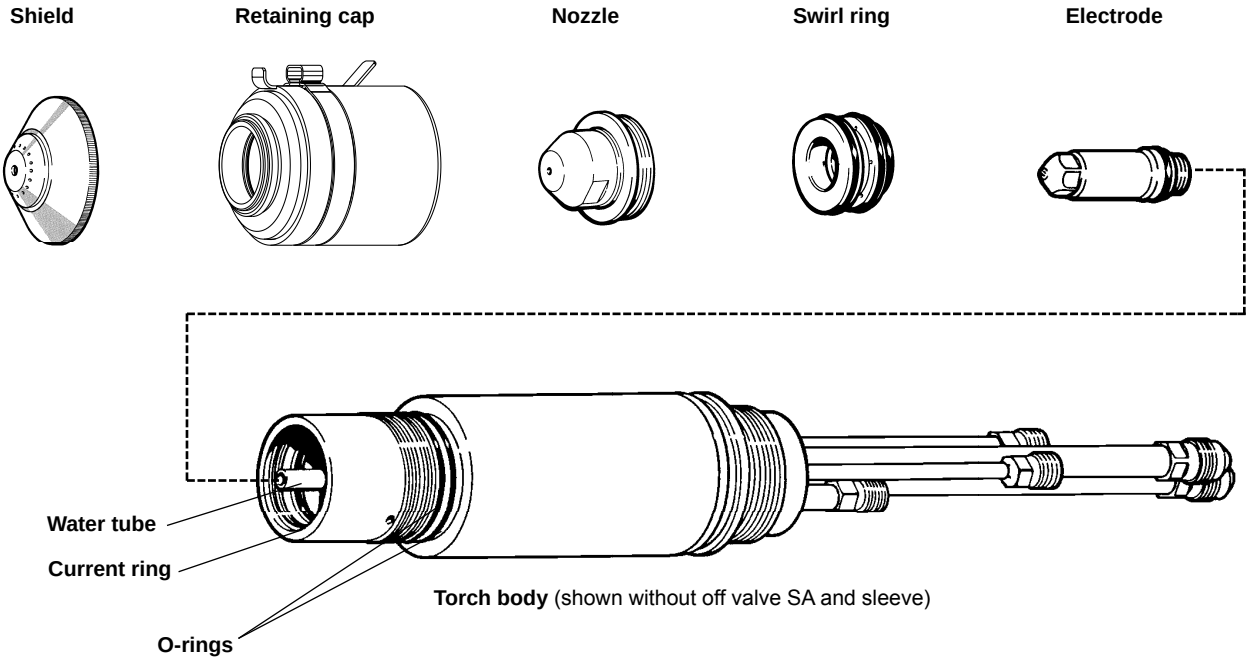


Figure 4-7 Changing Consumable Parts

Changing the Water Tube

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

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

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

1. Disconnect the power supply from the power source.
2. Remove all consumables from the torch (see *Changing Consumable Parts*).
3. Look for any damage or bends in the water tube.
4. Remove and replace the water tube by using the water tube wrench supplied by Hypertherm – Fig. 4-8. **When installing the water tube, do not overtighten it!** Tighten by hand only.

WARNING

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

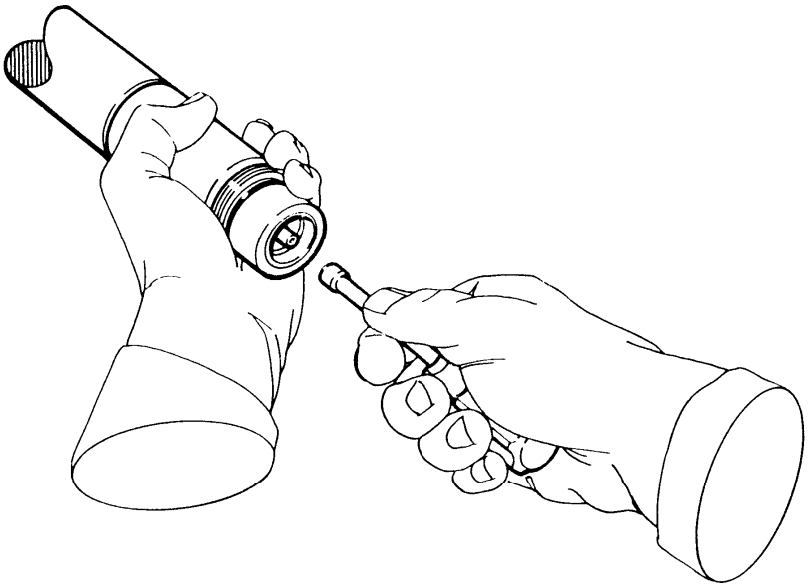
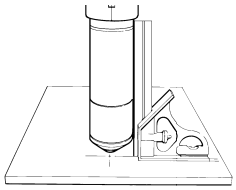


Figure 4-8 Changing the Water Tube

How to Optimize Cut Quality

The following tips and procedures will help produce square, straight, smooth and dross-free cuts.

Tips for Table and Torch



- Use a square to align the torch at right angles to the workpiece.
- The torch may travel more smoothly if you clean, check and “tune” the rails and drive system on the cutting table. Unsteady machine motion can cause a regular, wavy pattern on the cut surface.
- The torch must not touch the workpiece during cutting. Contact can damage the shield and nozzle, and affect the cut surface.

Plasma Set-Up Tips

Follow carefully each step in the *Daily Start-Up* procedure described earlier in this section.

Purge the gas lines before cutting.

Maximize the Life of Consumable Parts

Hypertherm’s LongLife® process automatically “ramps up” the gas and current flows at the start and ramps them down at the end of each cut, to minimize erosion of the electrode’s center surface. The LongLife process also requires that cuts start and stop on the workpiece.

- The torch should never fire into the air.
  - Starting the cut at the edge of the workpiece is acceptable, as long as the arc is not fired in the air.
  - To start with a pierce, use a pierce height that is 1.5 to 2 times the torch-to-work distance. See Cut Charts.
- Each cut should end with the arc still attached to the workpiece, to avoid arc blow-outs (ramp-down errors).
  - When cutting drop parts (small parts that drop down after being cut from the workpiece), check that the arc stays attached to the edge of the workpiece, for proper ramp-down.
- If arc blow-outs occur, try one or more of the following:
  - Reduce the cutting speed during the final part of the cut.
  - Stop the arc before the part is completely cut, to allow completion of the cut during the ramp-down.
  - Program the path of the torch into the scrap area for ramp-down.

    Note: Use a “chain cut” if possible, so the path of the torch can lead directly from one cut part into the next, without stopping and starting the arc. However, do not allow the path to lead off the workpiece and back on, and remember that a chain cut of long duration will cause electrode wear.

    Note: It may be difficult to achieve the full benefits of the LongLife process in some conditions.

Additional Factors of Cut Quality

Cut Angle

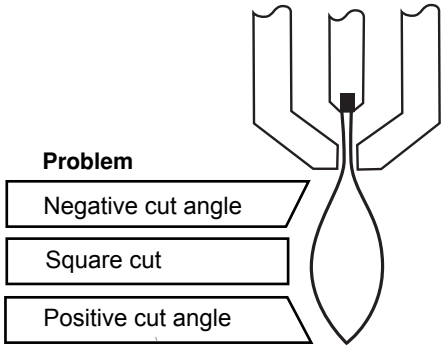
A cut part whose 4 sides average less than 4° of cut angle is considered acceptable.

Note: The squarest cut angle will be on the right side with respect to the forward motion of the torch.

Note: To determine whether a cut-angle problem is being caused by the plasma system or the drive system, make a test cut and measure the angle of each side. Next, rotate the torch 90° in its holder and repeat the process. If the angles are the same in both tests, the problem is in the drive system.

If a cut-angle problem persists after “mechanical causes” have been eliminated (See *Tips for Table and Torch,* previous page), check the torch-to-work distance, especially if cut angles are all positive or all negative.

- A positive cut angle results when more material is removed from the top of the cut than from the bottom.
- A negative cut angle results when more material is removed from the bottom of the cut.



Problem	Cause	Solution
Negative cut angle	The torch is too low.	Increase arc voltage to raise the torch.
Square cut		
Positive cut angle	The torch is too high.	Decrease arc voltage to lower the torch.

Dross

Low-speed dross forms when the torch’s cutting speed is too slow and the arc shoots ahead. It forms as a heavy, bubbly deposit at the bottom of the cut and can be removed easily. Increase the speed to reduce the dross.

High-speed dross forms when the cutting speed is too fast and the arc lags behind. It forms as a thin, linear bead of solid metal attached very close to the cut. It is welded to the bottom of the cut and is difficult to remove. To reduce high-speed dross:

- Decrease the cutting speed.
- Decrease arc voltage, to decrease the torch-to-work distance.
- Increase O_2 in the shield gas to increase the range of dross-free cutting speeds. (Only HyDefinition and HT4400 systems can accommodate mixed-gas shield gases.)

Notes: Dross is more likely to form on warm or hot metal than on cool metal. For example, the first cut in a series of cuts will likely produce the least dross. As the workpiece heats up, more dross may form on subsequent cuts.

Dross is more likely to form on mild steel than on stainless steel or aluminum.

Worn or damaged consumables may produce intermittent dross.

Straightness of the Cut Surface

A typical plasma cut surface is slightly concave.

The cut surface may become more concave, or convex. Correct torch height is required to keep the cut surface acceptably close to straight.

A strongly concave cut surface occurs when the torch-to-work distance is too low. Increase the arc voltage to increase the torch-to-work distance and straighten the cut surface.

A convex cut surface occurs when the torch-to-work distance is too great or the cutting current is too high. First, reduce the arc voltage, then reduce the cutting current. If there is overlap between different cutting currents for that thickness, try the consumables designed for the lower current.

Additional Improvements

Some of these improvements involve trade-offs, as described.

Smoothness of Cut Surface (Surface Finish)

- (HyDefinition and HT4400 only) On mild steel, a higher concentration of N_2 in the O_2-N_2 shield mixture may produce a smoother cut surface.
  Trade-off: This may produce more dross.

- (HyDefinition and HT4400 only) On mild steel, a higher concentration of O_2 in the O_2-N_2 shield mixture may increase the cutting speed and produce less dross.
  Trade-off: This may produce a rougher cut surface.

Piercing

- The pierce delay must be sufficiently long that the arc can pierce the material before the torch moves, but not so long that the arc “wanders” while trying to find the edge of a large hole.

- A higher shield gas preflow may help blow the molten metal away during piercing.
  Trade-off: This may reduce starting reliability.

  Note: When piercing at maximum thicknesses, the ring of dross that forms during the pierce may be high enough to contact the torch when the torch begins to move after the pierce is complete. A “flying pierce,” which makes the pierce while the torch is moving, may eliminate the torch vibration that follows contact between the torch and the ring of dross.

How to Increase Cutting Speed

- Decrease the torch-to-work distance.
  Trade-off: This will increase the negative cut angle

  Note: The torch must not touch the workpiece while piercing or cutting.

Section 5

MAINTENANCE

Introduction

Hypertherm assumes that the service personnel performing the troubleshooting testing are high-level electronic service technicians that have worked with high voltage electro-mechanical systems. Knowledge of final isolation troubleshooting techniques is also assumed.

In addition to being technically qualified, maintenance personnel must perform all testing with safety in mind. Refer to the *Safety* section for operating precautions and warning formats.

If you need additional assistance or need to order parts, call our Customer Service or Technical Service groups listed at the front of this manual.

	WARNING
SHOCK HAZARD: The large chopper capacitors store large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge capacitors with a screwdriver or other implement…explosion, property damage and/or personal injury will result. Wait at least five minutes after turning the power supply off before touching the chopper or the capacitors.	

Routine Maintenance

Torch and Torch Leads (See also *Torch Coolant Draining* at the end of this section)

Inspection

Inspect the torch and torch leads on a routine basis.

- The torch consumable parts and torch main body should always be inspected prior to cutting. Worn or damaged parts can cause gas and water leaks which can affect the cut quality. Check for pitting and burn marks on the consumable parts and replace them, if necessary. See *Changing Consumable Parts* in **Section 4**.
- Ensure that all connections are tight, but do not overtighten.
- The torch leads should be checked occasionally for cracking and damage.

Power Supply (See also *Torch Coolant Draining* at the end of this section)

Inspection and Cleaning

Inspect the power supply on a routine basis.

- Check the exterior for any damage. If there is damage, ensure that it does not affect the safe operation of the power supply.
- Remove covers and inspect the interior. Check wiring harnesses and connections for wear and damage. Check for loose connections, and look for areas of discoloration due to overheating.
- At the rear of the power supply, inspect the filter element of the water coolant assembly. If the filter becomes excessively dirty, torch coolant flow can slow down causing the flow switch to open (turn off) and make the coolant flow interlock status LED illuminate. The filter changes to a brown color when it is dirty. Replace the filter element (027005) when it starts to turn color.
- Every 2 weeks, inspect the air filter in the front panel of the power supply by removing the access cover and lifting the filter out. Replace the filter (027441) when dirty.
- Every 6 months, flush the power supply of its torch coolant and replace with new coolant (028872). Also, replace the water filter (027005) every 6 months.
- Every 6 months, clean the pump strainer with a mild soap and water solution.
  Note: Remove the pump from the system before removing the strainer to avoid any debris from falling into the pump housing. See Fig. 5-1.

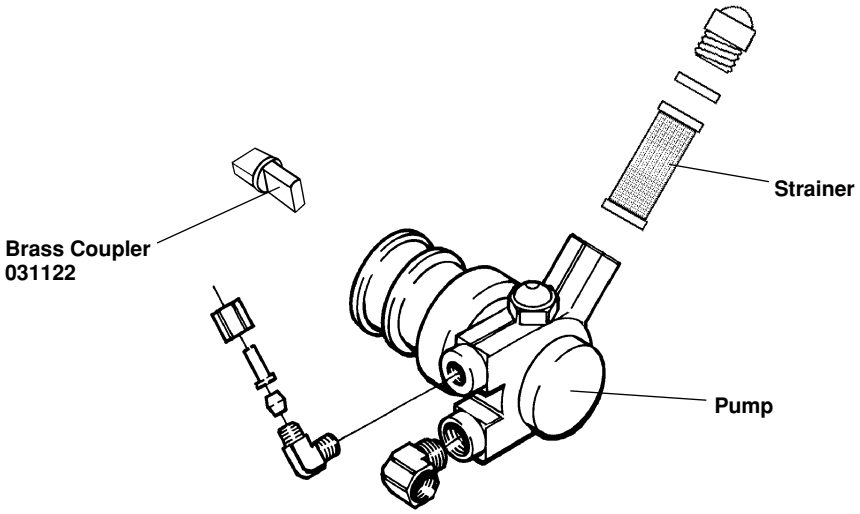


Figure 5-1 Cleaning the Pump Strainer

Cleaning

Check the inside of the power supply periodically for dust and foreign matter.

- Open the cover and blow out the power supply with compressed air. It is important to keep the cover closed except when cleaning or when maintenance is being performed.

Gas Console

Inspection

Inspect the gas console on a routine basis.

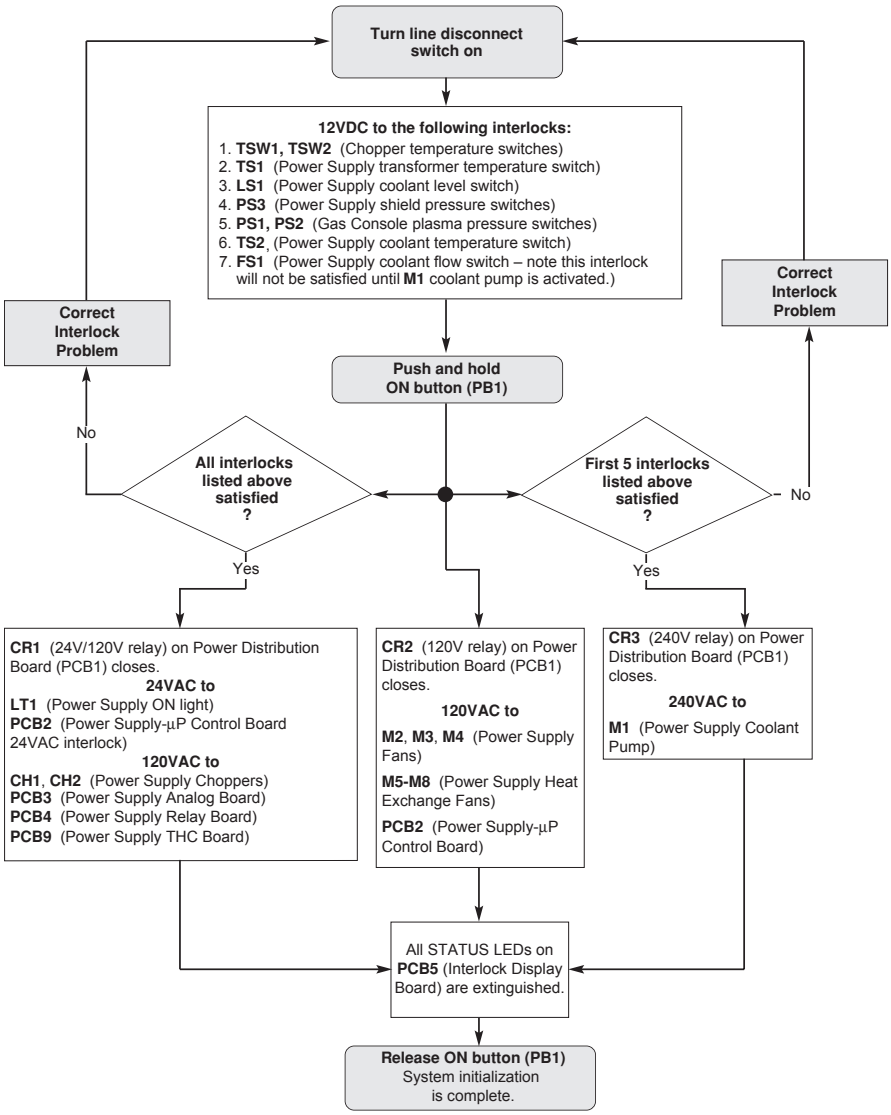
- Check the exterior for any damage. Look for damaged glass tubes in the flowmeters and check the pressure gauges for damage.
- Inspect all interconnecting cables, hoses and leads for wear and damage. Ensure that all connections are tight and that there are no leaks. Do not overtighten fittings.

Cleaning

Keep the flowmeters and pressure gauges free of dirt, dust and foreign matter.

Start Sequence

Shaded boxes represent action taken by the operator.



Initial Checks

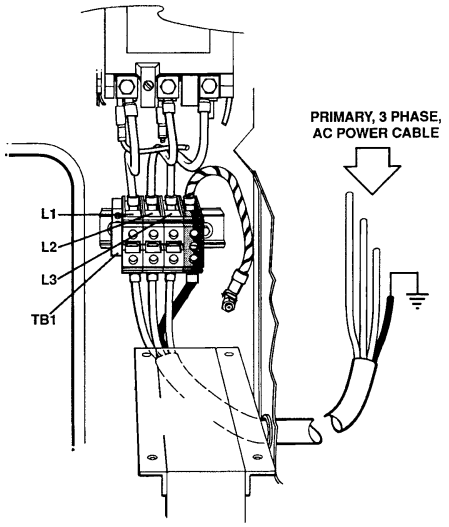
Before tracking down specific problems, it is good practice to do a visual check, and verify proper voltages are present at the power source, transformer and power distribution board.

WARNING

SHOCK HAZARD: Always use caution when servicing a power supply when it is plugged in and the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death.

1. Place the line disconnect switch in the off position.
2. Using a Phillips head screwdriver, remove the top plate, two side plates, front plate, and rear plate.
3. Inspect the interior of the power supply for discoloration on pc boards, or other apparent damage. If a component or module is obviously defective upon visual inspection, remove and replace it before testing. Refer to **Section 6** to identify parts and part numbers.
4. If no damage is apparent, place the line disconnect switch in the on position.
5. Measure the voltage at TB1 between L1, L2 and L3. Refer to Figure 5-2 for detail of TB1. The voltage between any two of the three points at TB1 should be equal to your supply voltage. If there is a problem at this point, disconnect the main power and check connections, power cable, and fuses at the line disconnect switch. Repair and/or replace defective component(s) if necessary.

Measure the voltage for the 400 volt CE power supplies between the U, V and W terminals of TB1 in the EMI filter located on the top of the power supply. Refer to the appendix section.



WARNING

There is line voltage at the contactor if the line disconnect switch is in the ON position, even if the ON (1) pushbutton on the HT2000 power supply has not been pressed. Use extreme care when measuring primary power in this area. Voltages present at the terminal block and contactor can cause injury or death!

Figure 5-2 Primary Power Measurement Location – HT2000LHF

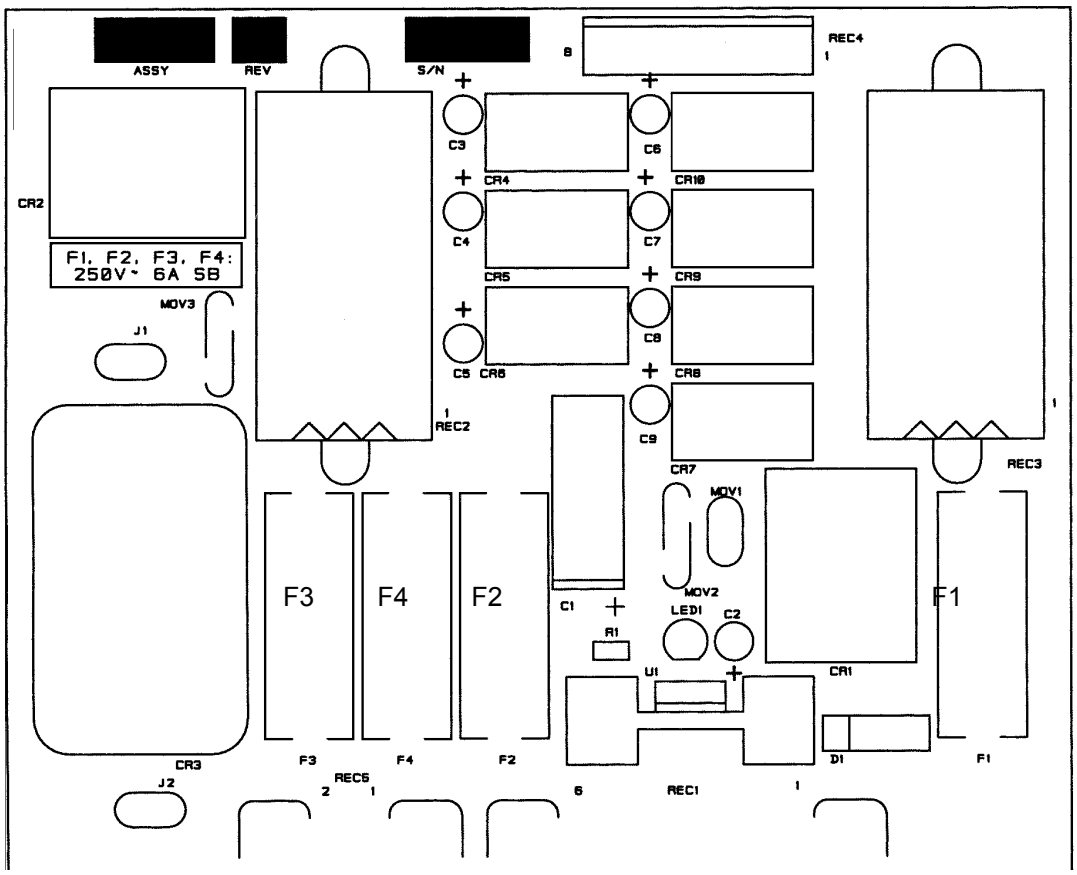


Figure 5-3 Power Distribution Board PCB1

6. Measure the voltage at Power Distribution Board PCB1. Refer to Figure 5-3 for detail of PCB1. Look on the board for fuses F1-F4. Measurements between each fuse and chassis ground should be as follows:

F1:	24VAC
F2:	120VAC
F3:	240VAC
F4:	120VAC

If voltages are not present, or incorrect at one or more of these points, disconnect the power and troubleshoot PCB1 fuses and associated pins, connectors and wiring between power distribution board connector REC1 and transformer secondary T1. Refer to **Section 6** for location of T1.

Also, check the main power circuit breaker CB1 and associated wiring and connections between T1 and points L1 and L2.

Repair and/or replace defective component(s) if necessary.

Troubleshooting

The troubleshooting section is presented by following normal operational sequence.

Before troubleshooting for specific problems, be sure that the unit passes *Initial Checks* as outlined earlier in this section.

WARNING

SHOCK HAZARD: Always use caution when servicing a power supply when the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death. If questions or problems arise during servicing, call the Hypertherm Technical Services Department listed at the front of this manual.

Problem	*Possible Causes* / Solutions
1. The green POWER ON pushbutton switch PB1 is pressed, but the fans are not operating and the green POWER ON indicator does not illuminate.	**1.1.** *The POWER ON (I) PB1 pushbutton is defective.* Check that the switch is operating correctly. The POWER ON switch is normally open.
	1.2. *The POWER OFF (0) PB2 pushbutton is defective.* Check that the switch is operating correctly. The POWER OFF switch is normally closed.
	1.3. *No jumper for PB2A and PB2B at TB5.* TB5 terminals 1&2 and 4&5 need a jumper if there is no optional remote I/O cable for switching the power supply on and off.
	1.4. *Associated wiring not making good contact.* Check wiring and repair or replace, if necessary.
2. The green POWER ON pushbutton switch PB1 is pressed, the POWER ON indicator illuminates, but the fans are not running.	**2.1.** *CR2 on the power distribution board PCB1 is defective.* Check that CR2 switches when the POWER ON pushbutton is pressed. See Figure 5-3 for location of CR2. If CR2 is defective, replace PCB1.
	2.2. *Connector from the power distribution board is not seated securely.* Check pins, connectors and associated wiring for continuity. Repair or replace, if necessary.
3. The green POWER ON pushbutton switch PB1 is pressed, the fans are operating, but the green POWER ON indicator does not illuminate.	**3.1.** *Pushbutton PB1 was not held down for a long enough period of time.* Press and hold PB1 for a minimum of 5 seconds.
	3.2. *Relay CR1 on the power distribution board is defective.* Check that CR1 switches when the POWER ON pushbutton is pressed. See Figure 5-3 for location of CR1. If CR1 is defective, replace PCB1.

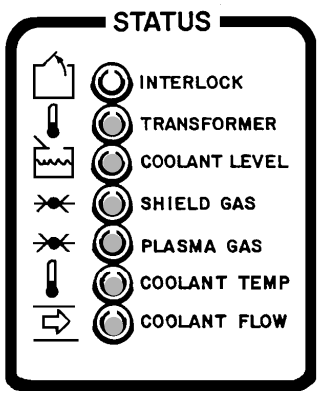
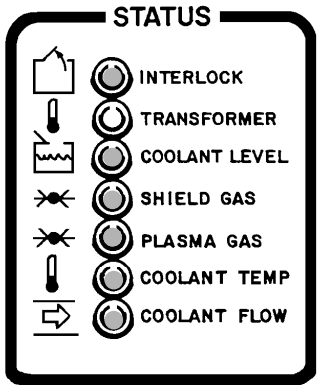
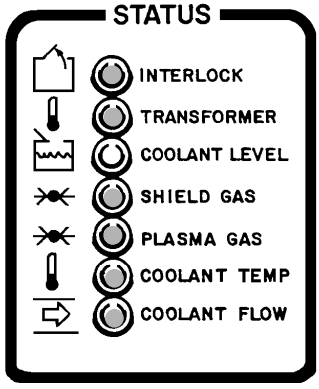
Problem	*Possible Causes* / Solutions
	3.3. *One or more of the STATUS LEDs remains illuminated, indicating a fault condition.* To troubleshoot STATUS fault conditions, see *Status LED Troubleshooting* later in this section.
4. The green POWER ON indicator is illuminated, the START command is given and the DC ON indicator is illuminated, but there is no high frequency and no pilot arc.	**4.1.** *There is no spark between the spark gap electrodes.* Clean (with emery cloth), align and reset the electrode gaps to .020" (0.51 mm), if necessary. The electrode surfaces between the gaps should be flat. If the surfaces are rounded, replace and reset the gap. • Inspect the high voltage transformer T3 in the power supply for signs of overheating. See Figure 6-7 for location of T3 . Replace T3 if it is overheating. • Check for 120VAC at T3 after the START command is given. • If there is no 120VAC at T3, use wiring diagrams in **Section 7** to check pins, connectors and associated wiring from T3 to relay board PCB4. If connections are OK, there may be a problem with either PCB4 or PCB2. • If there is 120VAC at T3 , shut down the system and remove capacitors C4, C5 and C6. (See Figure 6-7 for location of C4, C5 and C6) Restart the system and look for a faint spark across the gaps. • If a spark is not observed at the gaps, replace T3. If there is a spark, shut down system, and replace capacitors C4, C5 and C6. **(Always replace all the capacitors.)**
	4.2. *There is no high frequency at the torch.* Check for a shorted torch, or loose lead connections. Replace the torch or tighten the lead connections.
5. The green POWER ON indicator is illuminated, the torch START command is given and the DC ON indicator illuminates, and there is high frequency, but there is no pilot arc.	**5.1.** *Pilot arc relay CR1 is not closing.* See if the CR1 relay contacts close after the START command is given. See Figure 6-7 for location of CR1. If CR1 does not close: • With an AC voltmeter across the relay, see if 120VAC is coming from PCB4 after the START command is given. • If there is no 120VAC, check connectors, terminals, pins, and associated wiring to PCB4. • If wiring is OK, there is a problem either with PCB4 or PCB2.

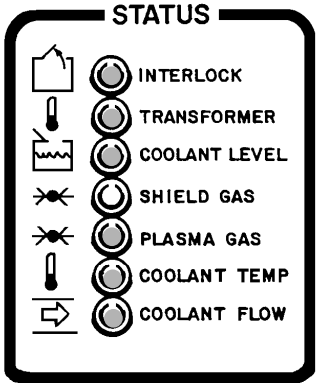
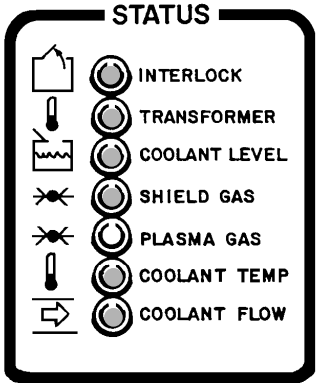
Problem	*Possible Causes* / Solutions
	5.2. *Pilot arc relay CR1 is defective.* If there is 120VAC across the relay (see previous steps), and CR1 does not close, replace CR1.
	5.3. *Main contactor (CON1) or PCB4 is defective.* • With an AC voltmeter, see if there is 120VAC at contactor CON1 after the START command is given. If there is no 120VAC, check pins, connectors and associated wiring from CON1 to PCB4. • If wiring is OK, PCB4 or PCB2 may be defective. • If there is 120VAC at CON1 as described above, measure the voltage between secondary terminals of the main transformer T2 after the START command is given. The voltage between any two of the three points connected to each chopper input should be equal to about 200VAC. If there is no voltage at any of the above points, replace CON1. If there is voltage at some but not all of the above points, check wiring and connections to and from T2. If wiring checks out OK, return to Initial Checks section and repeat steps 1-5.
	5.4. *Choppers are defective or not functioning.* See *Chopper Module Test Procedure l*ater in this section.
6. The unit stops cutting during cut, or cuts poorly.	**6.1.** *The work cable is not connected or it is broken.* Connect or repair the work cable.
	6.2. *Arc not transferring to workpiece.* Check the work cable connection to the workpiece. Good contact must be made in order for the arc to transfer.
	6.3. *There is insufficient air or gas pressure.* Check the gas inlet pressures and the plasma and shield gas pressures in TEST and RUN modes as specified in the *Cut Charts.*
	6.4. *Torch is getting insufficient current.* Check the arc current setting in the *Cut Charts* for the type and thickness of metal you are cutting.
	6.5. *The power supply has overheated.* Shut down the system and wait for the power supply to cool down. If the power supply will not restart, see *Status LED Troubleshooting* guide later in this section.
	6.6. *Choppers are defective or not functioning.* See *Chopper Module Test Procedure* later in this section.

Status LED Troubleshooting

Be certain that the power supply has been through the *Initial Checks* as outlined earlier in this section before troubleshooting STATUS LEDs.

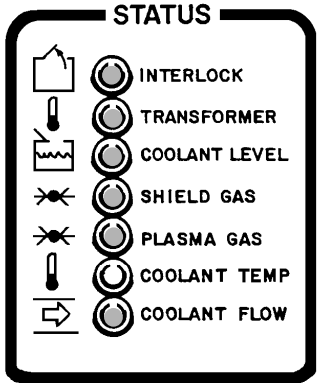
When any one of the STATUS LEDs illuminates, there is a fault condition that must be corrected in order for the HT2000LHF power supply to become operational. See **Section 7** in this manual for reference.

Problem	*Possible Causes* / Solutions
1. INTERLOCK LED illuminated: 	This LED should never illuminate. Call the Technical Services department listed in the front of this manual if this LED illuminates.
2. TRANSFORMER LED illuminated: 	**2.1.** *Main Transformer T2 or one of the choppers is overheating.* This LED will extinguish when the main transformer (T2) is operating in a normal temperature range (under 165° C (329° F)) and choppers CH1 and CH2 are also operating in a normal temperature range (under 82° C (180° F)). • Check the temperature switches (normally closed). • Check pins, connectors and wiring to temperature switches. • Leave the fans running, and try restarting the unit after one hour. If LED still illuminates, one of the choppers or the main transformer may need to be replaced.
3. COOLANT LEVEL LED illuminated: 	**3.1.** *Coolant level is low.* This LED will extinguish when a proper coolant level in the coolant reservoir is maintained. Level switch LS1 is located in the coolant reservoir, and will open when it senses that coolant level is too low. • Check the coolant level. • If the coolant level is adequate, check to see if LS1 switch is closed. • Check connections and wiring from LS1 to PCB1. Repair and/or replace defective component(s), if necessary.

Problem	*Possible Causes* / Solutions
4. SHIELD GAS/CAP LED illuminated: 	**4.1.** *Shield gas pressure is too low.* This LED will extinguish when shield gas pressure of 12 psi (0.83 bar) or greater is sensed by PS3 (located in the power supply). • Check to see that the shield gas supply is set to 90 psi (6.2 bar) as defined in the *Specifications* section of this manual. • Verify that all shield gas connections are secure, and that there are no leaks in any hoses connected to the power supply or gas console. **4.2.** *Torch cap not tightened securely.* If the torch retaining cap is not tightened securely, or there is debris in the retaining cap, the shield gas may escape and cause pressure switch PS3 to remain open. • Listen at the torch for a hissing sound during startup. • Remove the retaining cap and check for debris or O-ring damage. Clean or replace, if necessary. See *Changing Consumable Parts* in the **Operation** section. **4.3**. *Pressure switch PS3 in the power supply is not functioning.* PS3 is normally open, and closes when shield gas pressure is 12 psi (0.83 bar) or greater. • Using the wiring diagrams, check pins, connectors and wiring from the power distribution board (PCB1) to PS3. Repair and/or replace defective component(s), if necessary.
5. PLASMA GAS LED illuminated: 	**5.1.** *Plasma gas pressure is too low.* This LED will extinguish when PS1 and/or PS2 in the gas console senses plasma gas pressure of 80 psi (5.5 bar) or greater. • Verify that the plasma gas supply is set to 120 psi (8.3 bar) as defined in the *Specifications* section of this manual. • Verify that all plasma gas connections are secure, and that there are no leaks in any hoses connected to the gas console. **5.2.** *Pressure switches PS1 and/or PS2 not functioning.* These switches are normally open, and close when plasma gas pressure is at or above 80 psi (5.5 bar). After PS1 and PS2 are closed (in O_2 mode) or PS1 is closed (in N_2 mode), the Plasma Gas LED extinguishes. • Using the wiring diagrams, check pins, connectors and wiring from the power distribution board (PCB1) to PS1 and PS2. Repair and/or replace defective component(s), if necessary.

Problem | *Possible Causes* / Solutions

6. COOLANT TEMP LED illuminated:

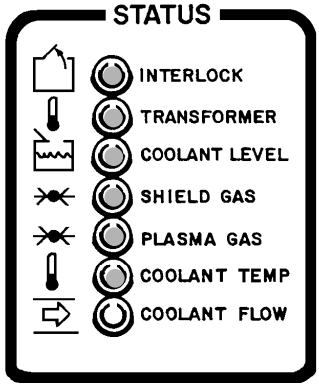


6.1. *Coolant is too hot.*
This LED will extinguish when temperature switch TS2 senses that the temperature of coolant in the coolant reservoir is under 160° F (71° C).

- Check to see if the water coolant is above 160° F (71° C).
- Check to see if TS2 (located in the coolant reservoir) is open. TS2 is normally closed, and is opened when a temperature above 160° F (71° C) is reached.
- Using the wiring diagrams, check pins, wires and connections from TS2 to PCB1.

Repair and/or replace defective component(s), if necessary.

7. COOLANT FLOW LED illuminated:



7.1. *Coolant flow is restricted.*
This LED will extinguish when flowswitch FS1 senses a coolant flow of at least 0.5 gpm (1.9 lpm) to the torch. FS1 is a normally open switch that closes when a flow greater than 0.5 gpm (1.9 lpm) is sensed. See *Coolant Flow Test Procedure* later in this section to troubleshoot coolant flow problems.

Note: Coolant flow LED illuminates when the line disconnect switch is turned ON because coolant reservoir pump M2 is not activated until the power supply POWER ON (PB1) is pressed.

Chopper Module Test Procedure

Note: Take voltages with a digital multimeter capable of storing min. and max. readings.

WARNING

SHOCK HAZARD: Use extreme care when working near the chopper modules. The large chopper capacitors store large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge capacitors with a screwdriver or other implement…explosion, property damage and/or personal injury will result.

1. Turn all power to the power supply OFF.
   Disconnect the mating receptacles in the power supply to disable the high frequency transformer T3. See Figure 6-7 for location of T3.

2. Remove large fuses F1 and F2. Check to see if the fuses are open.

3. Place the positive lead to the + side of the bridge and the negative lead to the – side of the bridge. See Figure 5-4. Note that actual connection points are hidden by cap support bracket in Figure 5-4.

4. Turn power to the power supply ON, and start the system up. After the START command has been given, check the voltage. The input to the chopper at these points should be about +280 VDC. If the input is OK and corresponding fuse F1 or F2 was blown, replace the chopper module.
   If there is no +280 VDC input, check input to bridge for shorts. Also, check contactor (CON1), connections and associated wiring to the contactor. Repair and/or replace defective component(s) if necessary.

5. If the voltage from above step is +280 VDC and corresponding fuse is not blown, check output of CH1 by placing the positive lead of the voltmeter at point + WORK on the chopper module (wire #48A) and negative lead at point - TORCH (wire #39A). (Check the output of CH2 by placing the leads of the voltmeter at the corresponding points on the other chopper module.)

6. Turn the system on and press the START command. After the START command has been given, check the voltage. If the output from each chopper at these points is +280 VDC, then the choppers are OK.

7. If the chopper does not output +280 VDC, check to see if the LED1 logic power light is illuminated. If LED1 is extinguished, check if 120V is going to JP6. If there is no 120V at JP6, check wiring back to the power distribution board. Repair or replace defective component(s), if necessary. Also check to see if LED3 is turning green when enabled (normal condition). If LED1 is illuminated and LED3 is red when enabled (fault condition), then make sure that JP9 is seated properly.

8. If the chopper still does not output 280V after completing step 7, there may be a problem with the control signal or the chopper module. The chopper drive signal comes through the analog board PCB3 as an analog level from 0 to +8 VDC, which varies the duty cycle and subsequent output current of the chopper. These analog signals are on pins 3&4 REC1 of PCB3 for CH1, and 5&6 REC1 for CH2.

To determine if there is a problem with the chopper modules or with control board PCB2 or analog board PCB3, proceed as follows:

- Ensure that the high frequency is still disabled (see step 1).
- Disconnect PL3.1 from REC1 on PCB3.
- Place voltmeter across the output of the chopper and press the START command.
- If the voltmeter reads +280 VDC, then replace either control board PCB2 or analog board PCB3.
- If the voltmeter reads 0 volts, then replace the corresponding chopper module CH1 or CH2.

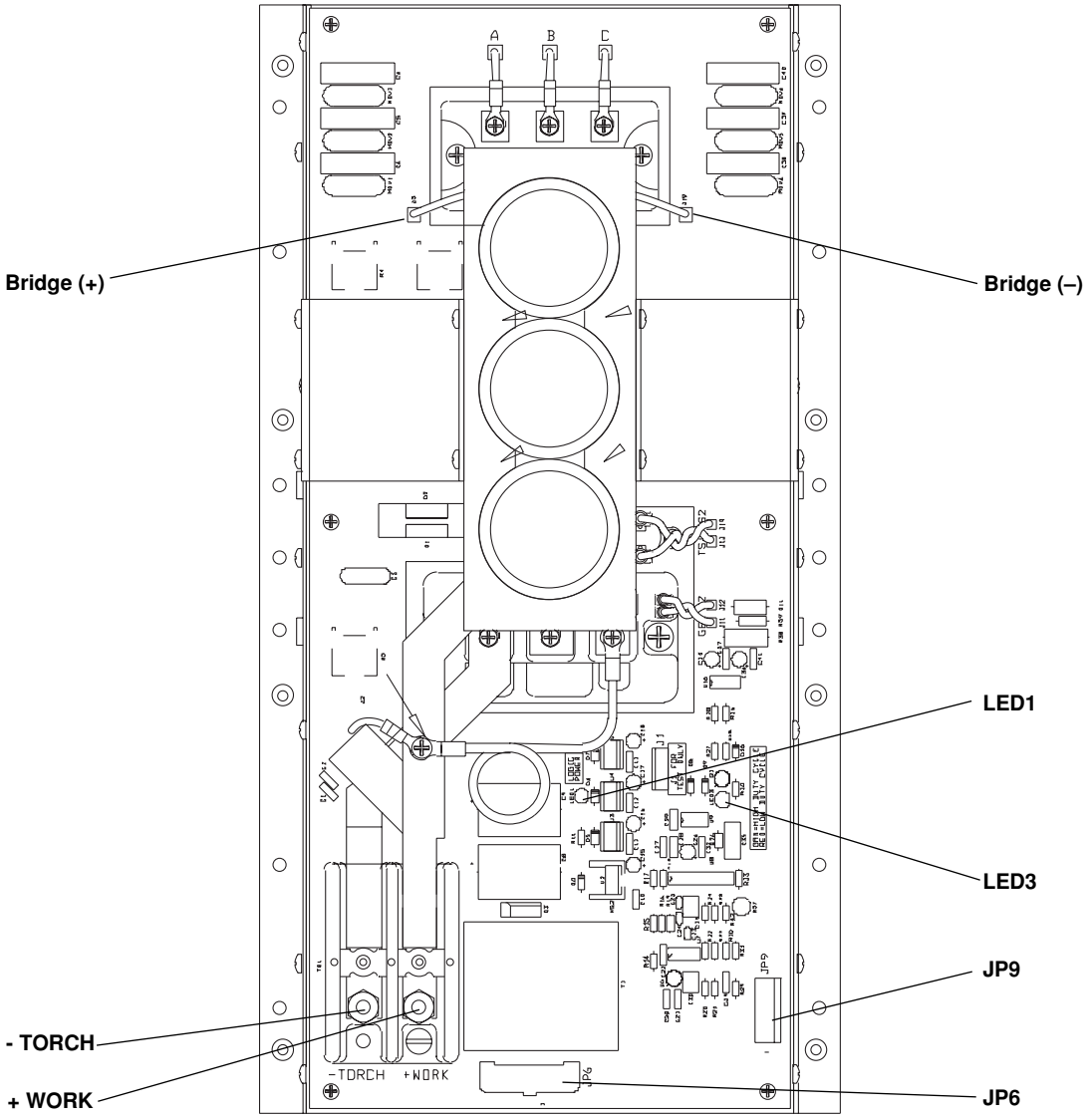


Figure 5-4 Chopper Module – Front View

Error Codes

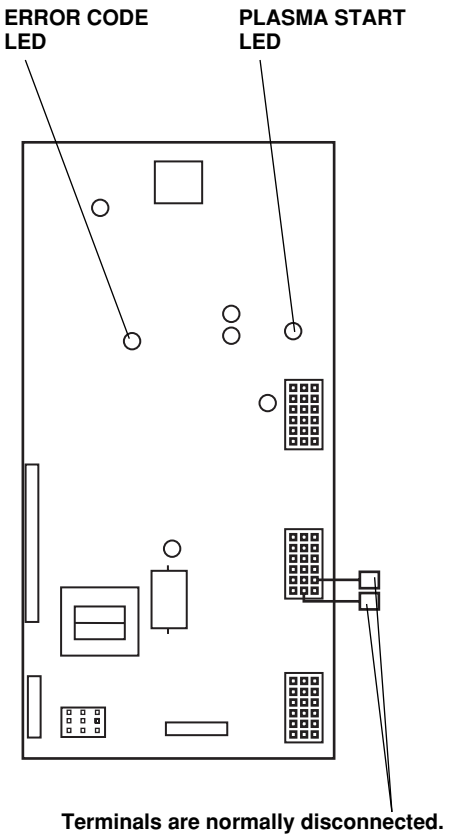
The microcontroller on control board PCB2 will alert the user when certain errors occur in the system, by flashing the Error Code LED on the control board . The power supply front cover must be removed to observe control board PCB2 and the Error Code LED (see Figure 6-1 for location of PCB2 and Figure 5-5 for location of Error Code LED on PCB2).

The Error Code LED will blink on for .5 seconds and off for .5 seconds with a 2-second gap before repeating the blinking sequence. The number of blinks between the 2-second gap is 1 of 10 error indications listed below.

During the error code flashing, all outputs from the control board are turned off, and the power supply is in an idle mode. After the error is corrected, you may resume operation of the system.

Note: 8 or 9 blinks will occur during normal operation. If the Error Code LED remains on without blinking, this indicates that a microcontroller internal RAM or ROM self-check error has occurred (power supply will hang up).

For troubleshooting purposes, the Plasma Start LED is also shown in Figure 5-5. When illuminated, this LED indicates that the plasma START command has been received at the control board.



Number of blinks	Explanation
1	Indicates that the IHS Complete signal has not been returned within 30 seconds after the plasma START command has been given.
2	Indicates that an "interlock" error has occurred.
3	Indicates that the HOLD input (for multi-torch systems) was not released within 30 seconds after the end of preflow.
4	Indicates that there was no transfer within 300ms.
5	Indicates that transferred current arc was lost during ramp up.
6	Indicates that the current was lost from chopper #1 (CH1).
7	Indicates that the current was lost from chopper #2 (CH2).
8	Indicates that transferred current arc was lost during ramp down.
9	Indicates that the software has an error.
10	Indicates that the input voltage has dropped below 15% of the nominal value. Eg: Input voltage for a 480V power supply drops below 408V.

Figure 5-5 Control Board Error Code LED Location and Code Explanation

Coolant Flow Test Procedure

WARNING

Push the OFF (0) button on the power supply and place the main disconnect switch in the OFF position before proceeding.

If the COOLANT FLOW Status LED illuminates, verify that the proper flow is maintained by following the troubleshooting sequence outlined in this procedure:

Check Reservoir Coolant

1. Shut off the power supply.
2. Remove the torch coolant reservoir cap.
3. Remove the power supply rear cover.
4. Verify that the reservoir is full of coolant. Add coolant, if necessary.

Verify Flow Rate Return from Torch

1. Find a clean 1-gallon (3.8 liter) container.
2. Locate the two coolant hoses that come off of the cathode block at the rear of the power supply (black hoses: one with a green tape band and one with a red tape band – See Fig. 5-6).
3. Remove the torch coolant return hose (black hose with the red band) from the cathode block.
4. Place the red banded hose into the 1-gallon container.

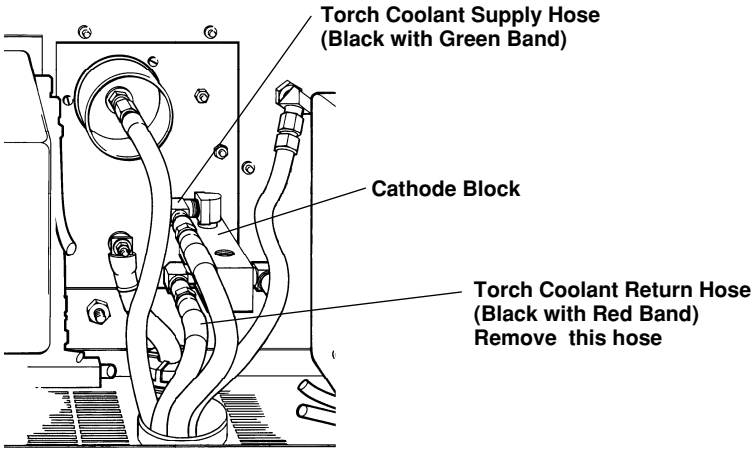


Figure 5-6 Torch Coolant Supply and Return Hoses

5. Turn the power supply power on.

6. Hold down the ON (I) button on the power supply.

7. Start timing for 30 seconds, and then release the button.

8. Verify that the container is 1/2 full. If not 1/2 full, repeat this test and time discharge for 1 minute. After 1 minute verify that the container is at least 3/4 full.

8.1. If the 1-gallon container is less than 3/4 full after step 8, go to *Verify Flow Rate to Torch.*

8.2. If the 1-gallon container is at least 3/4 full after step 8, the problem is either with the flow switch or the particulate filter.

- Remove the filter element and re-connect the coolant hose to the cathode block on the rear of the power supply.

- Start the power supply. If the COOLANT FLOW LED remains illuminated, replace the flow switch. If the LED does not illuminate, replace the filter element.

Verify Flow Rate to Torch

1. Press the power supply OFF (0) button and place the main disconnect switch to the OFF position.

2. Remove the torch consumables.

3. Replace only the retaining cap on the torch. (Do not replace the electrode, nozzle and swirl ring back in the torch.)

4. Place the empty 1-gallon container under the torch.

5. Turn the power back on and press and hold down the power supply ON (I) button.

6. Start timing for 1 minute. The torch should deliver at least 1 gallon (3.8 liters) of fluid in 1 minute.

7. If the torch delivers at least 1 gallon (3.8 liters) of fluid per minute, then the flow rate to the torch is OK. Replace the torch. If the torch does not deliver at least 1 gallon (3.8 liters) of fluid per minute, go to *Check Pump, Motor, and Solenoid Valve (V1).*

8. If replacing the torch does not satisfy the flow switch, then replace the torch leads.

Check Pump, Motor and Solenoid Valve (V1)

1. If the coolant is not flowing, check to see if the motor and valve V1 are getting 240VAC. Note: The 240VAC relay (CR3) on PCB1 will not close until the first 5 interlocks (STATUS) indicators are satisfied. (See *Start Sequence* flowchart earlier in this section.)

2. If the motor, pump and valve all seem to be functioning and the flow is not sufficient, replace the pump and motor assembly.

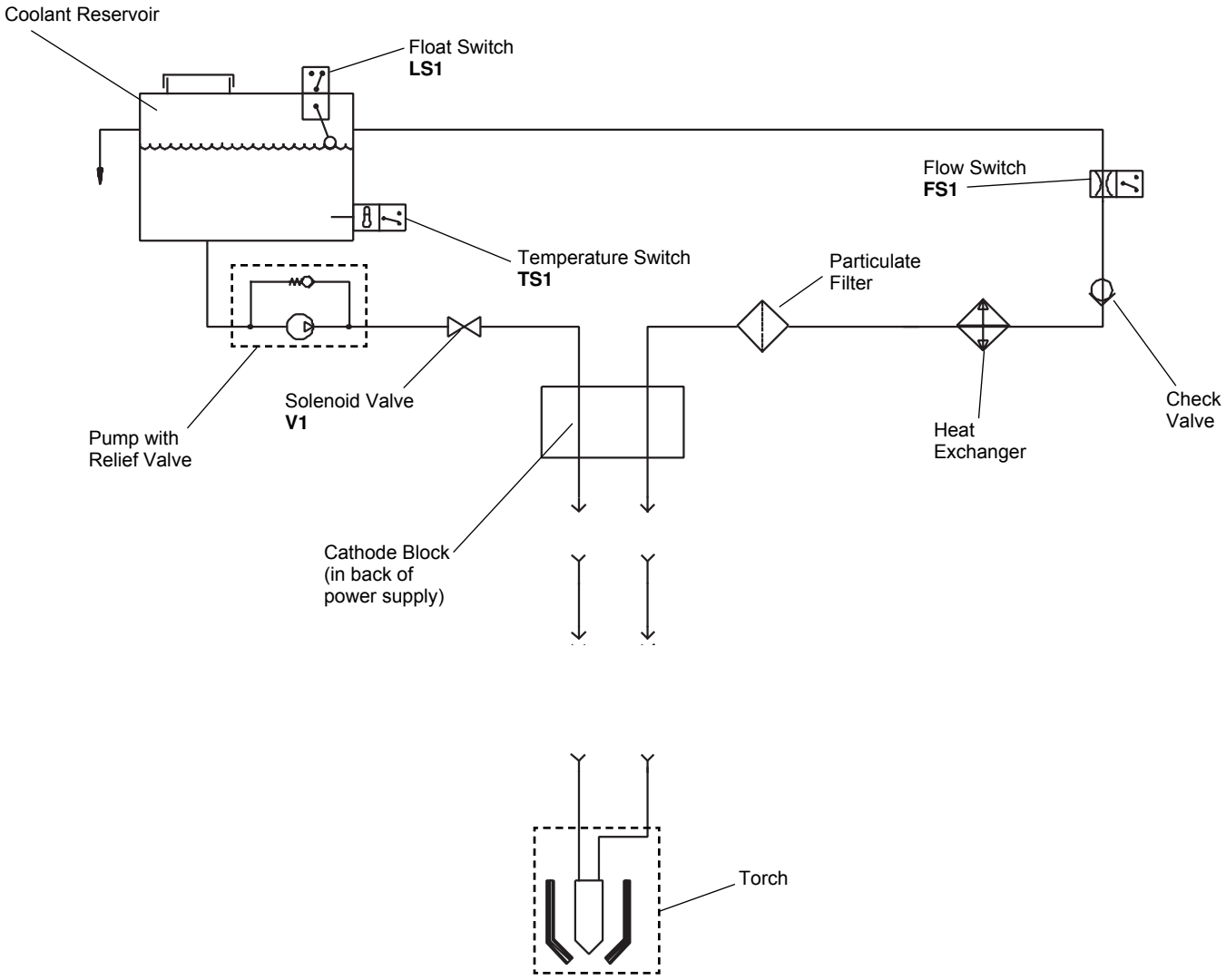


Figure 5-7 Plumbing Schematic of Power Supply Reservoir Assembly and Torch

Torch Coolant Draining

Hypertherm recommends draining the torch coolant from the power supply and torch before transporting the system. After this draining procedure, a small amount of coolant will remain in the system pump and valves. For this reason, Hypertherm also recommends that a suitable ratio of propylene glycol be purged through the system prior to draining if the system will experience extremely cold temperatures. Note that Hypertherm's stock propylene glycol solution 028872 is rated to 10° F (-12° C).

1. Disconnect all power to the system.

2. Remove the fill inlet cap from the reservoir to allow proper venting.

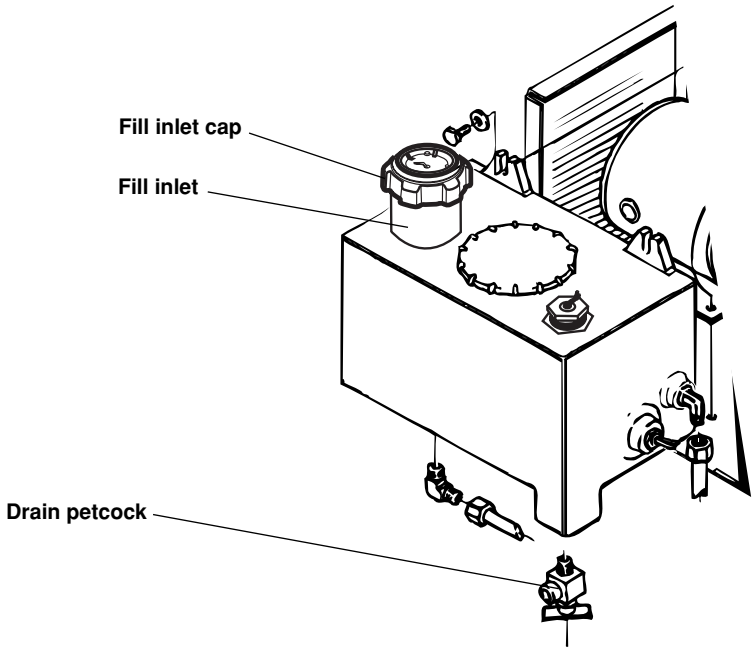


Figure 5-8 Coolant Tank Reservoir Drain Petcock Location

3. Drain the power supply reservoir by opening the petcock on the bottom of the reservoir tank. Close petcock after coolant is drained. See Fig. 5-8. On older systems, there is either no petcock, or the petcock is in a different position than the one shown in the figure above. Siphon coolant out of the tank through the fill inlet if there is no petcock.

4. Ensure that the torch and consumables are installed and connected to the power supply.

5. Disconnect the torch coolant supply hose (black hose with the green band) from the rear of the power supply . See Fig. 5-6.

6. Blow clean, dry, oil-free air at 80-120 psi (5.5 - 8.3 bar) into the torch coolant supply hose until coolant stops flowing into the reservoir.

7. Drain or siphon remaining coolant from the reservoir as in step 3.

8. Unscrew the coolant filter housing from the rear of the power supply. See Fig. 6-8 for location of filter housing.

9. Empty coolant from the filter housing.

10. Screw the coolant filter housing back into the rear of the power supply.

Preventative Maintenance Schedule **Year_____**

Daily:

- ☐ Verify proper inlet gas pressure -- See Instruction Manual, *Specification* section
- ☐ Verify proper gas flow settings -- **Mandatory at every consumable change** -- See Instruction Manual, *Operation* section
- ☐ Verify proper coolant pressure and temperature -- **Water Chillers only** -- See Instruction Manual, *Specification* section
- ☐ Replace consumables as needed, and inspect torch

Weekly: Date Completed:

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Week 1												
Week 2												
Week 3												
Week 4												
Week 5												

- ☐ Clean power supply with dry, oil free compressed air, or vacuum
- ☐ Verify cooling fans are working properly
- ☐ Clean torch threads and current ring
- ☐ Verify proper coolant level

Monthly: Date Completed:

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec

- ☐ Inspect for loose wire connections
- ☐ Inspect contacts on main contactor for wear
- ☐ Inspect pilot arc relay for pitting
- ☐ Verify proper operation of coolant flow switches
- ☐ Perform coolant flow test
- ☐ Check gas console packing nuts for tightness
- ☐ Perform gas leak test
- ☐ Inspect cable connections

Bi-Annually: Date Completed:

Service 1_____ Service 2_____

- ☐ Drain coolant system -- See Instruction Manual, *Maintenance* section
- ☐ Replace coolant filter element - See Instruction Manual, *Maintenance* section
- ☐ Replace coolant with genuine Hypertherm coolant

Annually: Date Completed:_____

- ☐ Replace pilot arc relay
- ☐ Replace main contactor

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Hypertherm

Section 6

PARTS LIST

Introduction

See **Section 3: Installation** and appendices A and C to find part numbers for cables and hoses.

HT2000LHF Power Supply: Front Panel

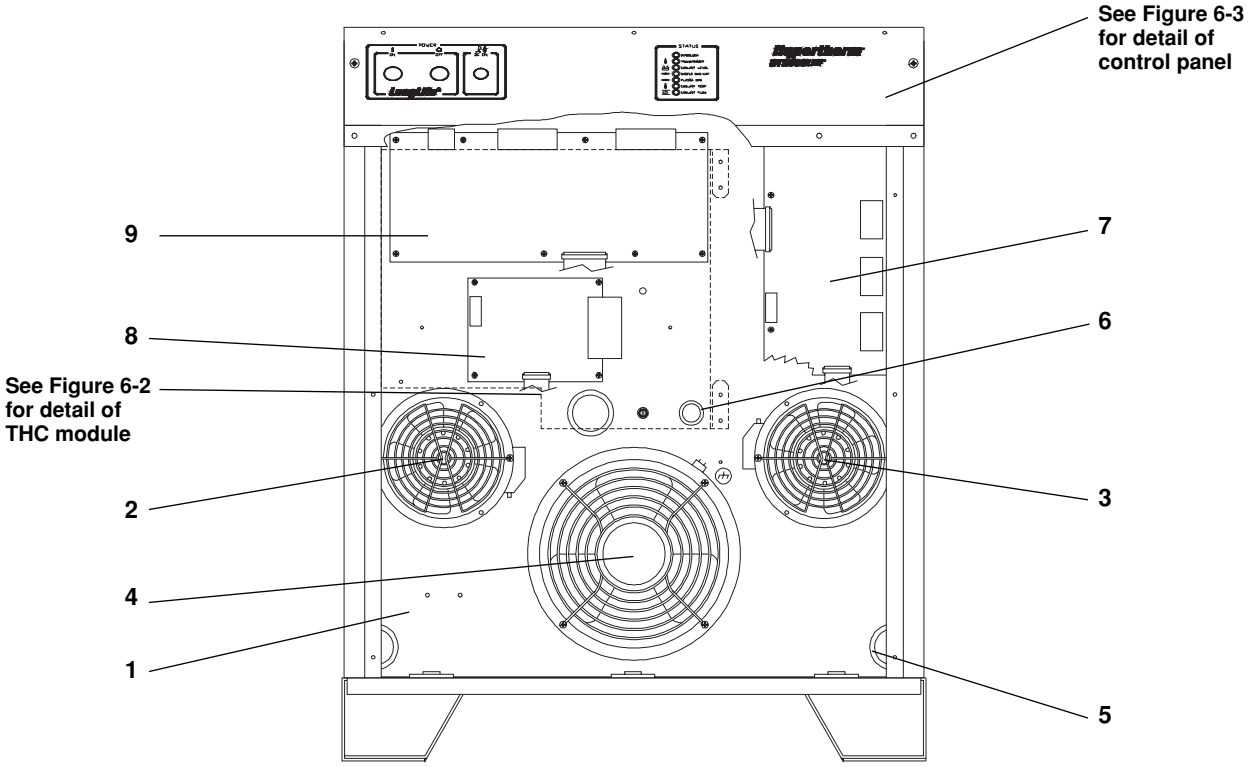


Figure 6-1 HT2000LHF Power Supply – Front Panel

Item	Part Number	Description	Designator	Qty.
1	001233	Panel, HT2000 Front		1
2	**129307**	**Fan SA:225CFM**	**M3**	1
	027080	Fan:225CFM 120VAC 50-60HZ		
	027568	Fan Guard:6.375 DIA		
3	**129307**	**Fan SA:225CFM**	**M2**	1
	027080	Fan:225CFM 120VAC 50-60HZ		
	027568	Fan Guard:6.375 DIA		
4	**129308**	**Fan SA:450-550CFM**	**M4**	1
	027079	Fan:450-550CFM 120VAC 50-60HZ		
	027567	Fan Guard:8.75 DIA		
5	008509	Bushing 1.75 MTG X 1.37 ID		3
6	008245	Bushing, 7/8" Hole X 11/16" ID		1
7	**041764**	**PCB Assy: HT2000LHF Control**	**PCB2**	1
8	**041276**	**PCB Assy: HT2000 Anlg**	**PCB3**	1
9	**041246**	**PCB Assy: Relay, HD1070 / HT2000**	**PCB4**	1
	001566*	Panel:HT2000 Front Filter		1
	001567*	Cover:HT2000 Front Filter Panel		1
	027441*	Filter:24 X 24 X 2 Fiberglass air		1
	029697**	**HT2000 THC SA**		

* Items not shown in Figure 6-1

** Used only in HT2000LHF power supplies with the THC option – see Figure 6-2

HT2000LHF Power Supply: THC Assembly (optional)

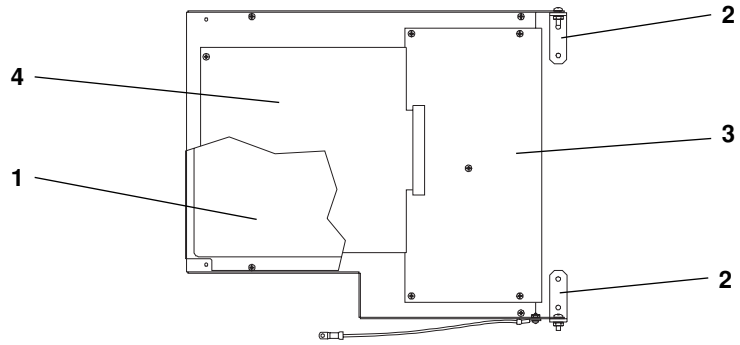


Figure 6-2 HT2000LHF Power Supply – THC Assembly

Item	Part Number	Description	Designator	Qty.
	029697	**HT2000 THC Assembly**		**1**
1	001297	Cover: HT2000 THC Dust		1
2	004338	Hinge: THC Pan, HT2000		2
3	**041294**	**PCB Assy: HT2000 THC Mother**	**PCB9**	1
4	**041186**	**PCB Assy: HT2000 Torch Hght Cntrl**	**PCB10**	1

HT2000LHF Power Supply: Control Panel

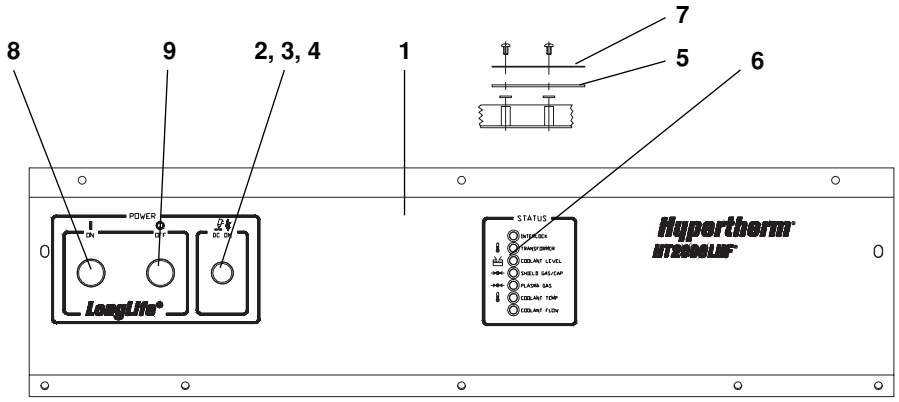


Figure 6-3 HT2000LHF Power Supply – Control Panel

Item	Part Number	Description	Designator	Qty.
	129331	**Contr Pnl SA, HT2000LHF**		1
1	001661	Pnl :HT2000LHF Cont		1
2	005151	Lamp holder		1
3	005149	Bulb, 120VAC	**LT2**	1
4	005089	Lens:White for 005088		1
5	**041536**	**PC BD Assy Intlk Dsply 200/4001**	**PCB12**	1
6	009063	Diode, Ind LED Amber		7
7	002278	Cover:HT2000 Cont. Panel SA		1
8	005121	Pushbutton, 2 NO Green Illumin	**PB1/LT1**	1
9	005122	Pushbutton, 2 NC Red Extended	**PB2**	1

HT2000LHF Power Supply: Center Wall Right Side

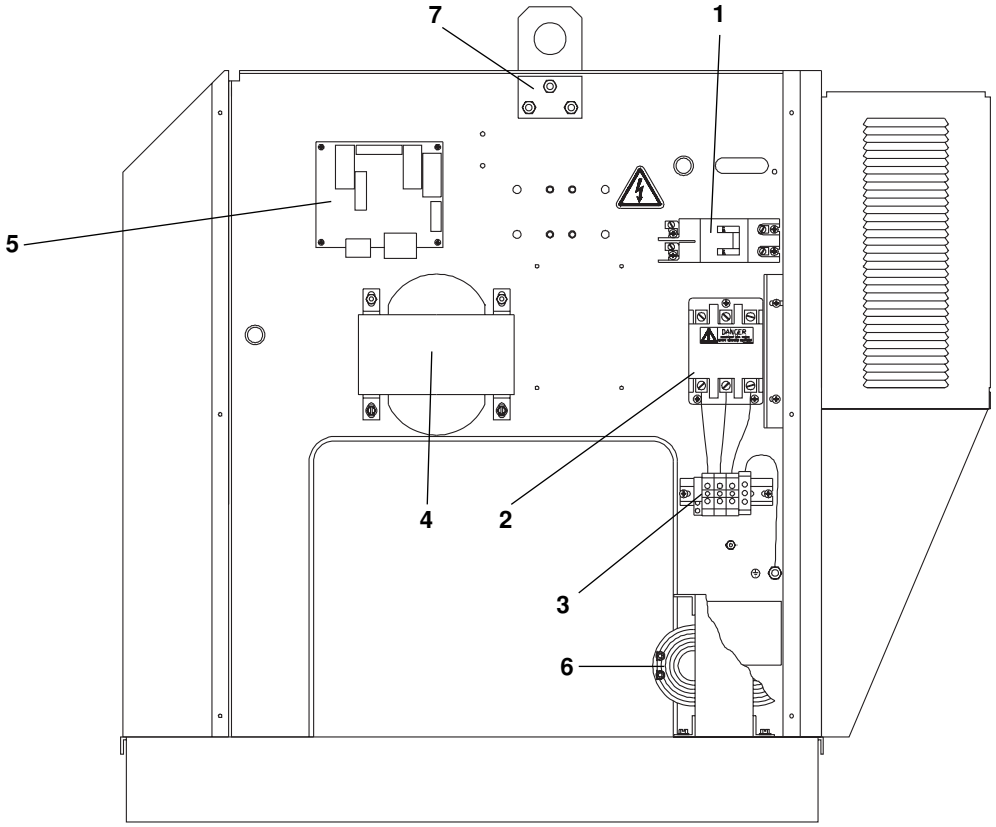


Figure 6-4 HT2000LHF Power Supply – Center Wall Right Side

Item	Part Number	Description	Designator	Qty.
1	003138	Circuit Breaker, 2 Pole, 600V 20A	**CB1**	1
2	003139	Contactor:90A 3P 120VAC	**CON1**	1
3	**029316***	**Incoming Power TB1 SA, MAX200**	**TB1**	1
4	**029422**	**Cont Transformer SA 200V/3ϕ/50Hz**	**T1**	1
4	**029441**	**Cont Transformer SA 208V/3ϕ/60Hz**	**T1**	1
4	**129311**	**Cont Transformer SA 240V/3ϕ/60Hz**	**T1**	1
4	**029362**	**Cont Transformer SA 400V/3ϕ/50Hz**	**T1**	1
4	**029713**	**Cont Transformer SA 440V/3ϕ/50-60Hz**	**T1**	1
4	**129312**	**Cont Transformer SA 480V/3ϕ/60Hz**	**T1**	1
4	**029404**	**Cont Transformer SA 600V/3ϕ/60Hz**	**T1**	1
5	**041534**	**PC BD Assy, Power Distribution**	**PCB1**	1
	008322	Fuse:8A 250V 1/4 X 1-1/4 Slow	**F1,F2,F3**	3
6	014080	Inductor, 4mh 100A	**L1**	1
7	004262	Plate, Lift, MAX100 & 80		1
	001601**	Plate:CE/LVD Lift Eye		1
	001602**	Gasket:CE/LVD Lift Eye		1

* See Appendix D for location of 029316 on 400V CE power supplies.

** Items not shown in Figure 6-4

HT2000LHF Power Supply: Center Wall Left Side

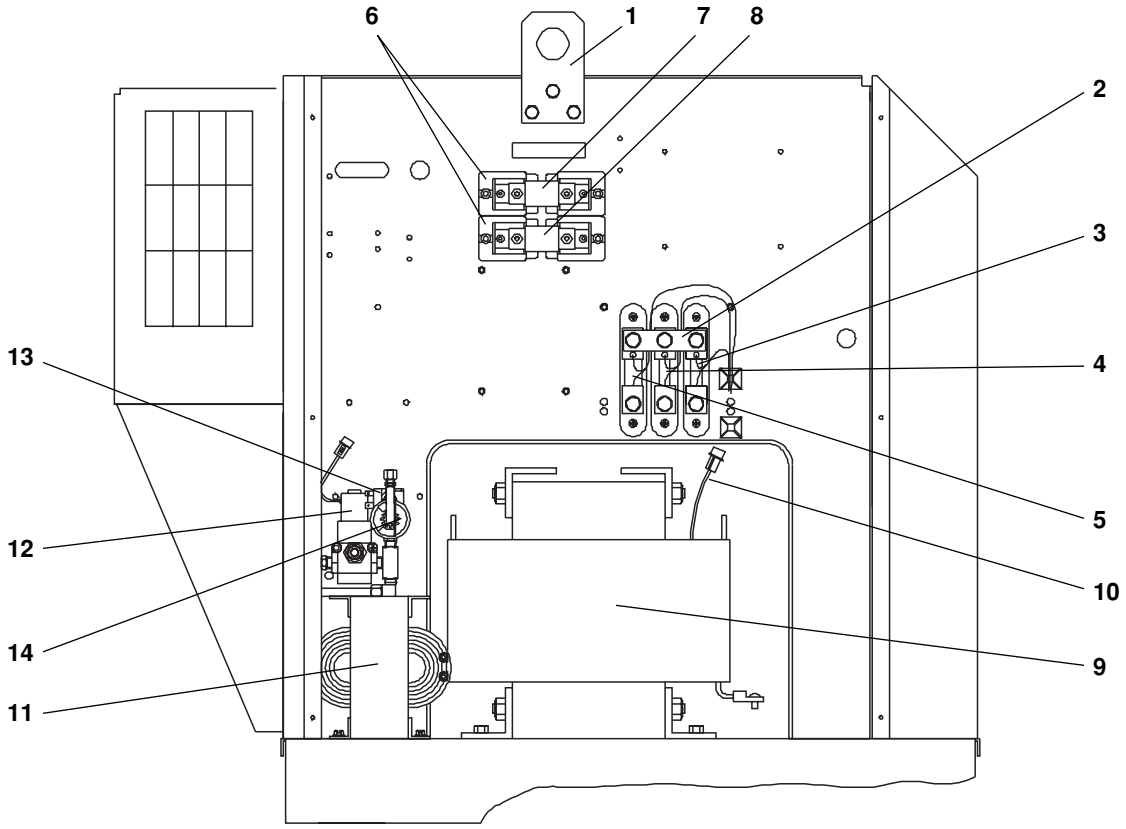


Figure 6-5 HT2000LHF Power Supply – Center Wall Left Side

Item	Part Number	Description	Designator	Qty.
1	004261	Bar, Lift, MAX100 & 80		1
2	004334	Busbar, HT2000 Shunt		1
3	007022	Shunt, 100A, 100mv	**R2**	1
4	007022	Shunt, 100A, 100mv	**R1**	1
5	007024	Shunt, 200A, 100mv	**R3**	1
6	008945	Fuseholder:100A/1000V		2
7	008317	Fuse, Semiconductor 125A, 250V	**F1**	1
8	008317	Fuse, Semiconductor 125A, 250V	**F2**	1
9	014111	Transformer 30KW 200V/3ϕ/50Hz	**T2**	1
9	014097	Transformer 30KW 208V/3ϕ/60Hz	**T2**	1
9	014078	Transformer 30KW 240V/480V/3ϕ/60Hz	**T2**	1
9	014088	Transformer 30KW 400V/3ϕ/50Hz	**T2**	1
9	014158	Transformer 30KW 440V/460V/3ϕ/50-60Hz	**T2**	1
9	014082	Transformer 30KW 600V/3ϕ/60Hz	**T2**	1
10	005102	Thermostat, 160°C, 6 Amp	**TS1**	1
11	014080	Inductor, 4mh 100A	**L2**	1
	129283	**Shield SA: HT2000LHF**		
12	006032	Solenoid Valve:150# 1/4 FPT 120V NC	**SV6**	1
13	006106	Solenoid Valve:1/8FPT 120V TFE-Plunger	**SV7**	1
14	005227	Pressure Switch:12 PSI	**PS3**	1

HT2000LHF Power Supply: Front Wall Inside

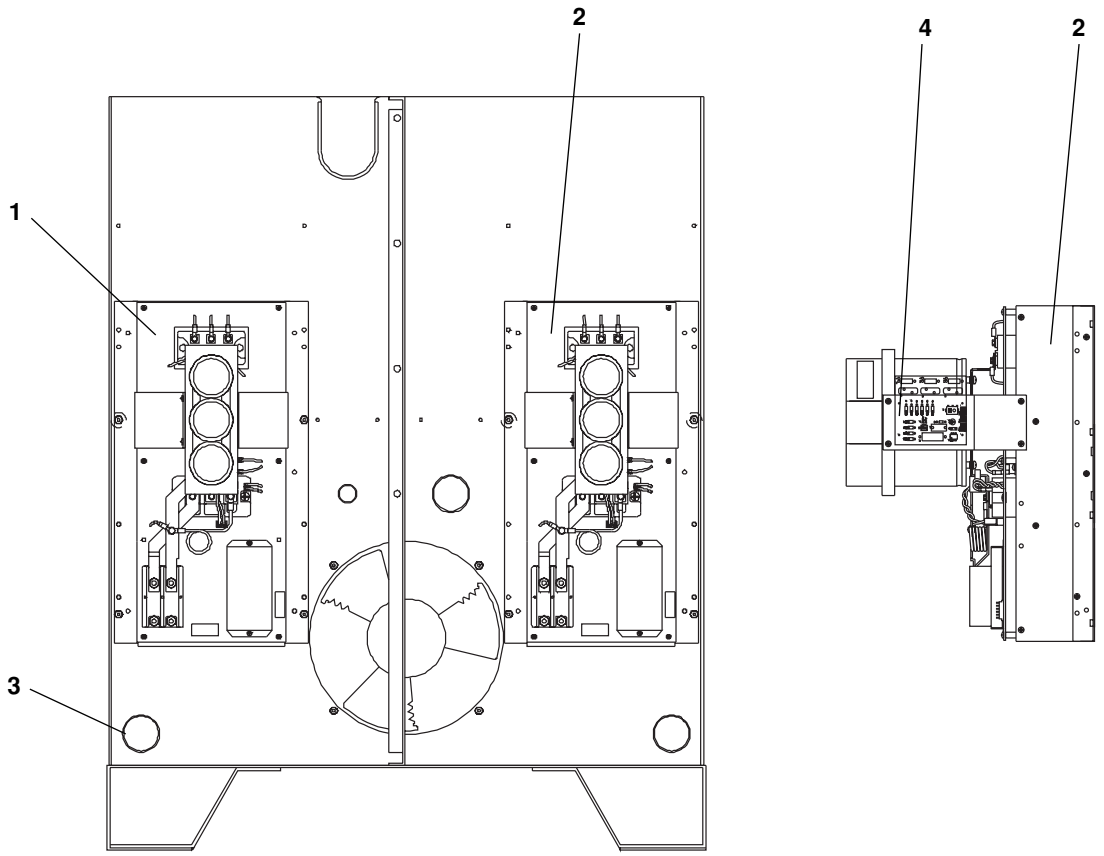


Figure 6-6 HT2000LHF Power Supply – Front Wall Inside

Item	Part Number	Description	Designator	Qty.
1	**129118**	**CH130 CE/LVD Chopper SA**	**CH1**	1
	005199	Temperature Switch 82°C	**TSW1**	1
2	**129118**	**CH130 CE/LVD Chopper SA**	**CH2**	1
	005199	Temperature Switch 82°C	**TSW2**	1
3	008509	Bushing 1.75 MTG X 1.37 ID		3
4	**041564**	**PCB Assy:Phase Loss Detection Circuit**		1

HT2000LHF Power Supply: Rear Wall Inside

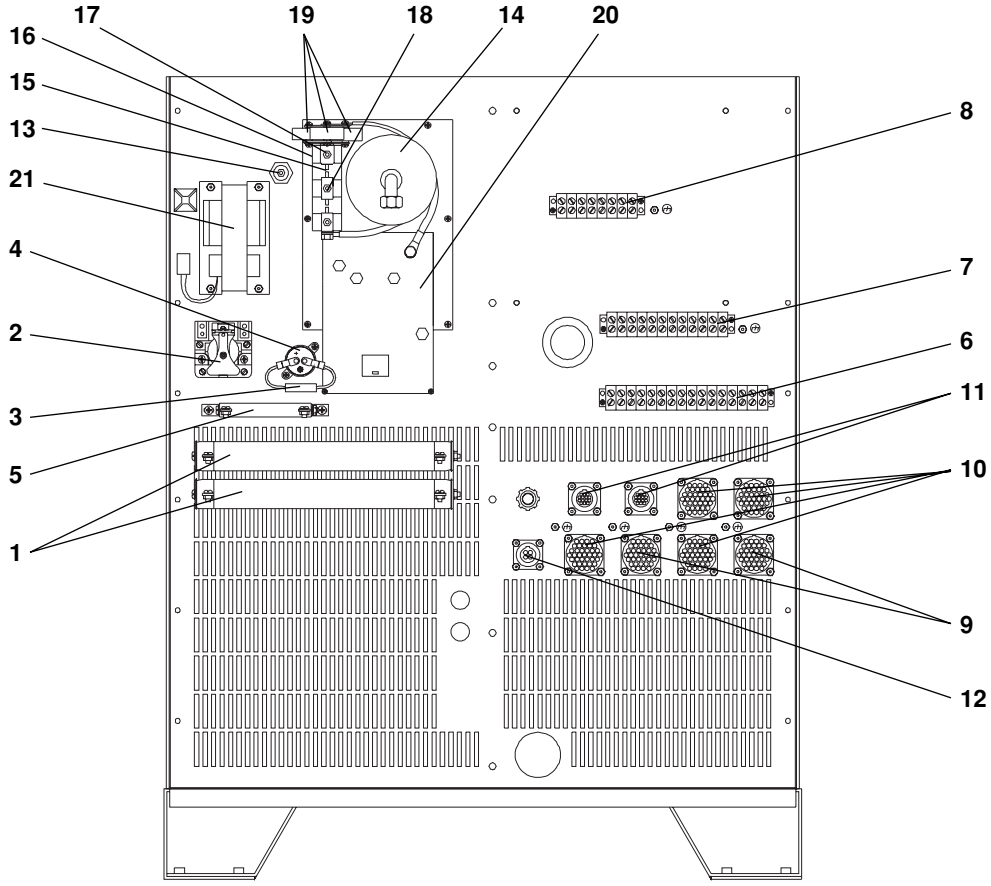


Figure 6-7 HT2000LHF Power Supply – Rear Wall Inside

Item	Part Number	Description	Designator	Qty.
1	009684	Resistor:4-ohm 420W with bracket	**R6A, R6B**	2
2	003021	Relay, 120VAC NO SPST	**CR1**	1
3	009015	Resistor: 10K Ohm, 10W	**R5**	1
4	009506	Capacitor: 250UF, 350VDC	**C1**	1
5	009438	Resistor: 5 Ohm, 50W	**R4**	1
	129274	**Harness SA HT2000LHF**		
6	008073	Terminal Strip (16)	**TB3**	1
7	008079	Terminal Strip (12)	**TB4**	1
8	008134	Terminal Strip (8)	**TB5**	1
9	008447	Receptacle, 23-37, Std Sex	**1X6, 1X5**	2
10	008208	Receptacle, 23-37, Rev Sex	**1X1,1X2,1X7, 1X4**	4
11	008201	Receptacle, 17-14, Rev Sex	**1X9, 1X3**	2
12	008210	Receptacle, 11-4, Rev Sex	**1X10**	1
13	**129284**	**Shield SA: HT2000LHF Shield Sense**		1
	129285	**HF-I/O PNL SA:HT2000-LHF**		1
14	009349	Coil Assembly:200A High Frequency	**T4**	1
	109077	**Spark Gap Assembly HT2000LHF**	**SG1**	1
15	004061	Electrode:Spark Gap 1/8 X 1.6		3
16	004140	Base:40/0/100/200/HD Spark Gap		1
17	004141	Block:009350 Spark Gap End		2
18	004142	Block:009350 Spark Gap Center		1
19	009975	Capacitor: 1400pF 20KV	**C4, C5, C6**	3
20	**041145**	**PCB ASSY:MAX200 I/O**		1
	029202	**Current Sensor Assembly**	**CS1**	1
21	129150	High Voltage Transformer SA 6kV	**T3**	1

HT2000LHF Power Supply: Rear Wall Outside

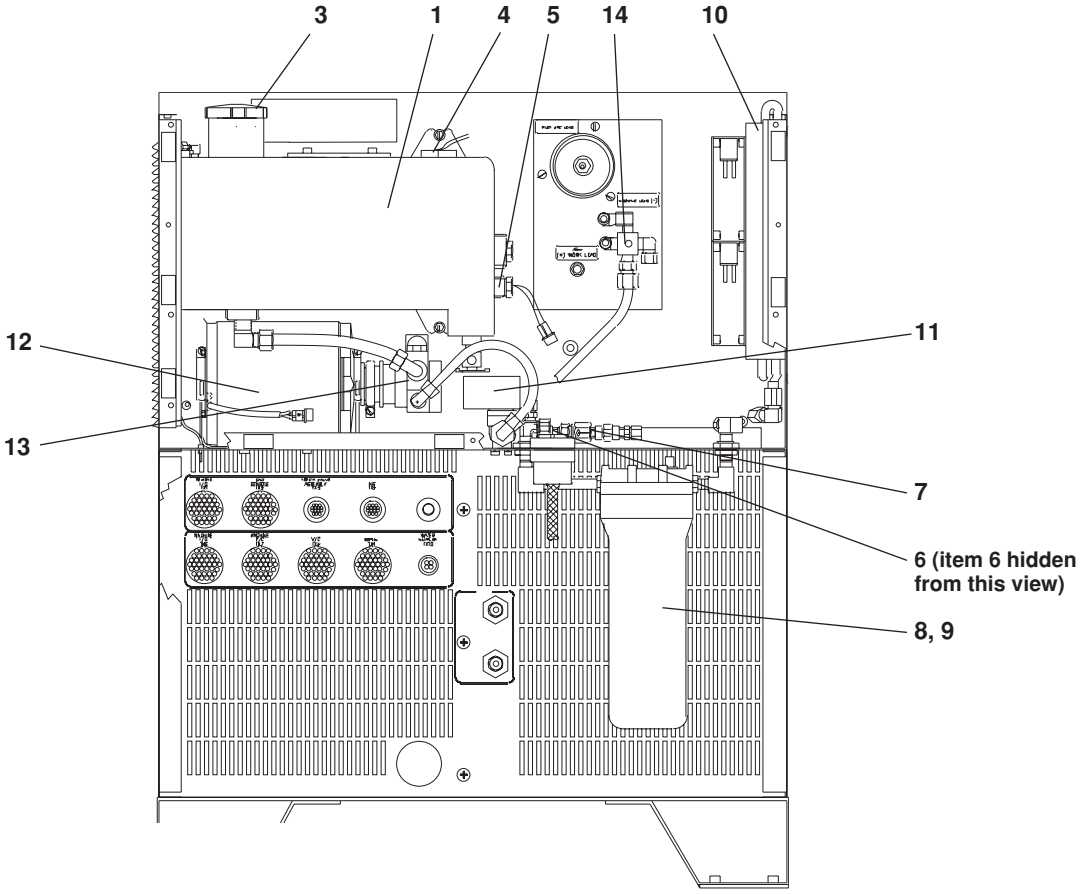


Figure 6-8 HT2000LHF Power Supply – Rear Wall Outside

Item	Part Number	Description	Designator	Qty.
	029313	**Reservoir SA, HT2000**		1
1	002304	Coolant Res.		1
3	022036	Gauge: Liquid Level		1
4	**129618**	**Switch, Level SA, 1/2 NPT**	**LS1**	1
5	**029323**	**Switch, Temp SA, 162 Deg F**	**TS2**	1
6	**029361**	**Flowswitch, 0.5GPM**	**FS1**	1
7	006053	Valve, Check 1/3 PSI, 1/4 NPTM		1
8	027005	Filter Element		1
9	027139	Filter Housing, 10" X 3/8 NPT		1
10	**029324**	**Heat Exchanger SA, MAX200**		1
	027978	Heat Exchanger, Water/Air	**M5,M6**	1
11	**129383**	**Valve SA:HT2000 Power Supply**		1
	006046	Valve, Sol 240V 3/8 NPT NC	**V1**	1
	129252	**Water Pump SA**		1
12	**128385**	**Kit: Motor, 1/3 HP Carbon 230/50-60**	**M1**	1
13	**128384**	**Kit: Pump, 70 GPH Positive Displace**		1
	031122*	Coupler:Pro Pump-Motor		1
	129285	**HF-I/O PNL SA:HT2000-LHF**		1
14	004314	Block:200 Cathode		1

* Item is not shown in Figure 6-8. See page 5-2 for illustration of part.

HT2000LHF Gas Console

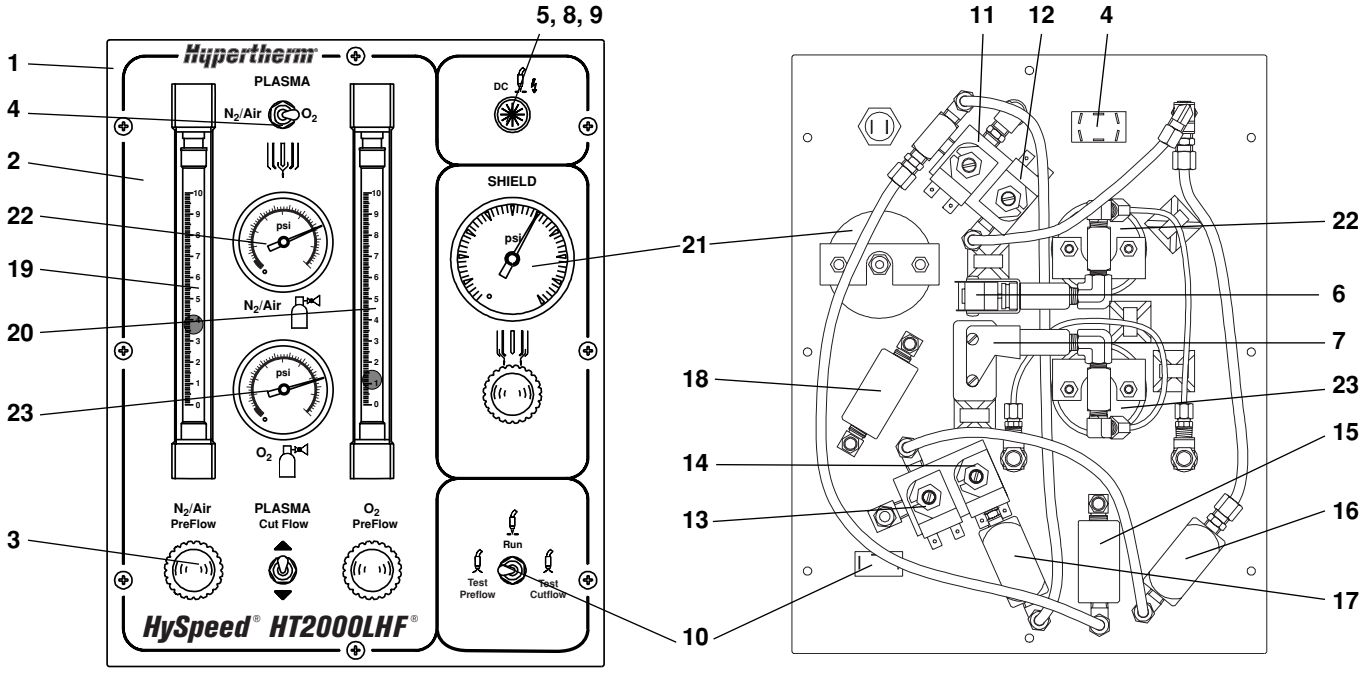


Figure 6-9 HT2000LHF Gas Console

Item	Part Number	Description	Designator	Qty.
	073239	**HT2000LHF Gas Console**		
1	001335	Encl: 2000 Gas Csl		1
2	001649	Pnl: HT2000LHF Gas Csl		1
3	004117	Cap: Ndl Valve		4
4	005181	Tgl Sw: DPDT Maint ON/NONE/ON	**S1**	1
5	005089	Lens:White for 005088		1
6	005243	Switch, Pressure 80 PSI	**PS1**	1
7	005243	Switch, Pressure 80 PSI	**PS2**	1
8	005149	Bulb, 120VAC T2	**LT1**	1
9	005151	Lamp Holder		1
10	005180	Tgl Sw: SP3T, Maint ON/OFF/ON	**S2**	1
11	006109	Solenoid Valve:150# Manf 120V 2-Way NC	**SV1A**	1
12	006109	Solenoid Valve:150# Manf 120V 2-Way NC	**SV1B**	1
13	006109	Solenoid Valve:150# Manf 120V 2-Way NC	**SV2**	1
14	006109	Solenoid Valve:150# Manf 120V 2-Way NC	**SV3**	1
15	006064	Valve, Ndl 1/8 FPT .125 Orf	**MV1**	1
16	006064	Valve, Ndl 1/8 FPT .125 Orf	**MV2**	1
17	006064	Valve, Ndl 1/8 FPT .125 Orf	**MV3**	1
18	006064	Valve, Ndl 1/8 FPT .125 Orf	**MV4**	1
19	011053	Flowmeter: 7.8 GPM/44 CFH	**FM1**	1
	011058	Fltube w/Float /BP-8 Flt:0-10 SC Cal 2%		
	011008	Shield: Plastic, for 011053 or 011056		
	011081	Flowmeter Float Stop		
20	011053	Flowmeter: 7.8 GPM/44CFH	**FM2**	1
	011058	Fltube w/Float /BP-8 Flt:0-10 SC Cal 2%		
	011008	Shield: Plastic, for 011053 or 011056		
	011081	Flowmeter Float Stop		
21	022008	Gauge, Press 100#/Bar 2.5" Dia.	**PG3**	1
22	022020	Gauge, Press 160#/Bar 2" Dia.	**PG1**	1
23	022020	Gauge, Press 160#/Bar 2" Dia.	**PG2**	1
	015299*	Filter:.10 Micron 1/8FPT Brass Inline	**FL1, FL2**	2
	004718**	Manifold, valve		2

* Located behind O_2 and N_2 inlet connections
** Located behind solenoid valves

Digital Remote Voltage & Current Control Console

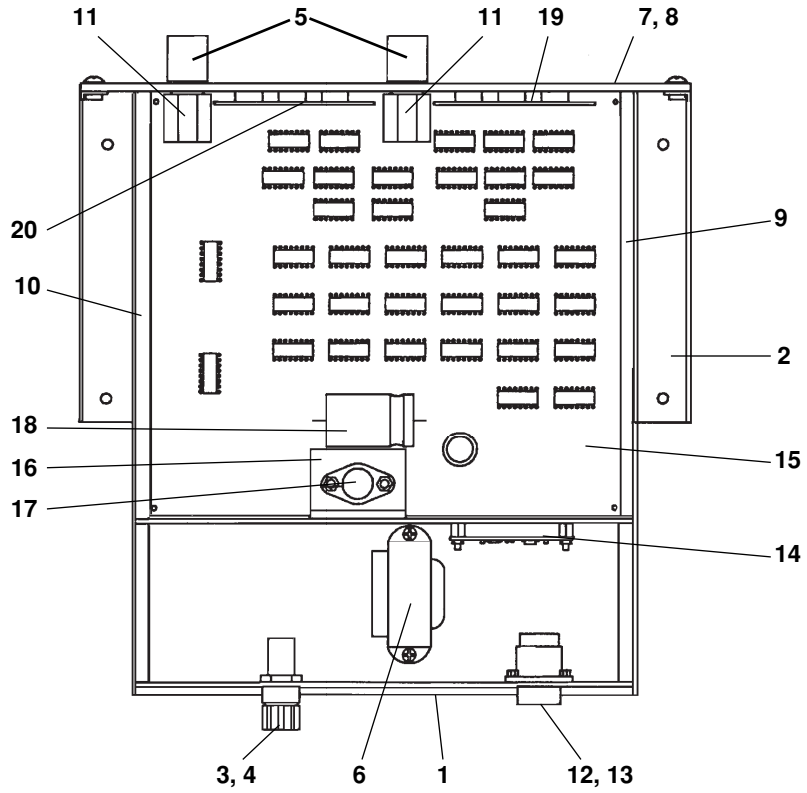


Figure 6-10 Digital Remote Voltage & Current Control Console

Item	Part Number	Description	Designator	Qty.
	073007	**Control Station, Digital Remote V/C MAX200**		**1**
	002107*	Cov: DR/PR V/C Top		1
	002106*	Cov: DR/PR V/C Bottom		1
1	002119	Panel, Rear, DR V/C		1
2	004119	Bracket, Mtg, DR/PR V/C		1
3	008069	Fuse, 3/8 Amp 313, 375		1
4	008165	Fuseholder, REM V/C		1
5	008164	Knob		2
6	014012	Transf'mer, DR/PR/SR V/C		1
	002118	**Encl, Assy DR V/C**		1
7	001133	Pl: HT400 DR V/C MDL FR		1
8	001131	Flg: HT400 DR/PR V/C MDL Fr		1
9	001137	FR: HT400 DR/PR/ST V/C Mdl LS		1
10	001138	FR: HT400 DR/PR/ST V/C Mdl RS		1
	029302	**Filter PNL-PCB SA DR/SR V/C**		1
11	009871	Potentiometer, 500 Ohm 10 turn		2
12	008175	Receptacle, Shell Size 13-9		1
13	008176	Pin, 20-24 AWG Type III+		6
14	**041070**	**PC BD Assy Opto-Iso**		1
15	**041187**	**PC BD Assy Dig/Sta V/C MAX200**		1
16	004116	Heatsink, DR/PR SR V/C		1
17	042059	IC, LM340AK-5.0		1
18	009274	Capacitor, 2600 UF 15VDC		1
19	**041076**	**PC BD Assy Rem Volt Disp**		1
20	**041077**	**PC BD Assy Rem Curr Disp**		1

* Items are not shown in Figure 6-10.

Programmable Remote Voltage & Current Control Console

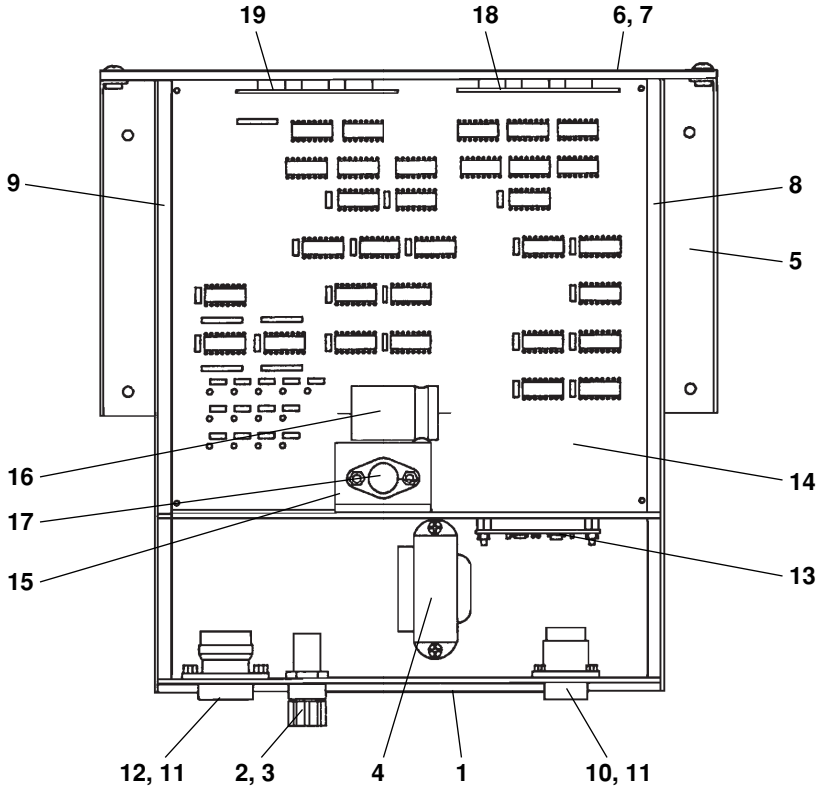


Figure 6-11 Programmable Remote Voltage & Current Control Console

Item	Part Number	Description	Designator	Qty.
	055004	**Control, Programmable V/C**		1
	002107*	Cov: DR/PR V/C Top		1
	002106*	Cov: DR/PR V/C Bottom		1
1	002123	Panel, Rear, PR V/C		1
2	008069	Fuse, 3/8 Amp 313, 375		1
3	008165	Fuseholder, REM V/C		1
4	014012	Transf'mer, DR/PR/SR V/C		1
5	004119	Bracket, Mtg, DR/PR V/C		1
	002122	**Encl Assy, PR V/C**		1
6	001139	PL: HT400 PR V/C MDL FR		1
7	001131	Flg: HT400 DR/PR V/C MDL Fr		1
8	001137	FR: HT400 DR/PR/ST V/C Mdl LS		1
9	001138	FR: HT400 DR/PR/ST V/C Mdl RS		1
	029089	**Filter PNL-PCB SA PR V/C**		1
10	008175	Receptacle, Shell 13-9 Size		1
11	008176	Pin, 20-24 AWG Type III+		22
12	008193	Recp, CPC 17-16 Standard Sex		12
13	**041070**	**PC BD Assy Opto-Iso**		1
14	**041085**	**PC BD Assy, PR V/C**		1
15	004116	Heatsink, DR/PR SR V/C		1
16	009274	Capacitor, 2600 UF 15VDC		1
17	042059	IC, LM340AK-5.0		1
18	**041076**	**PC BD Assy, Rem Volt Disp**		1
19	**041077**	**PC BD Assy, Rem Curr Disp**		1

* Items are not shown in Figure 6-11.

Initial Height Sensing Control Console

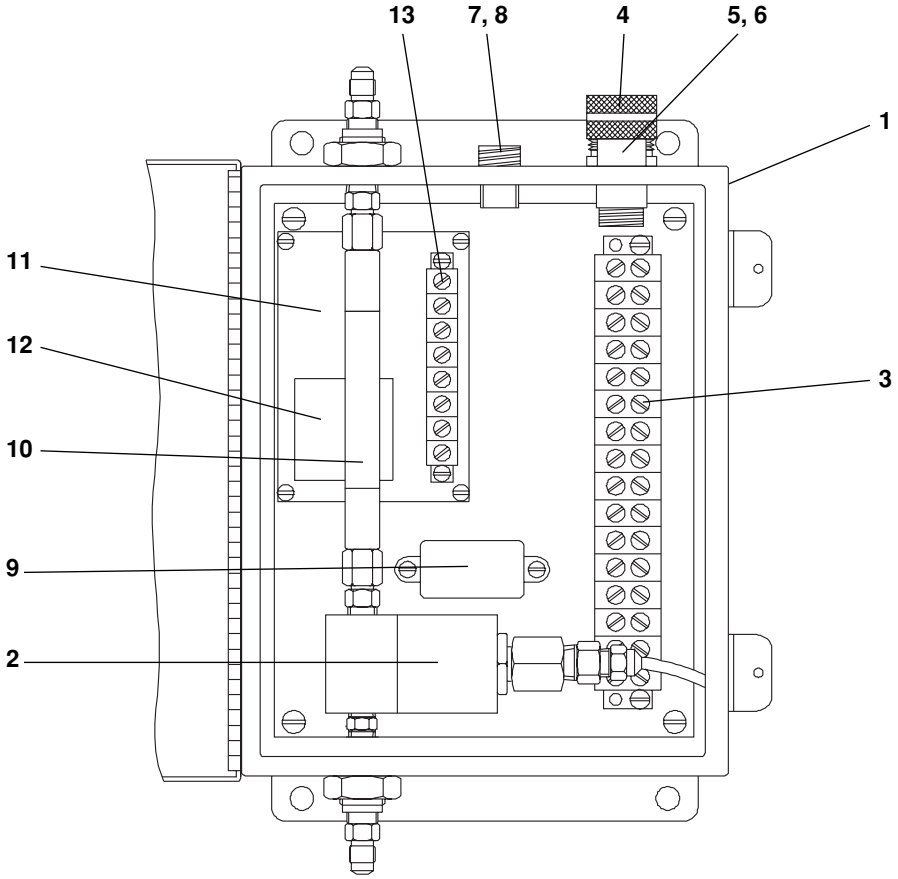


Figure 6-12 Initial Height Sensing Control Console

Item	Part Number	Description	Designator	Qty.
	053016	**Control Console, IND IHS, HT400**		
1	002095	Encl., Control Console UW-IHS		1
2	006021	Valve, SOL 75# 1/4 NPTF		1
3	008073	Terminal Strip (16)		1
4	008071	Strain Relief, 1/2 X .375-.500		1
5	008175	Receptacle, Shell Size 13-9		1
6	008176	Pin, 20-24 AWG Type III+		7
7	008186	Socket, 20-24 AWG Type III+		8
8	008210	Receptacle, 11-4		2
9	009041	Filter, AC, 1 Amp 1B3		1
10	**024038**	**Hose Assy, #4 x 7"**		1
11	**041043**	**PC BD Assy UW-IHS**		1
12	041023	Power Source, IHS		1
13	008094	Terminal Strip (8)		1

Argon-Hydrogen Manifold

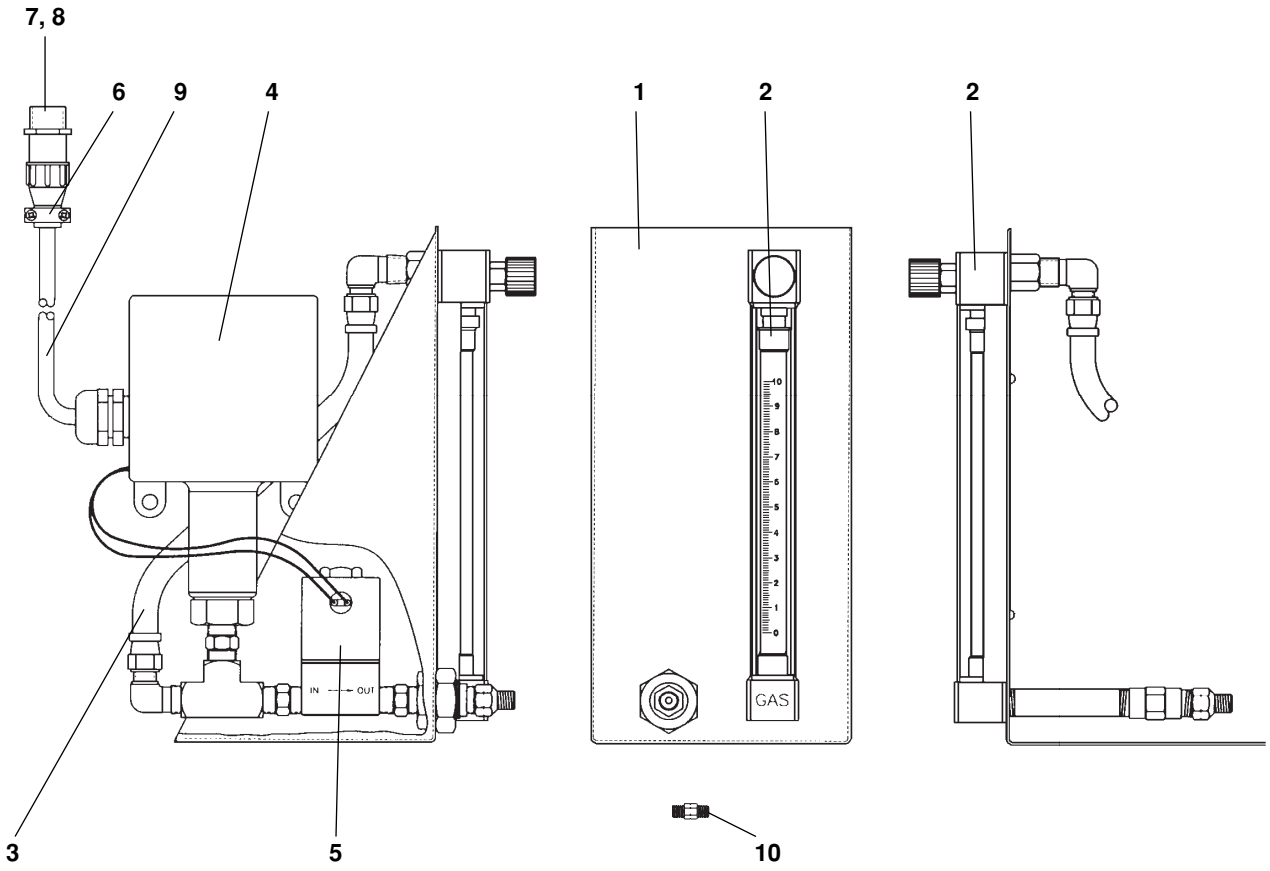


Figure 6-13 Argon-Hydrogen Manifold

Item	Part Number	Description	Designator	Qty.
	073109	**Argon-Hydrogen Manifold**		1
1	002050	Bracket: Ar/H2 Manifold		1
2	011005	Flowmeter: 0-10 SC/BT-8 w/valve	**FM1**	1
3	**024143**	**Hose Assy, #4 X 9"**		1
	029831	**Manifold SA: 073109 H35 Manifold**		1
4	005046	Pressure Switch: 0-200 1/4FPT	**PS1**	1
5	006009	Solenoid Valve:200# 1/4FPT 120V NC	**SV5**	1
	023702	**Cable: HT2000 H35 Manifold Press. Sw.**		1
6	008195	CACLP:CPC Size 11		1
7	008205	Pin: 18-16 AWG Type III + CRP		4
8	008807	Receptacle Shell:CPC 11-4	**14X1**	1
9	047055	Cable, 18-2 TW PR, Unshielded		6 ft
10	015049	Connector: LH Male Brass		1

Timer/Counter

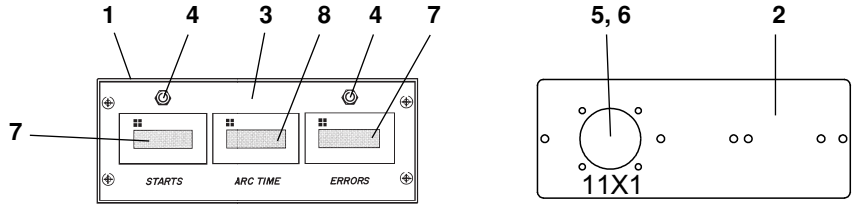


Figure 6-14 Timer/Counter

Item	Part Number	Description	Designator	Qty.
	073194	**HT2000 Cntr-Tmr**		
1	001068	Encl:DCC/PCC/RCC RVR		1
2	001391	Pnl:DCC RCVR Rear		1
3	001392	Pnl:DCC RCVR Front		1
4	005161	PB Sw:Blk SPST NO Sub-Mini		2
5	008176	Pin:24-20 AWG Type III + CRP		4
6	008193	Receptacle Shell:CPC 17-16 Std Sex	**11X1**	1
7	027274	Counter, Self Powered LCD		2
8	027275	Meter, Elapsed Time LCD		1
	003140*	Relay:120VAC DP AU Cont		2

* Items are not shown in Figure 6-14.

Remote Current Control Console

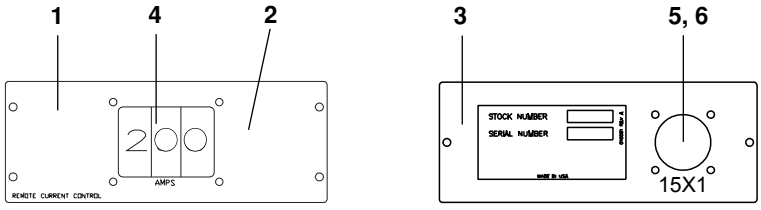


Figure 6-15 Remote Current Control Console

Item	Part Number	Description	Designator	Qty.
	073045	**Remote Current Control Console**		
1	001068	Enclosure:DCC/PCC/MAX200 RCC		1
2	001339	Panel:MAX200 RCC Front		1
3	001340	Panel:MAX200 RCC Rear		1
4	005123	Thumbwheel Switch:MAX200		1
5	008176	Pin:24-20 AWG Type III+CRP		7
6	008193	Receptacle Shell:CPC 17-16 Std Sex	**15X1**	1

HYSpeed HT2000LHF Torches

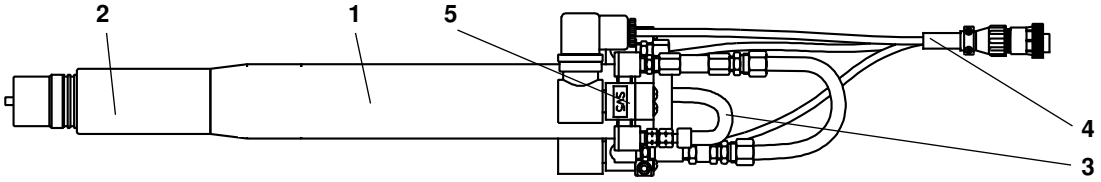


Figure 6-16 HT2000LHF Standard Torch Assembly with Valve Cluster

Item	Part Number	Description	Designator	Qty.
	128255	**HT2000LHF Machine Torch Assy with Valve Cluster**		
1	120894	Torch Mounting Sleeve:2"		1
2	**120584**	**HT2000 Torch Main Body**		1
	020963	Water Tube:PAC200T/2000 Electd Cool		1
	044027	O-Ring:Buna 70 Duro 1.301X.070		2
3	**024550**	**Hose Assembly:3/16 Blue with Green LH'A' 1'**		1
4	**123321**	**Cable:HT2000-LHF Torch Off-Valve 24"**		1
5	**129840**	**Off-Valve Subassembly (Valve Cluster):HT2000LHF**		1
	006100	Solenoid Valve:150# 1/8 FPT DIN		3
	120546	Bracket:HT2000LHF Off-Valve		1
	220242*	**Nozzle Retaining Cap with IHS: Hyspeed, 200A**		1
	220239*	**Shield: Hyspeed, 200A**		1
	220237*	**Nozzle: Hyspeed, 200A**		1
	220235*	**Electrode: Hyspeed, 200A**		1
	220236*	**Swirl Ring: Hyspeed, 200A**		1

* Hyspeed consumables are for cutting mild steel with Oxygen at 200A only.

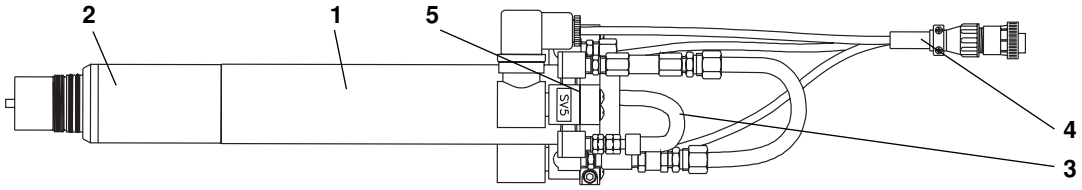


Figure 6-16A HT2000LHF Stainless Steel Torch Assembly with Valve Cluster

Item	Part Number	Description	Designator	Qty.
	128369	**HT2000LHF Stainless Steel Machine Torch Assy with Valve Cluster**		
1	020041	Torch Mounting Sleeve:2" Generic		1
2	**120356**	**HT2000 S.S. Torch Main Body**		1
	020963	Water Tube:PAC200T/2000 Electd Cool		1
	044027	O-Ring:Buna 70 Duro 1.301X.070		2
3	**024550**	**Hose Assembly:3/16 Blue with Green LH'A' 1'**		1
4	**123321**	**Cable:HT2000-LHF Torch Off-Valve 24"**		1
5	**129840**	**Off-Valve Subassembly (Valve Cluster):HT2000LHF**		1
	006100	Solenoid Valve:150# 1/8 FPT DIN		3
	120546	Bracket:HT2000LHF Off-Valve		1
	120837	**Nozzle Retaining Cap, with IHS tab**		1
	020424	**Shield, 200A**		1
	020605	**Nozzle, 200A .082 O2**		1
	120667	**Electrode:HT2000 200A O2, LL**		1
	120833	**Swirl Ring:HT2000 O2**		1
	020046	**Torch Mounting Bracket with Clevis 2" (not part of 128255 or 128369 assembly)**		

HySpeed HT2000 Consumable Starter Kit #128824

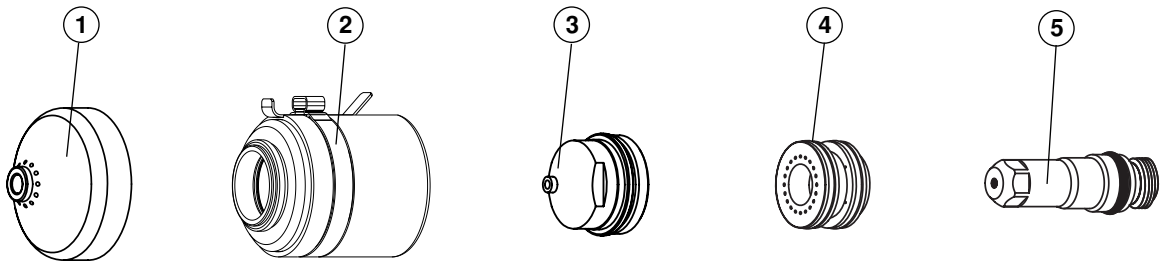


Figure 6-17 HySpeed HT2000 Starter Consumable Parts

Item	Part Number	Description	Qty.
	128824	**Kit: HySpeed HT2000 ConsumableStarter**	
	001285	Box: Gray Plastic	1
1	**220239**	**Shield, Hyspeed 200A**	**1**
2	**220242**	**Nozzle Retaining Cap with IHS tab, HySpeed 200A**	**1**
3	**220237**	**Nozzle, Hyspeed 200A**	**3**
5	**220236**	**Swirl RIng: Hyspeed 200A**	**1**
7	**220235**	**Electrode: HySpeed 200A**	**3**
	027055	Lubricant, Silicon, 1/4 Oz Tube	1
	804560	Quick Set-up Card: HT2000 HySpeed	1

HySpeed HT2000 Consumable Parts Kit #128825

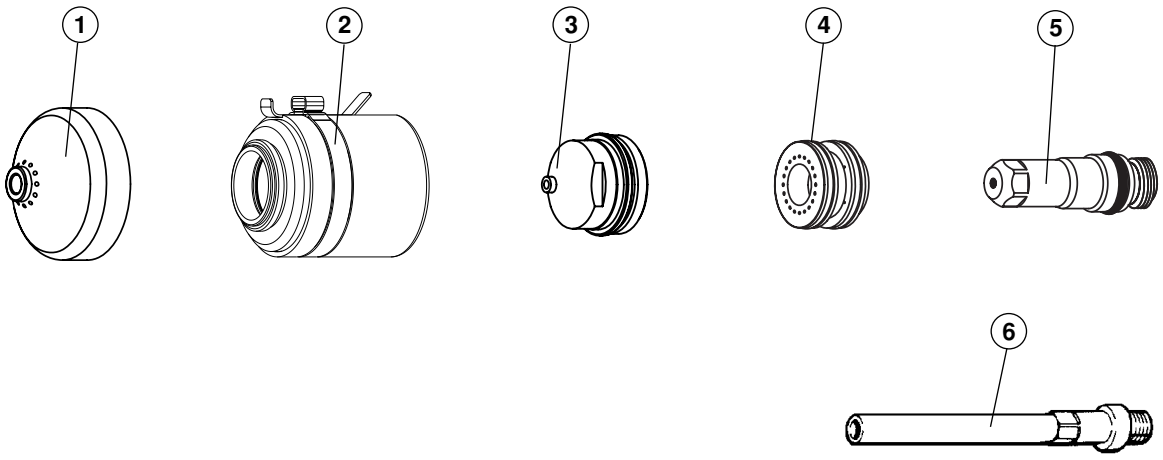


Figure 6-18 HySpeed HT2000 Consumable Parts

Item	Part Number	Description	Qty.
	128825	**Kit: HySpeed HT2000 Consumable Parts**	
	001067	Box: Gray Plastic	1
1	**220239**	**Shield, Hyspeed 200A**	**1**
1	**020424**	**Shield, 200A**	**1**
1	**020448**	**Shield, 100A**	**1**
2	**220242**	**Nozzle Retaining Cap with IHS tab, HySpeed 200A**	**1**
2	**120837**	**Nozzle Retaining Cap, with IHS tab**	**1**
3	**220237**	**Nozzle, Hyspeed 200A**	**3**
3	**020690**	**Nozzle, 100A .055 O2**	**2**
4	**020608**	**Nozzle, 200A .086 Air/N2/H35**	**3**
4	**020611**	**Nozzle, 100A .059 Air**	**3**
5	**220236**	**Swirl RIng: Hyspeed 200A**	**1**
6	**020607**	**Swirl Ring, Air/N2/H35**	**1**
6	**020613**	**Swirl Ring, Air**	**1**
6	**020679**	**Swirl Ring, Air/N2**	**1**
7	**220235**	**Electrode: HySpeed 200A**	**3**
7	**120667**	**Electrode: HT2000 200A Oxy LL**	**2**
7	**020415**	**Electrode, N2/H35**	**2**
7	**120547**	**Electrode: HT2000 100A LL**	**2**
8	020963	Water Tube:PAC200T/2000 Electd Cool	1
	027055	Lubricant, Silicon, 1/4 Oz Tube	1
	027194	Wrench, Nozzle, 3/4"	1
	027524	Wrench, Nozzle, 1"	1
	044027	O-Ring, Buna-N	2
	027347	Tool: Water Tube Removal	1
	004147	Electrode Gauge Assy	1

HT2000 Consumable Parts Kit

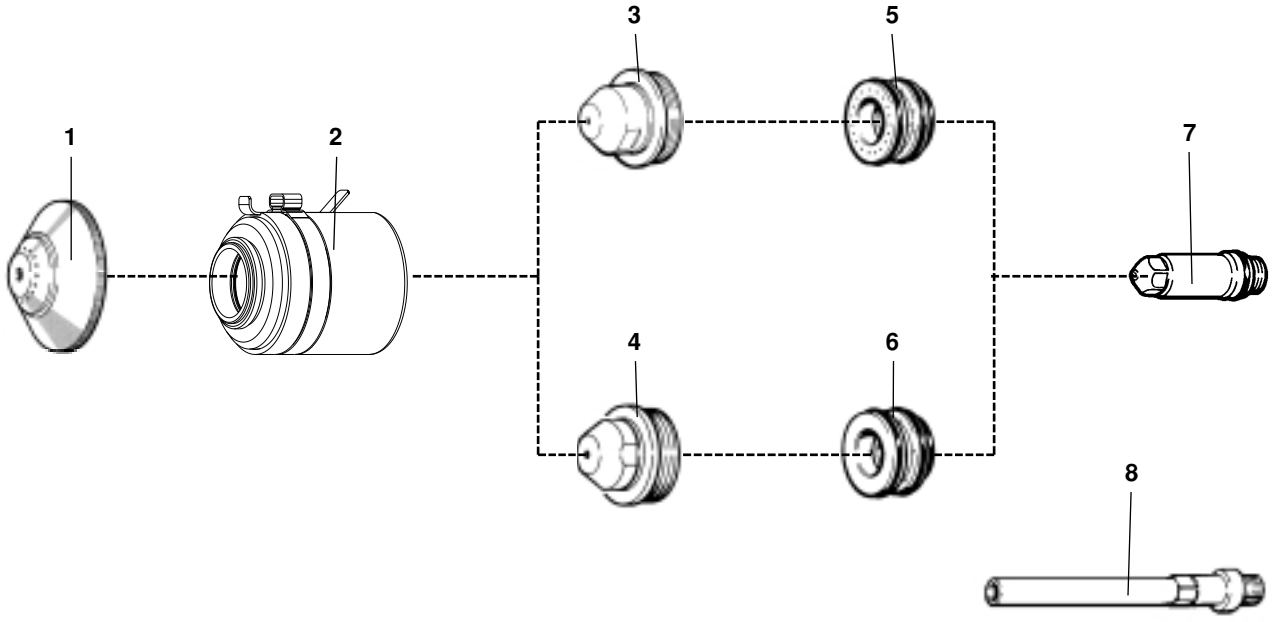


Figure 6-19 HT2000 Consumable Parts

Item	Part Number	Description	Qty.
	028602	**Kit: HT2000 Consumable Parts**	
	001067	Box: Gray Plastic	1
1	**020424**	**Shield, 200A**	1
1	**020448**	**Shield, 100A**	1
2	**120837**	**Nozzle Retaining Cap, with IHS tab**	1
3	**020605**	**Nozzle, 200A .082 O2**	5
3	**020690**	**Nozzle, 100A .055 O2**	3
4	**020608**	**Nozzle, 200A .086 Air/N2/H35**	5
4	**020611**	**Nozzle, 100A .059 Air**	3
5	**120833**	**Swirl Ring: HT2000 O2**	1
6	**020607**	**Swirl Ring, Air/N2/H35**	1
6	**020613**	**Swirl Ring, Air**	1
6	**020679**	**Swirl Ring, Air/N2**	1
7	**120667**	**Electrode:HT2000 200A O2 LL**	5
7	**020415**	**Electrode, N2/H35**	5
7	**120547**	**Electrode, HT2000 100A LL**	3
8	020963	Water Tube:PAC200T/2000 Electd Cool	1
	027055	Lubricant, Silicon, 1/4 Oz Tube	1
	027194	Wrench, Nozzle, 3/4"	1
	027524	Wrench, Nozzle, 1"	1
	044027	O-Ring, Buna-N	2
	027347	Tool: Water Tube Removal	1
	004147	Electrode Gauge Assy	1

HT2000 Beveling Consumable Parts Kit

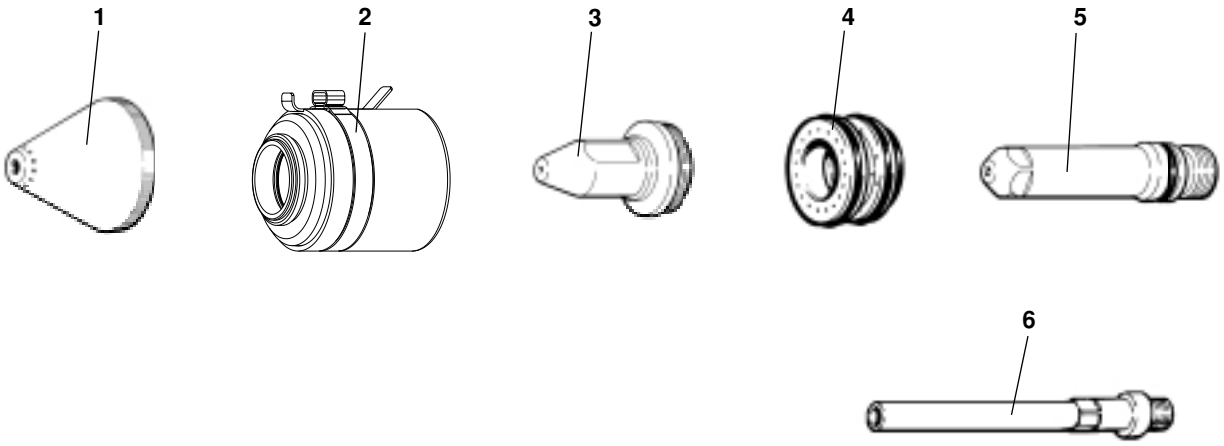


Figure 6-20 HT2000 Beveling Consumable Parts

Item	Part Number	Description	Qty.
	128406	**Kit: HT2000 Beveling Consumable Parts**	
	001067	Box: Gray Plastic	1
1	**120260**	**Shield: HT2000 Extended**	2
2	**120837**	**Nozzle Retaining Cap, with IHS tab**	1
3	**120259**	**Nozzle, HT2000 200A Oxygen Extended**	5
4	**120833**	**Swirl Ring: HT2000 O2**	2
5	**120258**	**Electrode:HT2000 Extended**	5
6	120257	Water Tube:Electd Cool Extended	1
	027055	Lubricant, Silicon, 1/4 Oz Tube	1
	027194	Wrench, Nozzle, 3/4"	1
	044027	O-Ring, Buna-N	2
	027347	Tool: Water Tube Removal	1

Recommended Spare Parts

Power Supply

Part Number	Description	Designation	Qty.	Pg. Ref.
027080	Fan: 225CFM 120VAC 50/60 Hz	M2,M3	1	6-2
027079	Fan: 450-550 CFM 120VAC 50/60 Hz	M4	1	6-2
041764	PCB Assy: HT2000LHF Control	PCB2	1	6-2
041246	PCB Assy: Relay, HD1070/HT2000	PCB4	1	6-2
005121	Pushbutton: 2 NO Green Illumin	PB1/LT1	1	6-3
005122	Pushbutton: 2 NC Red Extended	PB2	1	6-3
005149	Bulb: 120VAC	LT2	2	6-3
041294	PCB Assy: HT2000 THC Mother	PCB9	1	6-3
041186	PCB Assy: HT2000 THC	PCB10	1	6-3
003138	Circuit Breaker, 2 Pole, 600V 100A	CB1	1	6-4
003139	Contactor: 90A 3 Pole, 120VAC	CON1	2	6-4
041534	PCB Assy: Power Distribution	PCB1	1	6-4
005102	Thermostat: 160°C, 6 Amp	TS1	1	6-5
008317	Fuse: Semiconductor 125A, 250V	F1,F2	5	6-5
005227	Switch, Pressure 12 psi	PS3	1	6-5
006032	Solenoid Valve:150# 1/4 FPT 120V NC	SV6	1	6-5
006106	Solenoid Valve: 3-way 120VAC 1/8FPT	SV7	1	6-5
129118	CH130 Chopper SA	CH1,CH2	1	6-6
009684	Res: 4 Ohm 420W	R6A, R6B	1	6-7
003021	Relay, 120VAC NO SPST	CR1	1	6-7
009349	Coil Assembly: 200A HF	T4	1	6-7
009975	Cap: .1400pF 20kV	C4, C5, C6	3	6-7
004061	Electrode:Sprk Gap 1/8 x 1.6		3	6-7
129150	HV Transformer SA, 6kV	T3	1	6-7
029202	Current Sensor Assembly	CS1	1	6-7
129618	Switch, Level SA, 1/2 NPT	LS1	1	6-8
029323	Switch, Temp SA, 162 Deg. F	TS2	1	6-8
006046	Valve, Sol 240V 3/8 NPT NC	V1	1	6-8
128384	Kit: Pump, 70 GPH Positive Displace		1	6-8
029361	Flowswitch, 0.5 gpm	FS1	1	6-8

Gas Console

Part Number	Description	Designation	Qty.	Pg. Ref.
005243	Pressure Switch:80psi	PS1,PS2	1	6-9
005149	Bulb, 120VAC	LT1	1	6-9
006109	Solenoid Valve: 150# 1/8FPT 120V 2-Way	SV1-3	1	6-9
006064	Needle Valve: 1/8 FPT .125 Orifice	MV1-MV4	1	6-9
011053	Flowmeter: 7.8 GPM/44CFH	FM1,FM2	1	6-9
011058	Flowtube with Float /BP-8 Flt:0-10 SC Cal 2%		2	6-9
011008	Shield: Plastic, for 011053 or 011056		2	6-9
011081	Flowmeter Float Stop		2	6-9
022020	Gauge: Pressure, 160 psi/bar, Panel Mnt	PG1-PG2	1	6-9
022008	Gauge, Press 100#/Bar 2.5" Dia.	PG3	1	6-9

Hypertherm

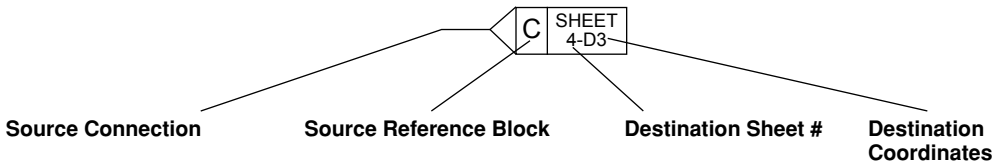
Section 7

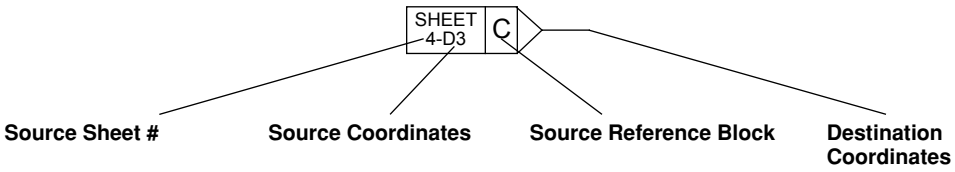
WIRING DIAGRAMS

Introduction

This section contains the wiring diagrams for the HT2000LHF system. When tracing a signal path or referencing with the **Parts List** or **Troubleshooting** sections, please be aware of the following format to assist you in understanding the wiring diagrams' organization:

- Sheet numbers are located in the lower right-hand corner.
- Page-to-page referencing is done in the following manner:



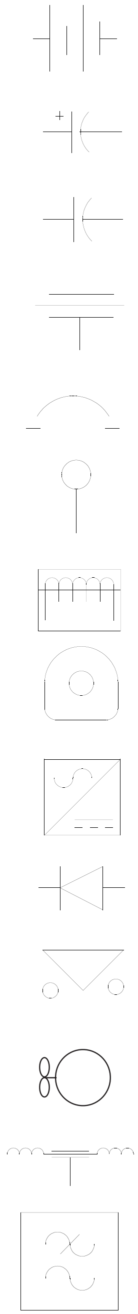


Destination and **Source Coordinates** refer to letters A-D on the Y-axis of each sheet and numbers 1-4 on the X-axis of each sheet. Lining up the coordinates will bring you to the source or destination blocks (similar to a road map).

- When referencing components to the wiring diagrams, designations may appear to be repeated. Eg. C1 appears on sheet 2 in the wiring diagrams in 2 locations. Sections of the power supply on that page are outlined with a dotted box and a label. Within different sections, the same designation may appear. Be certain to check the dotted box label when looking for or cross-referencing HT2000LHF parts.

Wiring Diagram Symbols

Wiring diagram symbols and their identification precede the system wiring diagrams in this section.



Battery

Cap, polarized

Cap, non-polarized

Cap, feed-thru

Circuit breaker

Coax shield

Current Sensor

Current sensor

DC supply

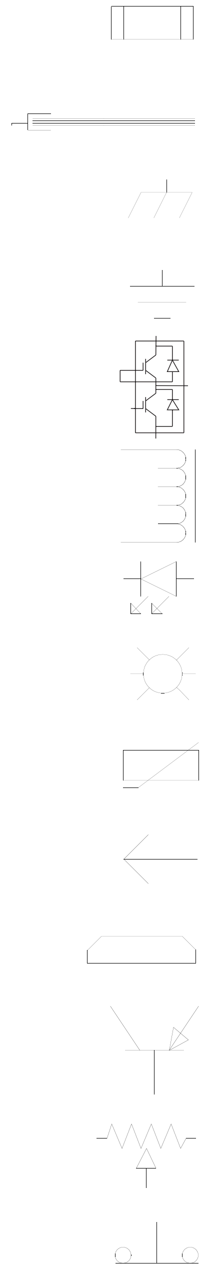
Diode

Door interlock

Fan

Feedthru LC

Filter, AC



Fuse

Ground Clamp

Ground, Chassis

Ground, Earth

IGBT

Inductor

LED

Light

MOV

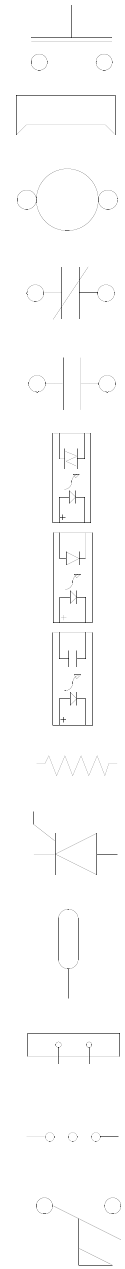
Pin

Plug

PNP Transistor

Potentiometer

Push Button, Normally Closed



Push Button, Normally Open

Receptacle

Relay, Coil

Relay, Normally Closed

Relay, Normally Open

Relay, Solid State, AC

Relay, Solid State, DC

Relay, Solid State, Dry

Resistor

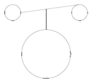
SCR

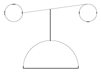
Shield

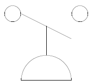
Shunt

Spark Gap

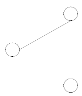
Switch, Flow

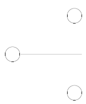

Switch, Level, Normally Closed

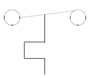

Switch, Pressure, Normally Closed

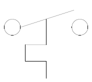

Switch, Pressure, Normally Open

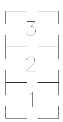

Switch, 1 Pole, 1 Throw


Switch, 1 Pole, 2 Throw

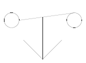

Switch, 1 Pole, 1 Throw, Center Off

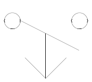

Switch, Temperature, Normally Closed

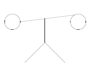

Switch, Temperature, Normally Open

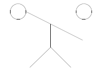


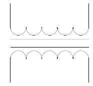
Terminal Block

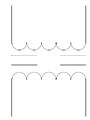

Time Delay Closed, NC/Off

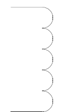

Time Delay Open, NO/Off

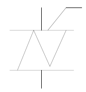

Time Delay Open, NC/On

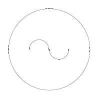

Time Delay Closed, NO/Off


Transformer

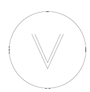

Transformer, Air Core

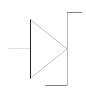

Transformer Coil


Triac

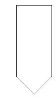

VAC Source

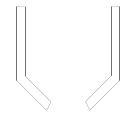

Valve, Solenoid

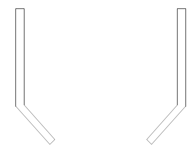

Voltage Source

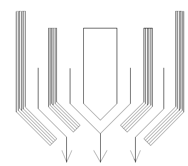

Zener Diode

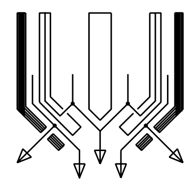
Torch Symbols


Electrode


Nozzle


Shield


Torch


Torch, HyDefinition™

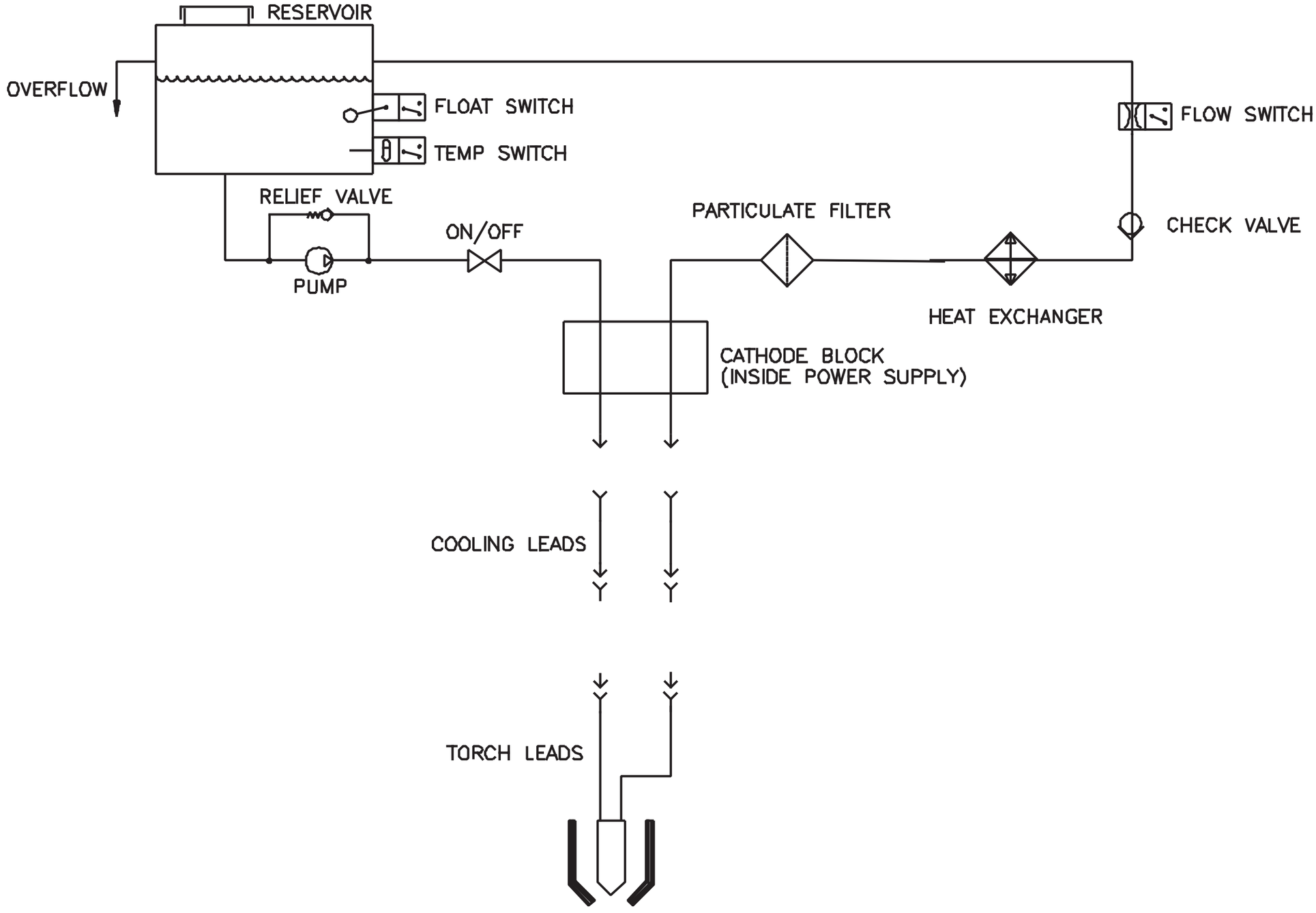


Figure 7-1 HT2000LHF Coolant Flow Diagram

3 Phase
Power
w/ Ground

Air Regulator
029758

Air/024061

Unit 8
IHS
028390

8X2
8X3
8X1

IHS/Sensor Cable 023869

Air Hose 024042

IHS/Sensor Cable 023870

PS/IHS Cable
023859

1X9

Shielded Torch Leads
028546

1X3

PS/TCH VLV ASSY CABLE 123261

Shield Gas
024302

Shield Sense
024061

Unit 3
Gas
Console
073239

Cutflow 024307

Preflow 024026

Oxygen/024204
Nitrogen/024112
Air/024012

3X1

1X2

Gas Cable 023549

4X1
4X1

Valve Cluster

Torch and Torch Valve Assy
128255

Unit 14
Ar-H
Console
073109

Ar-H

Plasma
024354

TCH MTG SA
029334

Water
Hose
024012

14X1

Ar-H Cable 023660

Unit 1

HT2000
Power Supply
200 Amp

W/ THC

073227 200/50-60
073229 208/60
073231 240/60
073233 480/60
073235 400/50-CE
073237 600/60
073262 440/50-60

W/O THC

073228 200/50-60
073230 208/60
073232 240/60
074234 480/60
073236 400/50-CE
073238 600/60
073263 440/50-60

Positive Lead 023403

Workpiece

Unit 9
W-M
Water
Supply
Voltage
Dependant

3 Phase
Power

Water
Supply

1X10

W-M Contactor Cable 023866

I/O
Machine Interface Cable
023841

1X6

Remote I/O CABLE
123294

1X1

V&C
Machine Interface Cable
023851

1X7

OR

RCC Cable 023871

1X7

Computer
Interface
Customer Supplied

Req'd for:
-No V/C Remote
-055004

Unit 15
Remote Current Control
073045
(OPTIONAL)

15X1

SERIAL I/O
Remote/PS Cable 023878

1X4

VOLT/CUR
Remote/PS Cable (055004 ONLY)
023834

1X5

Unit 5
Remote
V/C

073007 Digital V/C
055004 Programmable V/C

5X1
5X2

Timer Cable 023687

11X1

Optional
Ext. Counter/Time
073194

Hold Cable
023340

2nd HT2000 System
(Optional control w/Machine I/O Cable)

MATERIAL

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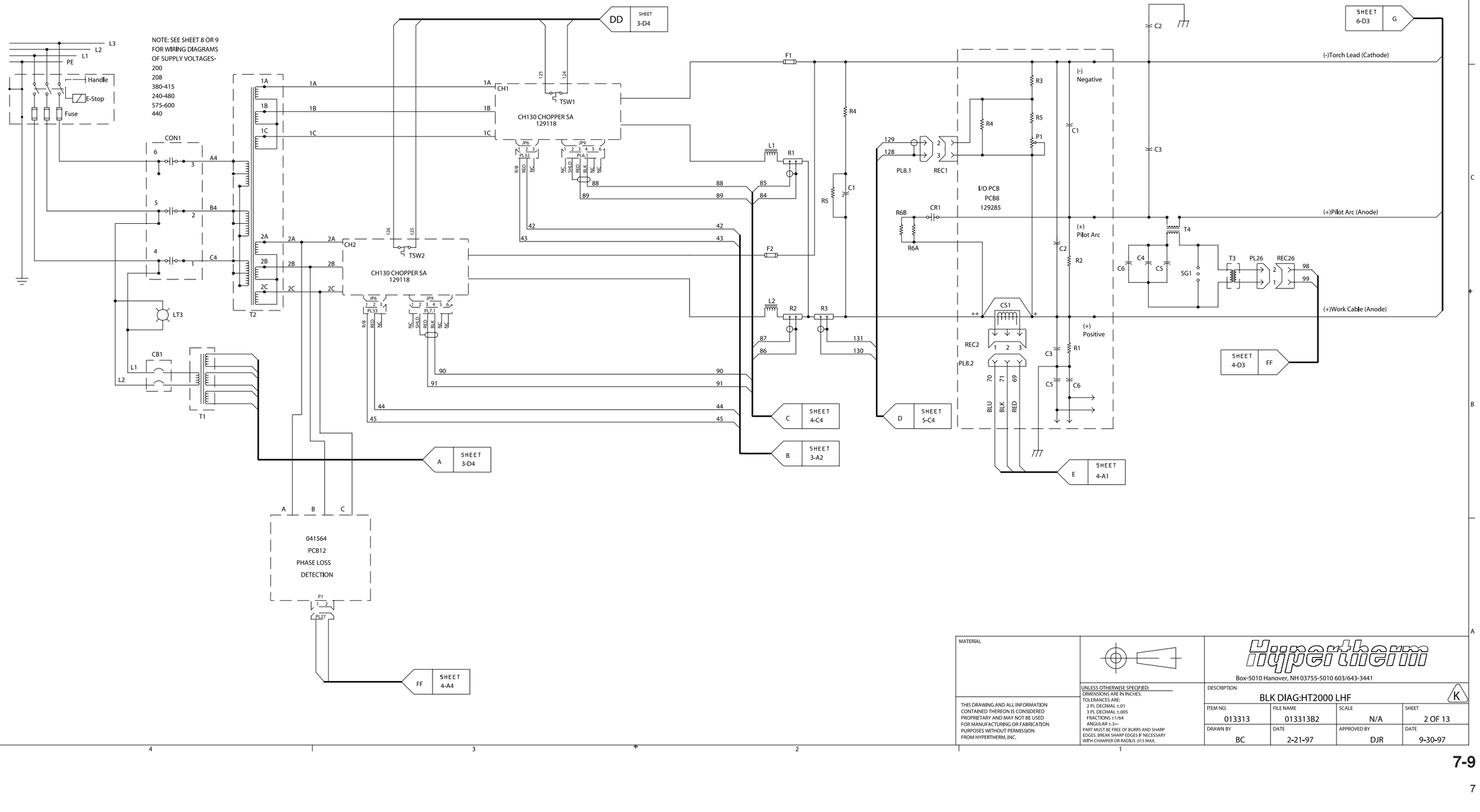
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES.
TOLERANCES ARE:
2 PL DECIMAL ±.01
3 PL DECIMAL ±.005
FRACTIONS ±1/64
ANGULAR ±.5=
PART MUST BE FREE OF BURRS AND SHARP EDGES, BREAK SHARP EDGES IF NECESSARY WITH CHAMFER OR RADIUS .015 MAX.

Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B1	N/A	1 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97



MATERIAL

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3 PL DECIMAL ±.005
FRACTIONS ±1/64
ANGULAR ±.5=
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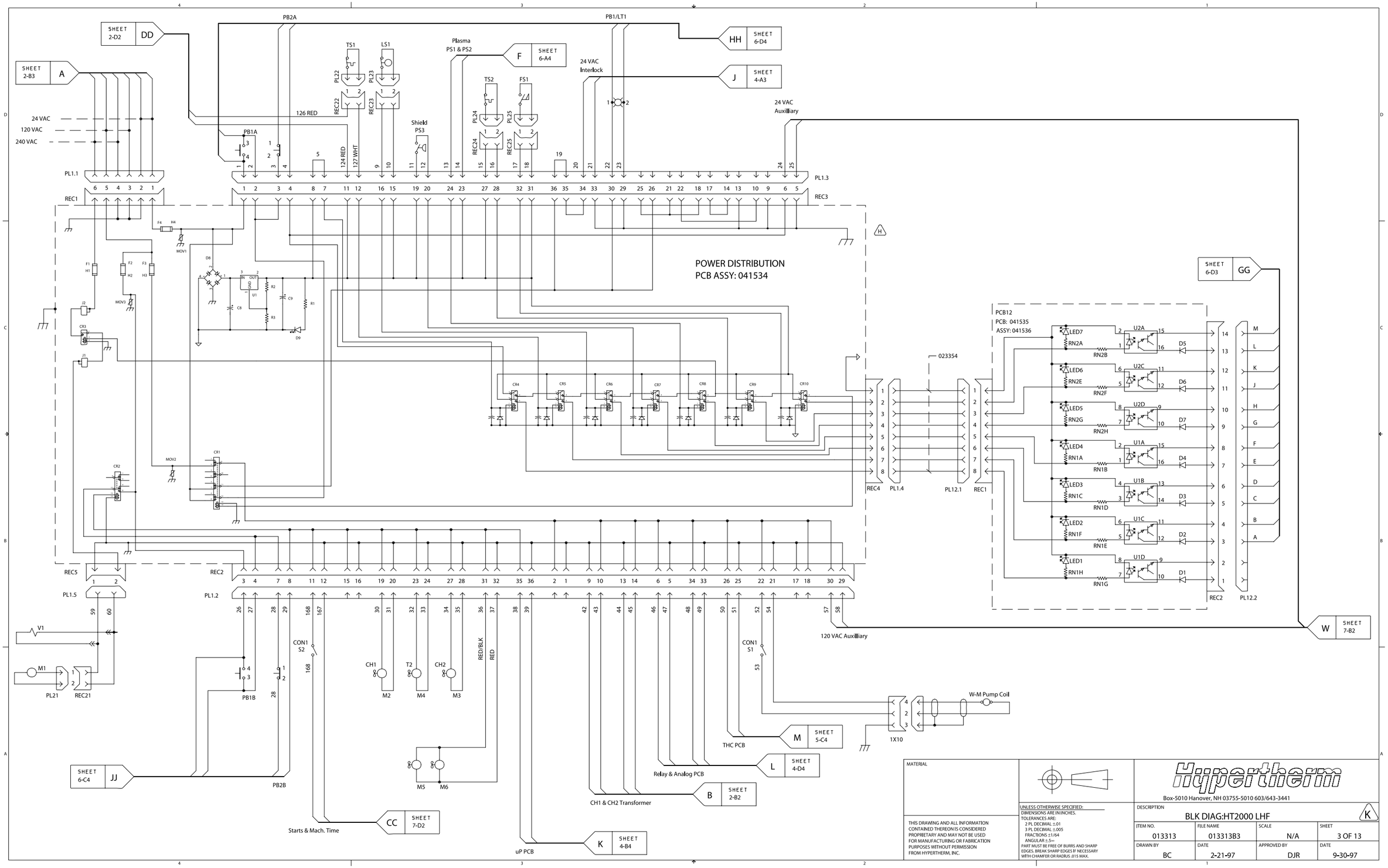
Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B2	N/A	2 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97



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FRACTIONS ±1/64
ANGULAR ±.5=
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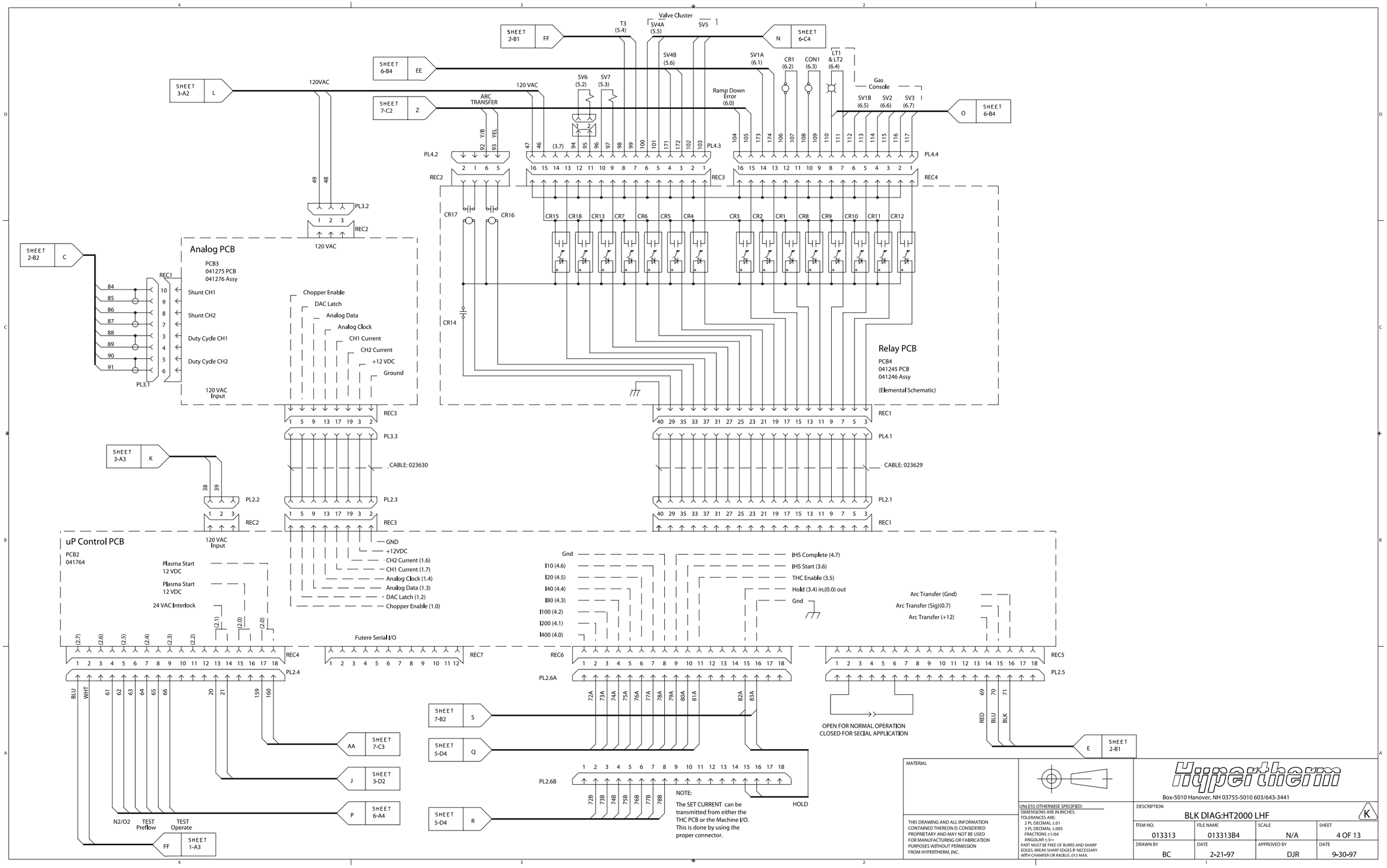
Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B3	N/A	3 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97



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FRACTIONS ±1/64
ANGULAR ±.5=
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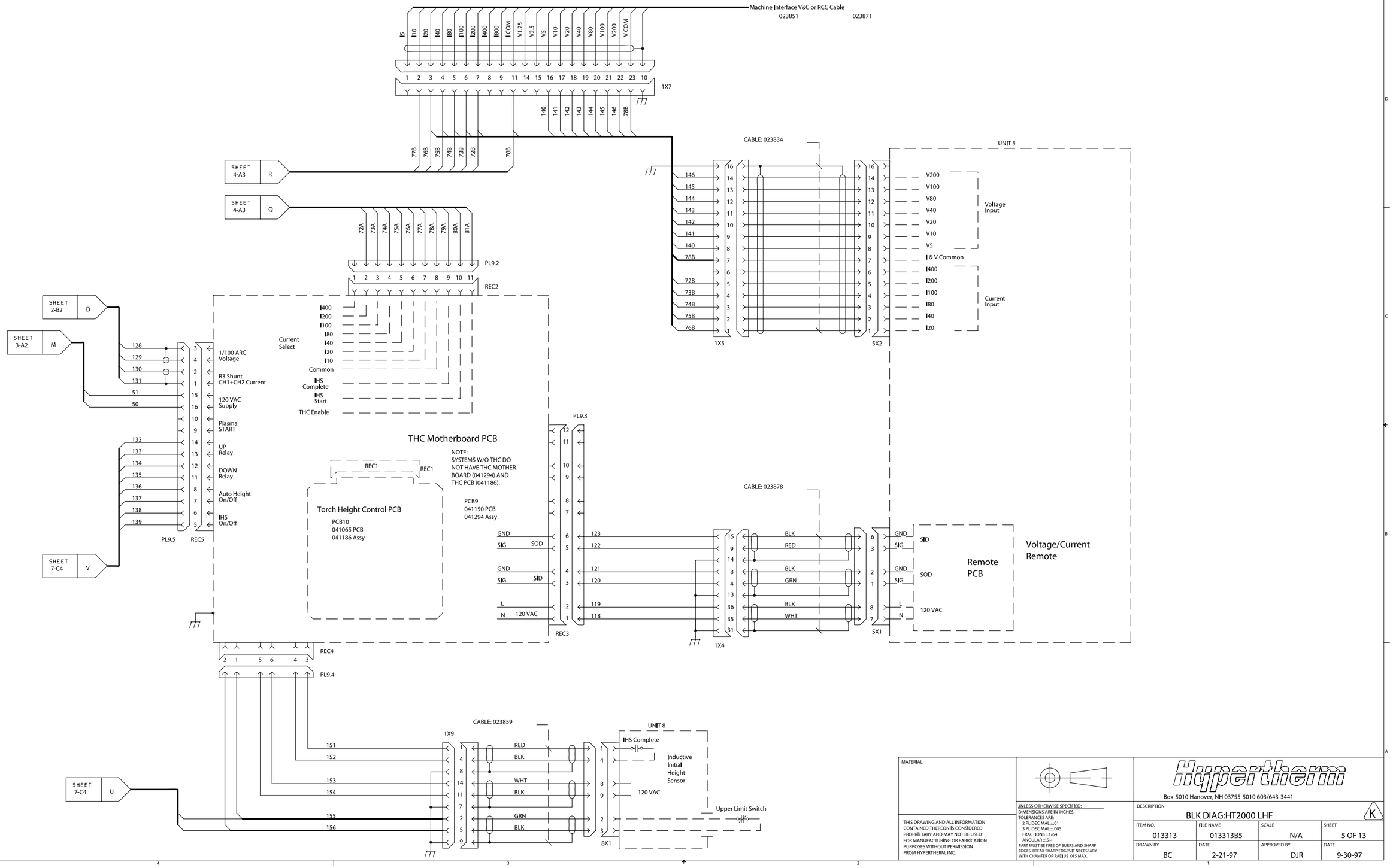
Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B4	N/A	4 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97



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ANGULAR ±.5=
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Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B5	N/A	5 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97

SHEET 2-D1 G
(+) Work Cable (Anode) 023403
(-) Torch Lead (Cathode) 023403
(+) Pilot Arc (Anode) 023631

SHEET 3-D2 HH
SHEET 3-A4 JJ
TB5
PB2A 3 4
PB2B 28 29
SHEET 3-C1 GG
FS1 TS2 PS1 PS2 PS3 LS1 TS1
PB1A PB2A PB1 LT1
LT1
PB1B PB2B
1X1
27 26 29 28 110 111 1 2 3 4 23 22 M L K J H G F E D C B A
31 36 35 34 30 29 25 24 23 37 33 32 28 27 26 7 3 2 13 20 19 10 17 16 21 15 14 18 12 11 4 9 8 1 6 5

NOTE: 1x1 pins 23 & 24, 29 & 30, and 35 & 36 source 120VAC.

Remote I/O

SHEET 4-D2 N
SHEET 7-B2 BB
SHEET 4-D3 EE
SHEET 4-D2 O
SHEET 4-A3 P
SHEET 3-D3 F
Plasma PS1 & PS2

CABLE: 123261
CABLE: 123321
Valve Cluster
SV4A
SV4B
SV5
1X3
4X1
101 100 171 172 103 102
1 2 3 6 5 4 7 8 9

CABLE: 023549
111 110 113 112 173 174 115 114 117 116 62 61 64 63 66 65 13 14
2 3 7 8 9 4 27 28 22 16 17 10 11 12 18 19 20 13 14 15 21 35 36 31 32 33 37
1X2
3X1
LT1 DC
SV1B
SV1A
SV2
SV3
Gas Console
S1-A O2 N2
S1-B O2 N2
Preflow
S2
Run
Operate
20
N2 PS1 PS2 O2
19
UNIT 3

Torch

MATERIAL
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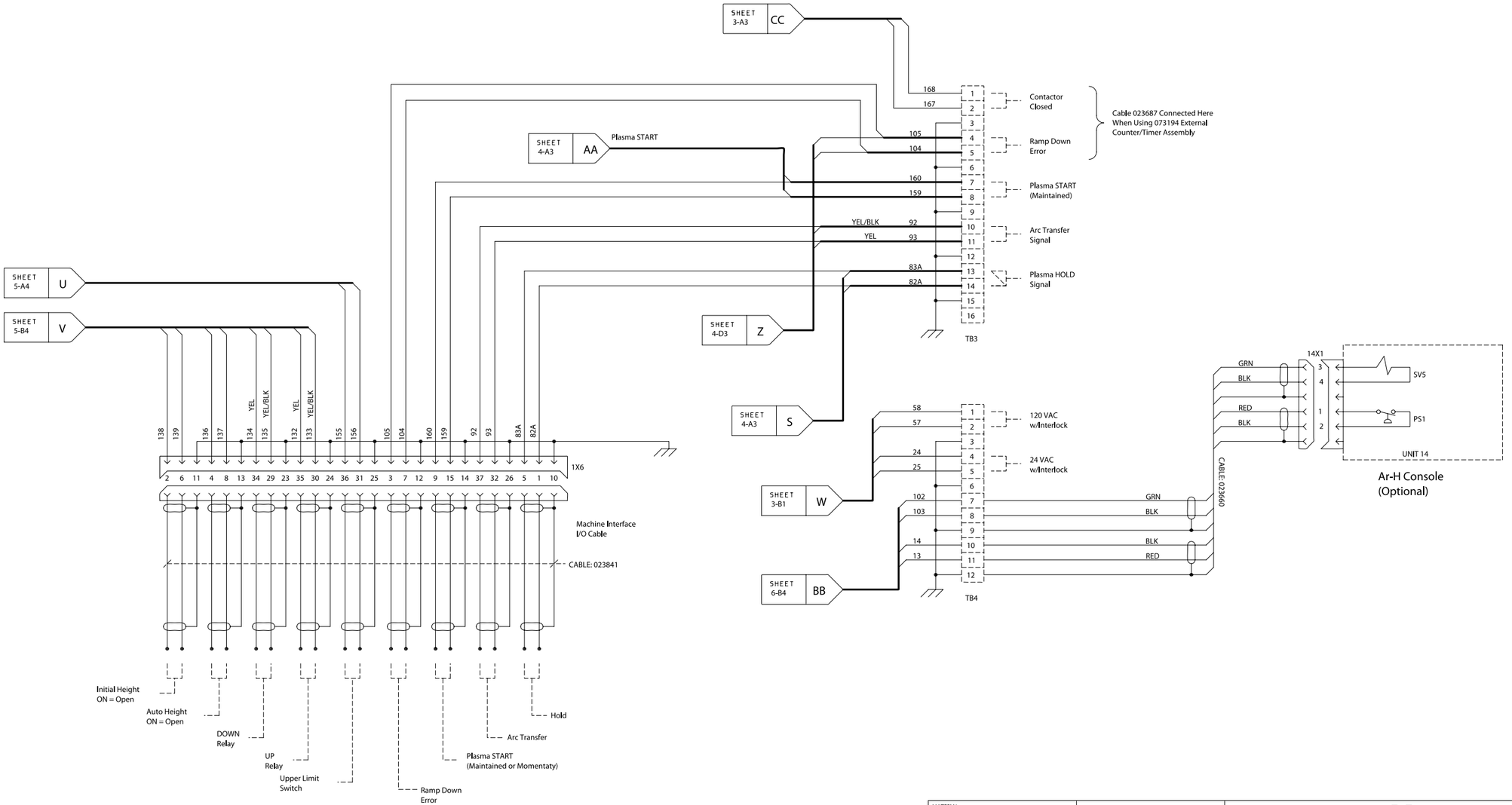
FRACTIONS ±1/64
ANGULAR ±.5°
PART MUST BE FREE OF BURRS AND SHARP EDGES. BREAK SHARP EDGES IF NECESSARY WITH CHAMFER OR RADIUS .015 MAX.

Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION			
BLK DIAG:HT2000 LHF K			
ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B6	N/A	6 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97



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3 PL DECIMAL ±.005
FRACTIONS ±1/64
ANGULAR ±.5°
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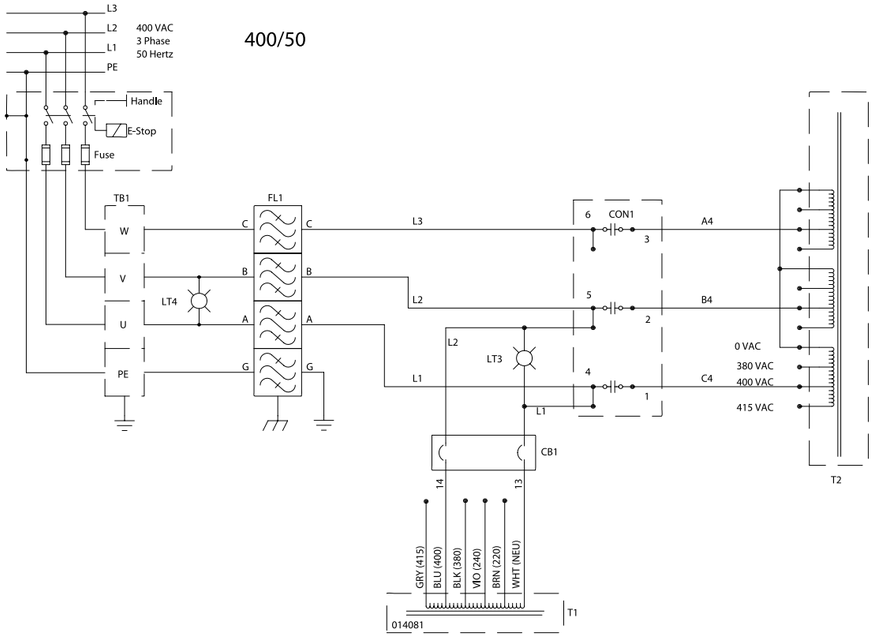
Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

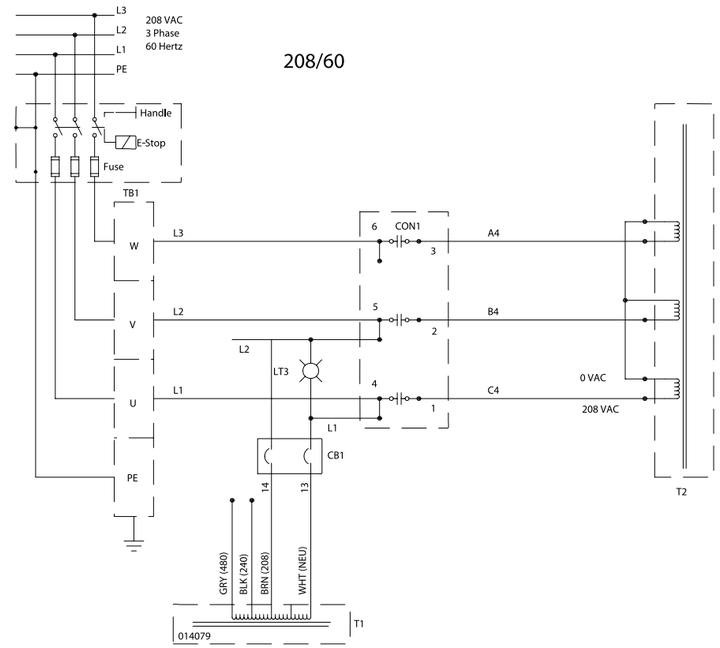
DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B7	N/A	7 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97

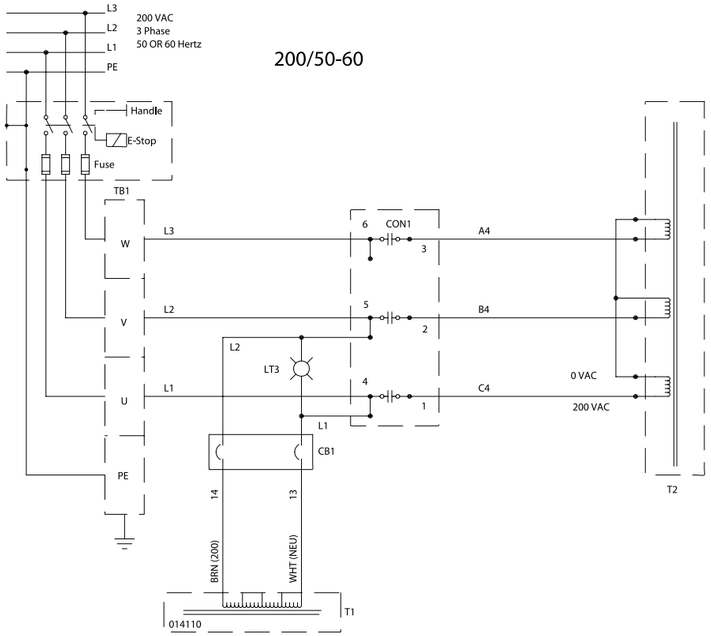
400/50



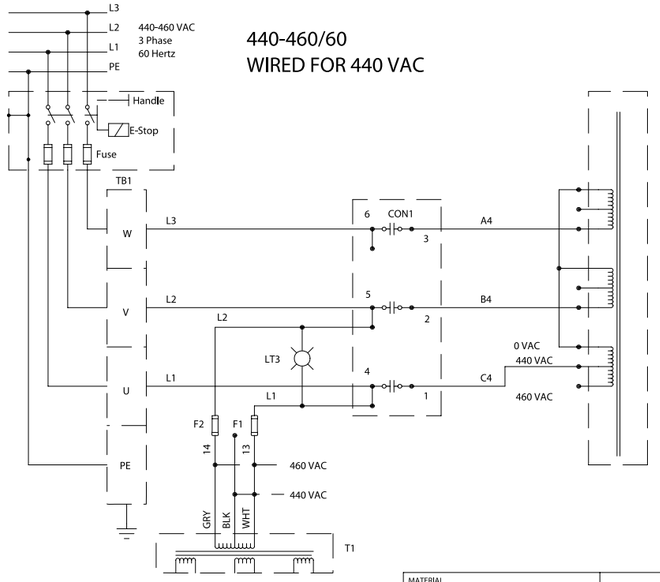
208/60



200/50-60



440-460/60
WIRED FOR 440 VAC



MATERIAL

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ANGULAR ±.5=
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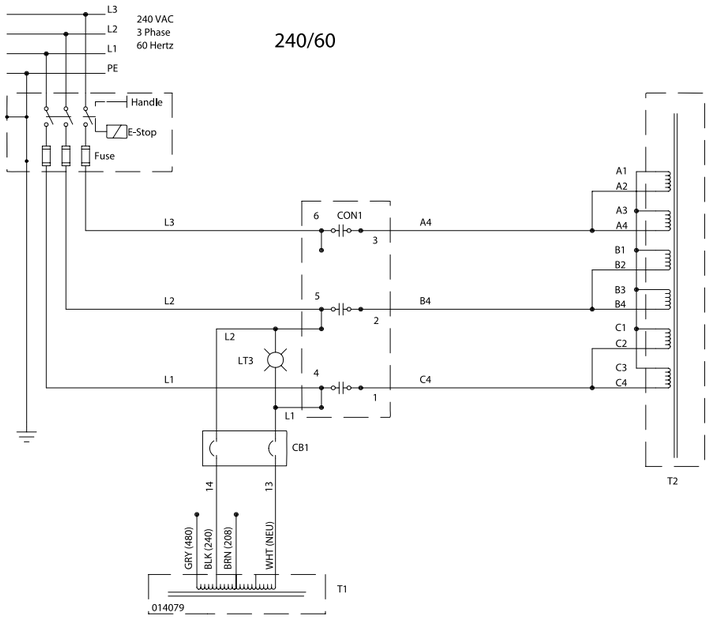
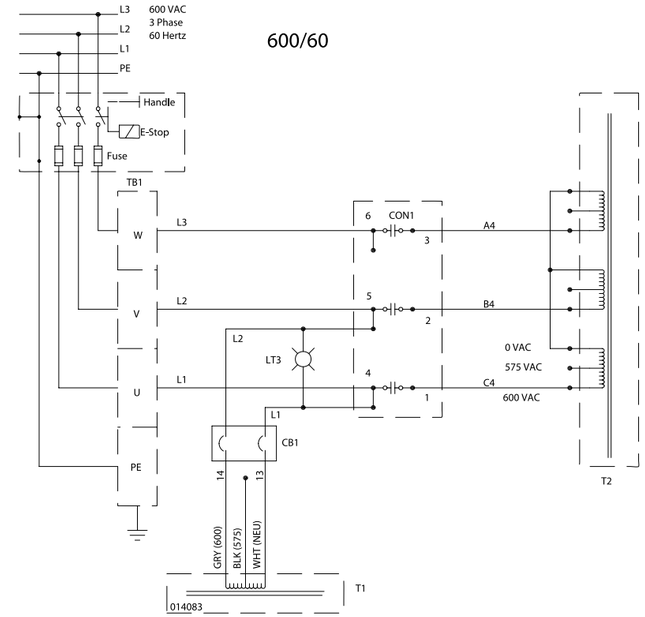
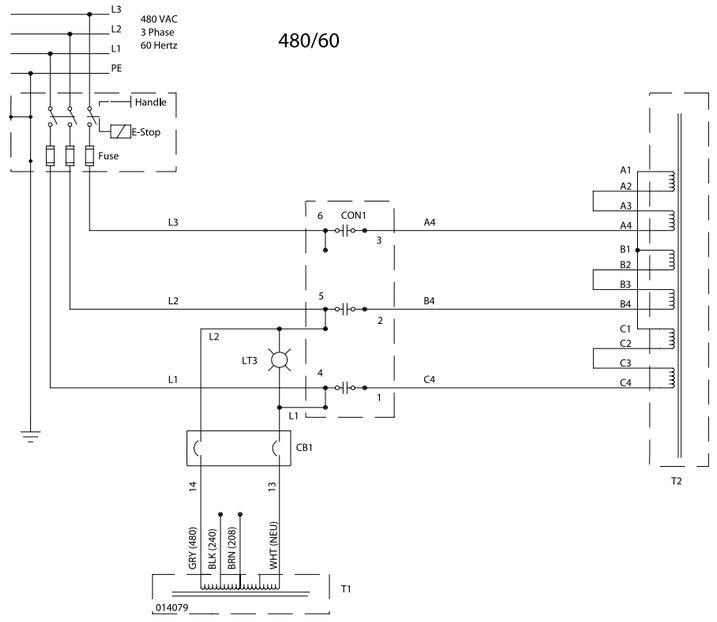
Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B8	N/A	8 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97







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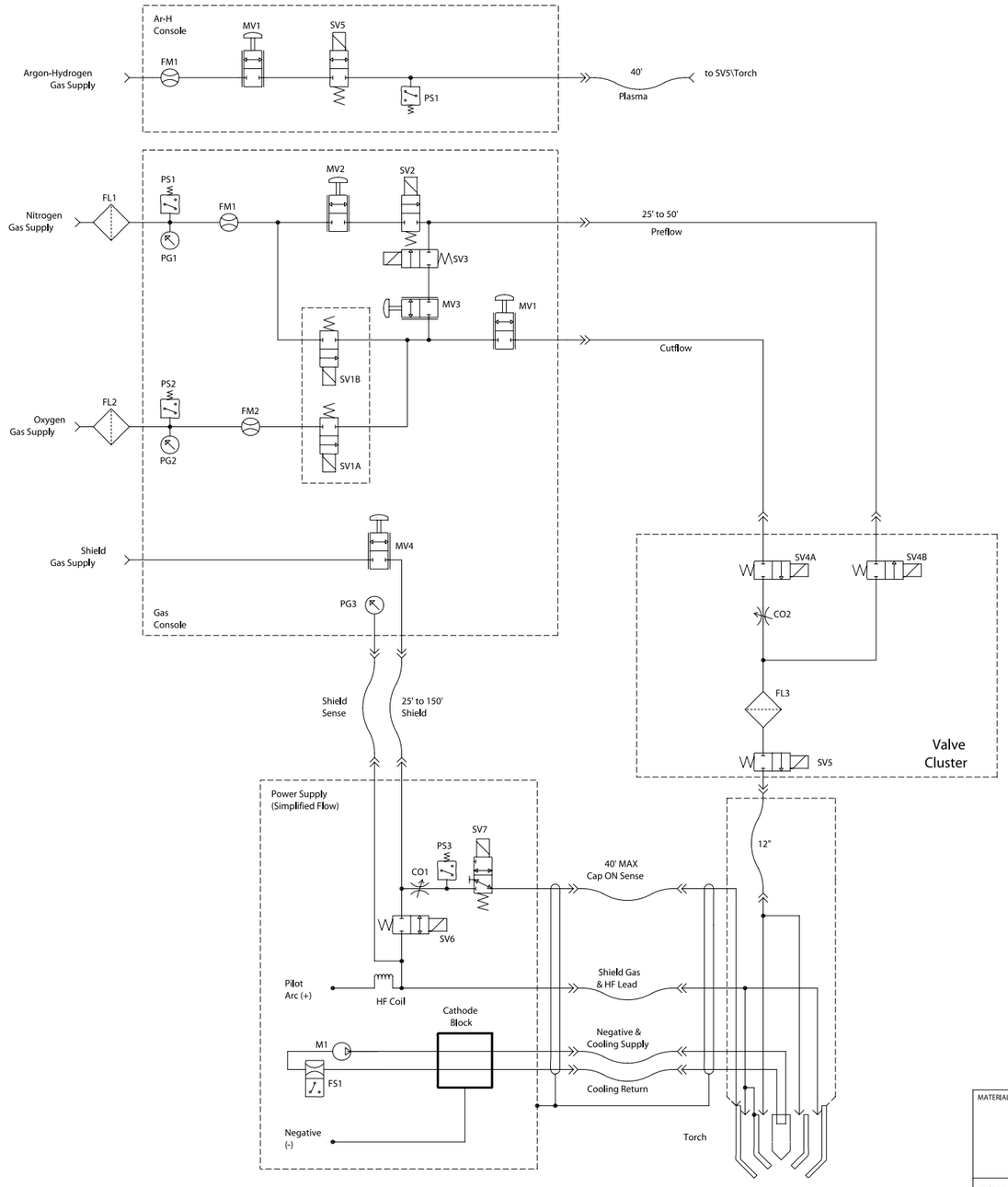
PART MUST BE FREE OF BURRS AND SHARP EDGES. BREAK SHARP EDGES IF NECESSARY WITH CHAMFER OR RADIUS .015 MAX.

Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B9	N/A	9 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97



CO1 Critical Orifice, Cap OFF
FM1 Flow Meter, Nitrogen
FM2 Flow Meter, Oxygen
FS1 Flow Switch, Cooling
PG1 Pressure Gauge, Nitrogen Inlet
PG2 Pressure Gauge, Oxygen Inlet
PG3 Pressure Gauge, Plasma
PS1 Pressure Switch, Nitrogen Inlet
PS2 Pressure Switch, Oxygen Inlet
PS3 Pressure Switch, Shield/Cap OFF
M1 Motor, Pump Cooling
FL1 Filter, N2
FL2 Filter, O2
FL3 Filter, Plasma

MV1 Metering Valve, Plasma Motor
MV1 Metering Valve, N2 Preflow
MV3 Metering Valve, O2 Preflow
MV4 Metering Valve, Shield
SV1A Solenoid Valve, O2
SV1B Solenoid Valve, N2 Cutflow
SV2 Solenoid Valve, N2 Preflow
SV3 Solenoid Valve, O2 Preflow
SV4A Solenoid Valve, Cutflow
SV4B Solenoid Valve, Preflow
SV5 Solenoid Valve, Plasma OFF
SV6 Solenoid Valve, Shield ON
SV7 Solenoid Valve, Cap OFF

MATERIAL

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ANGULAR ±.5°
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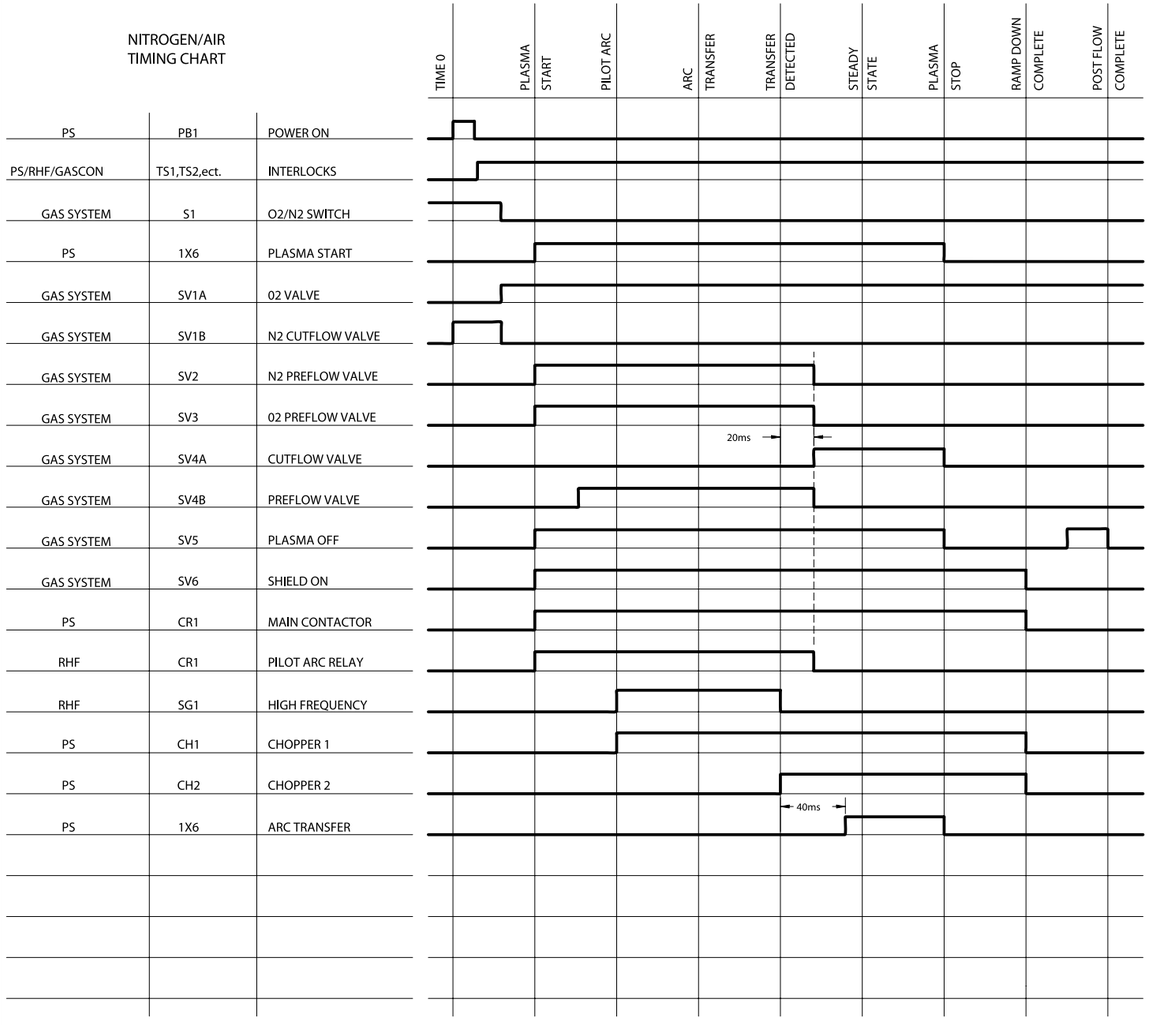
Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B10	N/A	10 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97

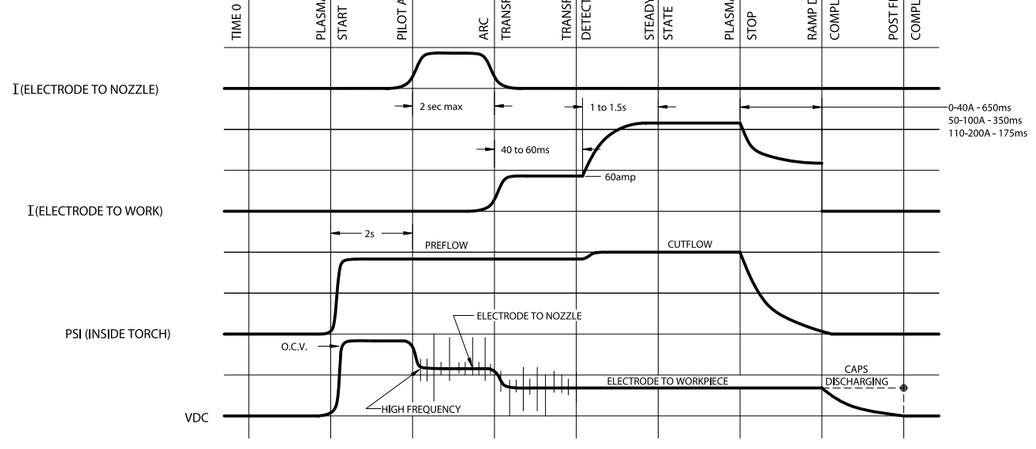
NITROGEN/AIR
TIMING CHART



Solenoid valve status for N_2 timing chart

N_2 or Air Cutting Mode			
Component	Idle	Cutflow	Preflow
SV1A	OFF	OFF	OFF
SV1B	ON	ON	ON
SV2	OFF	OFF	ON
SV3	OFF	OFF	OFF
SV4A	OFF	ON	OFF
SV4B	OFF	OFF	ON
SV5	OFF	ON	ON
SV6	OFF	ON	ON
SV7	ON	ON	ON

NITROGEN/AIR OPERATION
CURRENT, PRESSURE,
AND VOLTAGE WAVEFORMS



MATERIAL

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3 PL DECIMAL ±.005
FRACTIONS ±1/64
ANGULAR ±.5°
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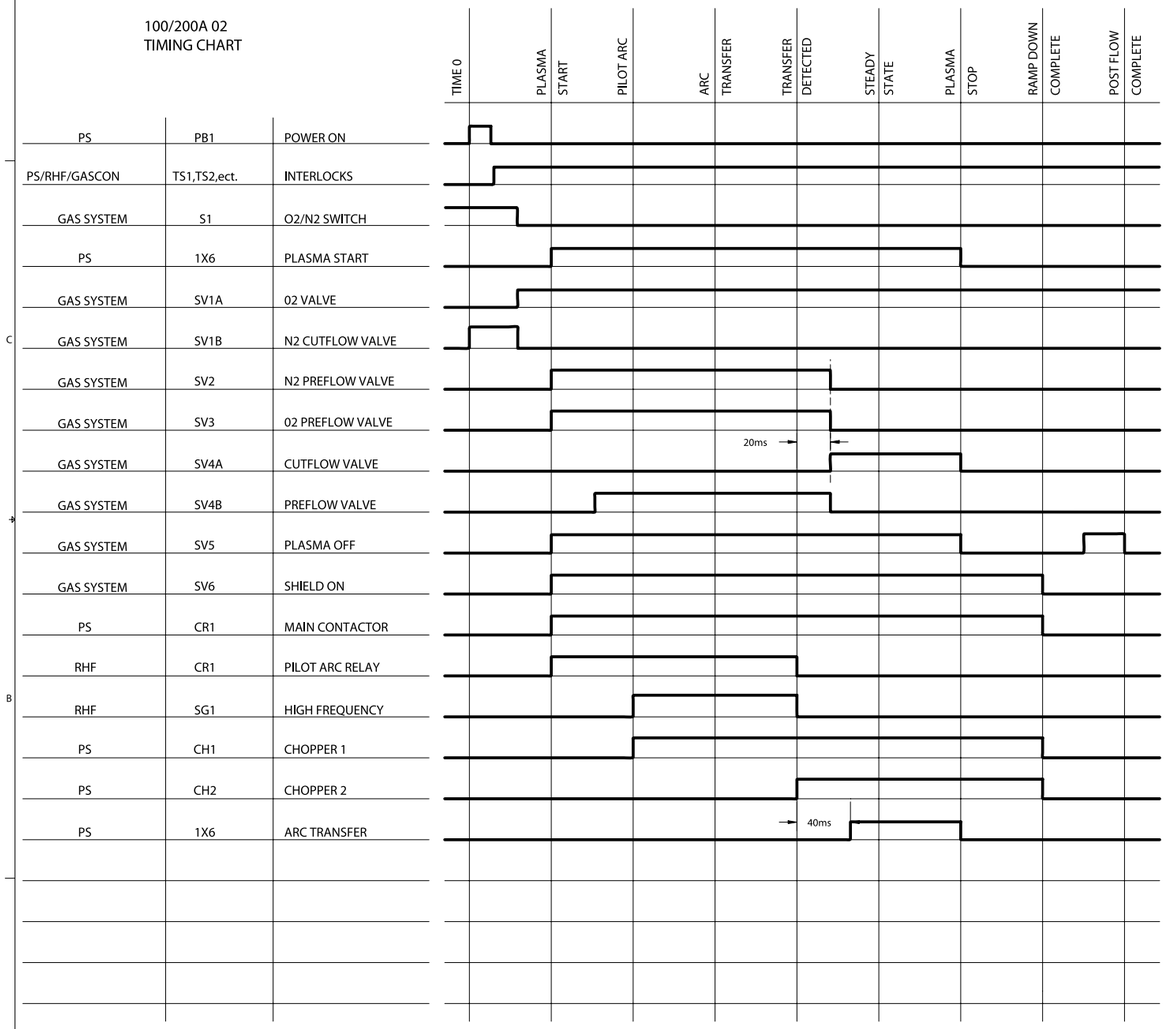
Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION			
BLK DIAG:HT2000 LHF			K
ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B11	N/A	11 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97

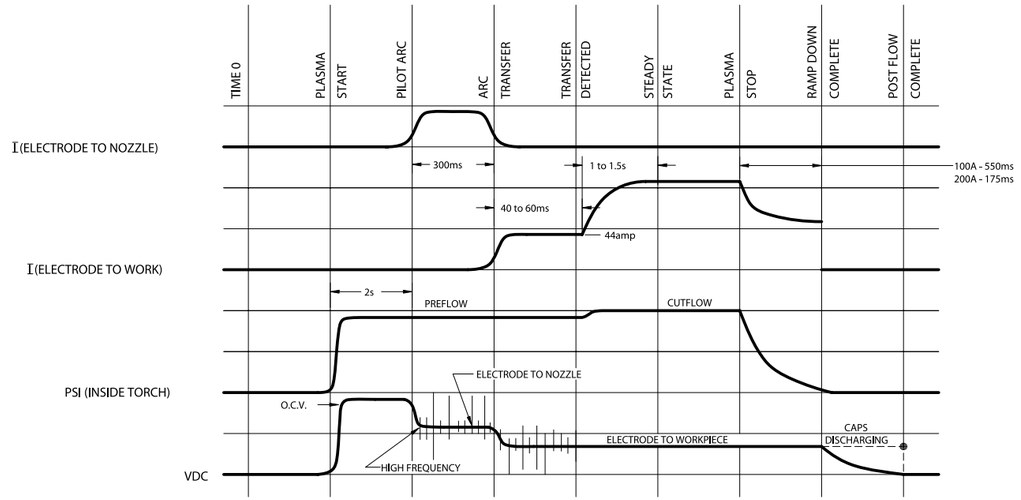
100/200A 02
TIMING CHART



Solenoid valve status for O_2 timing chart

O_2 or Air Cutting Mode			
Component	Idle	Cutflow	Preflow
SV1A	ON	ON	ON
SV1B	OFF	OFF	OFF
SV2	OFF	OFF	ON
SV3	OFF	OFF	ON
SV4B	OFF	OFF	ON
SV4B	OFF	OFF	ON
SV5	OFF	ON	ON
SV6	OFF	ON	ON
SV7	ON	ON	ON

OXYGEN OPERATION
CURRENT, PRESSURE,
AND VOLTAGE WAVEFORMS



MATERIAL

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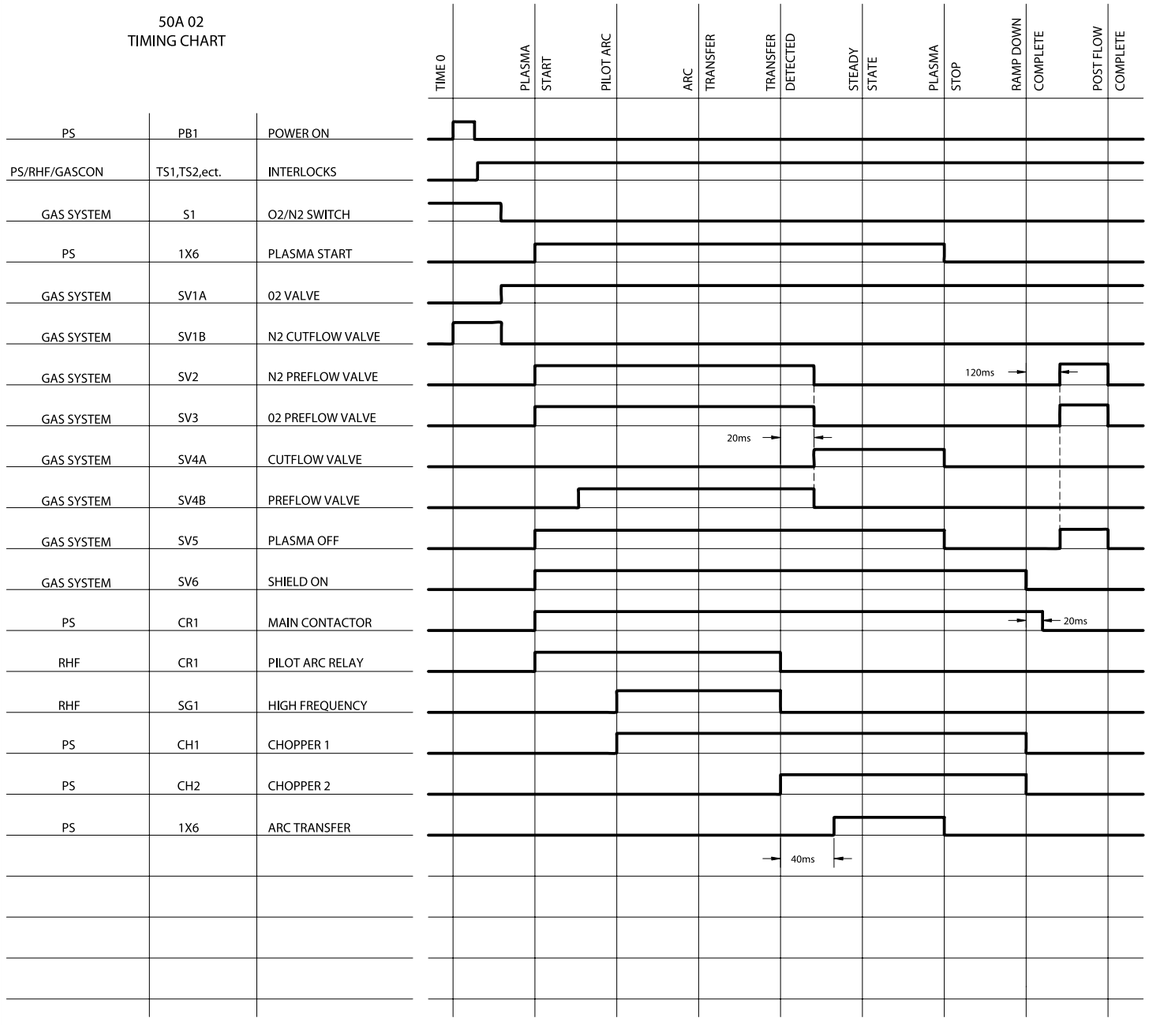
Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B12	N/A	12 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97

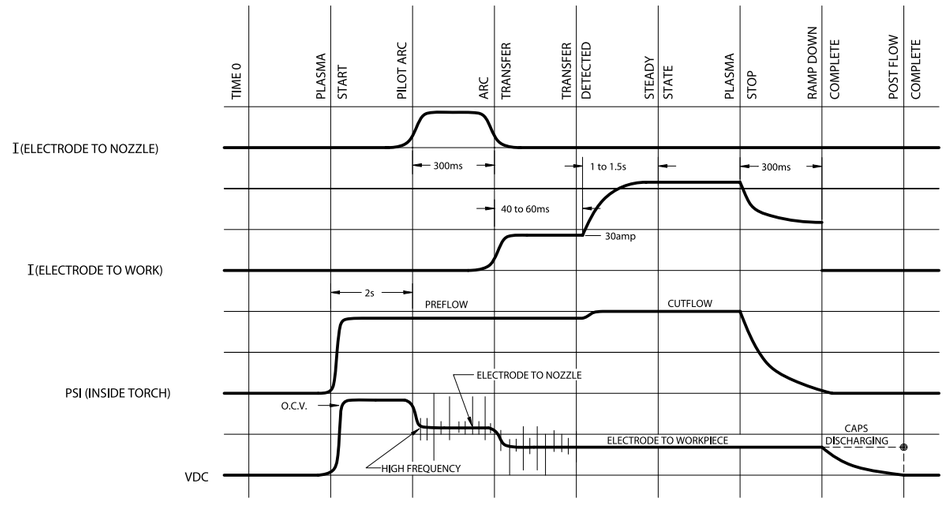
50A 02
TIMING CHART



Solenoid valve status for O_2 timing chart

O_2 or Air Cutting Mode			
Component	Idle	Cutflow	Preflow
SV1A	ON	ON	ON
SV1B	OFF	OFF	OFF
SV2	OFF	OFF	ON
SV3	OFF	OFF	ON
SV4B	OFF	OFF	ON
SV4B	OFF	OFF	ON
SV5	OFF	ON	ON
SV6	OFF	ON	ON
SV7	ON	ON	ON

OXYGEN OPERATION
CURRENT, PRESSURE,
AND VOLTAGE WAVEFORMS



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Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION: BLK DIAG:HT2000 LHF (K)

ITEM NO.	FILE NAME	SCALE	SHEET
013313	013313B13	N/A	13 OF 13
DRAWN BY	DATE	APPROVED BY	DATE
BC	2-21-97	DJR	9-30-97

Hypertherm

Appendix A

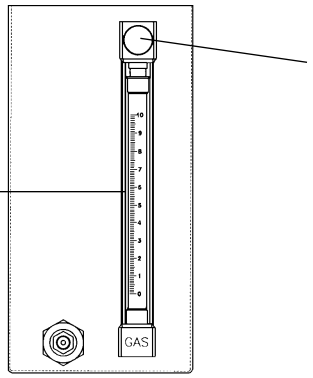
ARGON-HYDROGEN CUTTING AND GOUGING

Introduction

This section contains installation and operation information for cutting and gouging using argon-hydrogen as the plasma gas.

- See *Installation* to make the remaining power supply and gas console connections.
- **Do not use the water muffler when cutting with argon-hydrogen!**

Argon-Hydrogen Manifold FRONT PANEL CONTROLS and INDICATORS (Fig. a-1)



MV1
Adjusts argon-hydrogen plasma gas flow rate % in Test/Preflow mode. Preflow plasma gas flow rate percentages are specified in the *Argon-Hydrogen Cut Charts*.

FM1
Indicates the argon-hydrogen plasma gas flow rate %. Flow rates for argon-hydrogen are specified in the *Argon-Hydrogen Cut Charts*.

Figure a-1 Argon-Hydrogen Manifold Front Panel Controls and Indicators

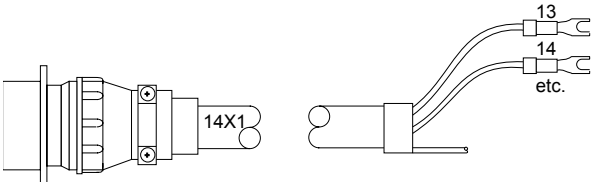
Installation

		WARNING
Before operating the argon-hydrogen manifold, turn all power and gases connected to the system OFF. Follow the installation and operation procedures before turning power and gases ON.		

(13) *Argon-Hydrogen Cable – Argon-Hydrogen Manifold to Power Supply*

1. Connect the receptacle end of the argon-hydrogen cable to the cable connection point on the argon-hydrogen manifold. (Figure a-2)

2. Connect the other end of the cable to TB4 (smaller terminal strip on the inside rear panel of the power supply). Match up wires 102, 103, 13 and 14 to wires already connected to the strip. Connect the two shield wires to points labeled as PE (protective earth).



(13)

Part No.	Length
023660	15 ft (4.6 m)
023661	25 ft (7.6 m)
023662	50 ft (15 m)
023663	75 ft (23 m)
023664	100 ft (30 m)
023665	150 ft (46 m)

14x1	TB4	Color	Signal
1	13	Red	PS1 / Plasma
2	14	Black	PS1 / Plasma
	12	Shield	Shield
3	102	Green	SV5 / Plasma Off
4	103	Black	SV5 / Plasma Off
	9	Shield	Shield

Argon-Hydrogen supply to Argon-Hydrogen Manifold

- Attach one end of the supply hose to the argon-hydrogen supply tank regulator, and attach the other end to the argon-hydrogen supply hose connection on the manifold. (Figure a-2)

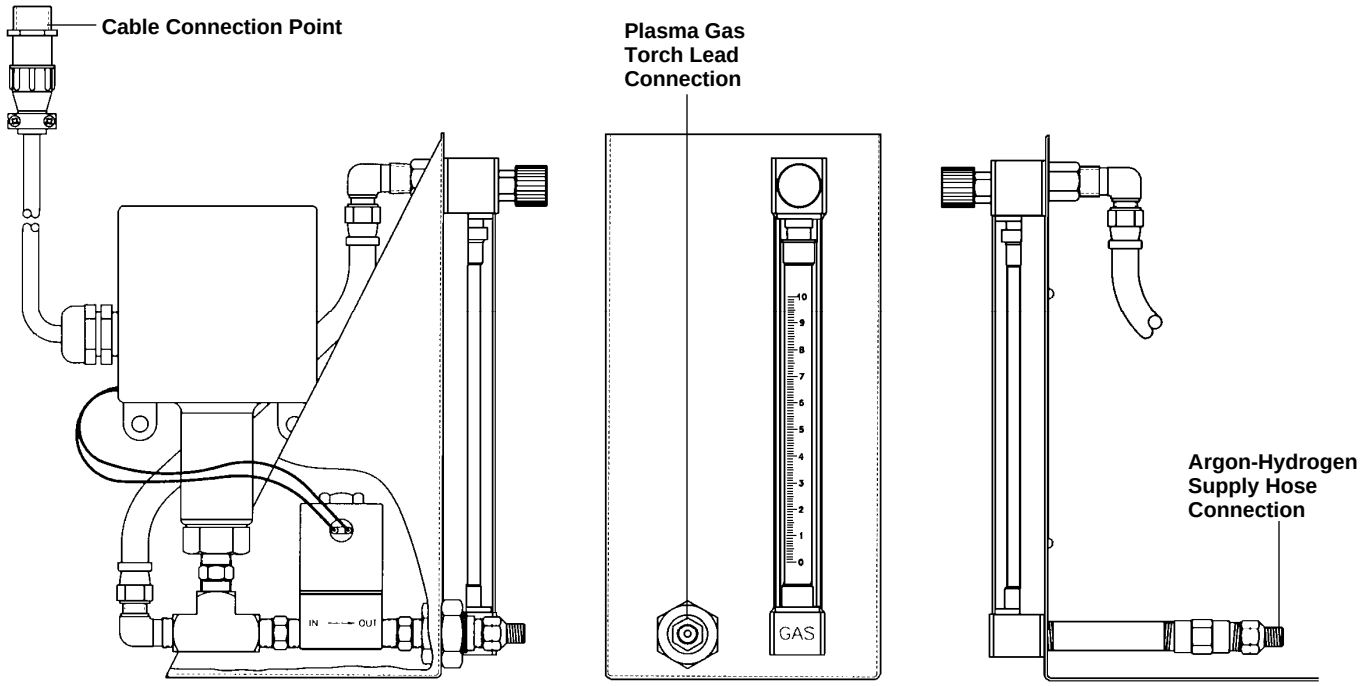
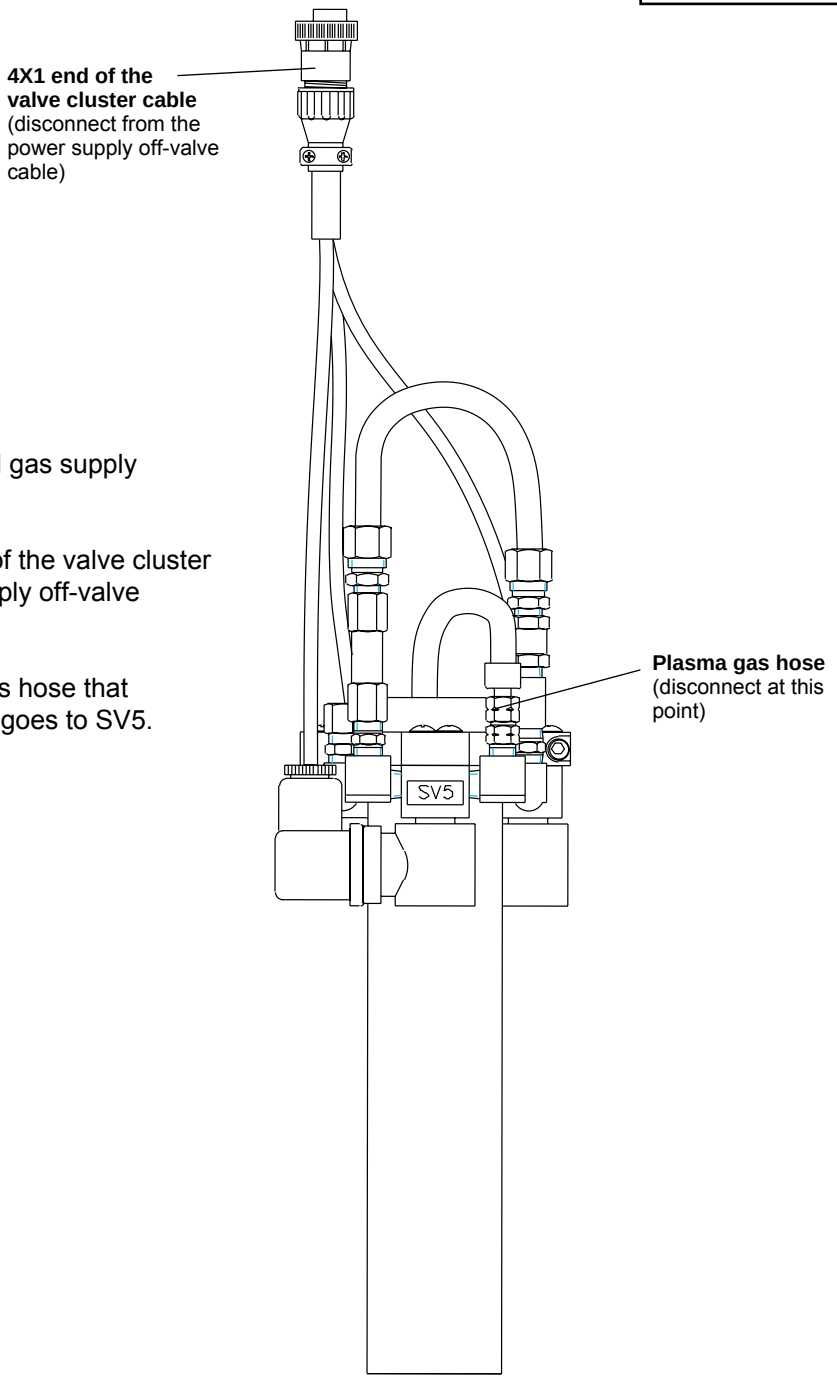


Figure a-2 Argon-Hydrogen Manifold Connection Points

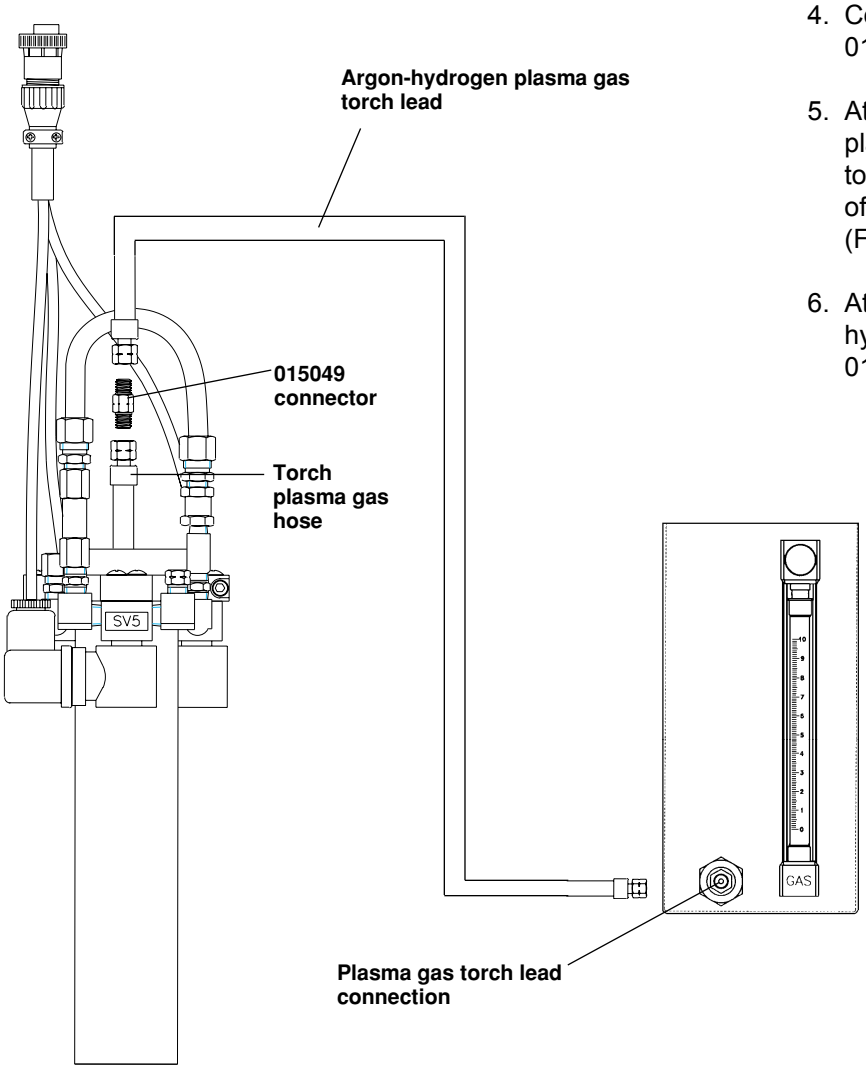
Argon-Hydrogen plasma gas torch lead – Argon-Hydrogen Manifold to Torch

Part No.	Length
024355	12 in (305 mm)
024354	10 ft (3 m)
024368	20 ft (6.2 m)
024369	30 ft (9.1 m)
024370	40 ft (12.4 m)
024443	50 ft (15 m)
024467	75 ft (23 m)



1. Turn <u>all</u> plasma and shield gas supply tanks **OFF**.
2. Disconnect the 4X1 end of the valve cluster cable from the power supply off-valve cable.
3. Disconnect the plasma gas hose that comes from the torch and goes to SV5.

Figure a-4 Converting the HT2000LHF Torch for Argon-Hydrogen Cutting – 1 of 2



4. Connect the left-hand threaded connector 015049 to the torch plasma gas hose.

5. Attach one end of the argon-hydrogen plasma gas torch lead to the plasma gas torch lead connection located on the front of the argon-hydrogen manifold. (Figure a-4)

6. Attach the other end of the argon-hydrogen plasma gas torch lead to the 015049 connector.

Figure a-4 Converting the HT2000LHF Torch for Argon-Hydrogen Cutting – 2 of 2

Nitrogen supply to Gas Console

- Connect the nitrogen supply to the shield connection at the rear of the gas console. (Figure a-5)

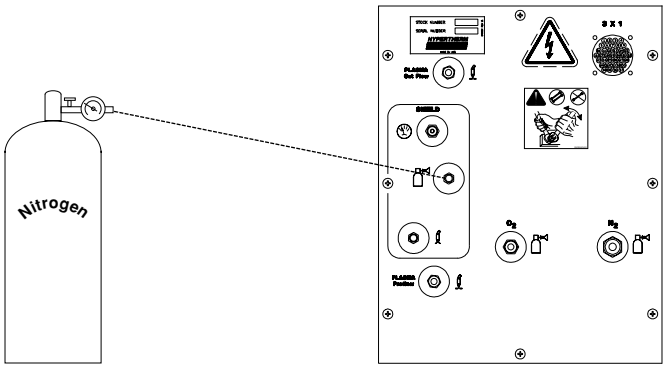


Figure a-5 Nitrogen Supply to Gas Console

Operation

Prior to operation, ensure that your cutting environment and that your clothing meet the safety requirements outlined in the ***Safety*** section of this manual. If problems occur during operation, refer to the *Installation* portion of this section as well as **Section 3**.

	WARNING
Before operating this system, you must read the Safety section thoroughly! Verify main disconnect switch to the power supply is OFF before proceeding with the following steps	

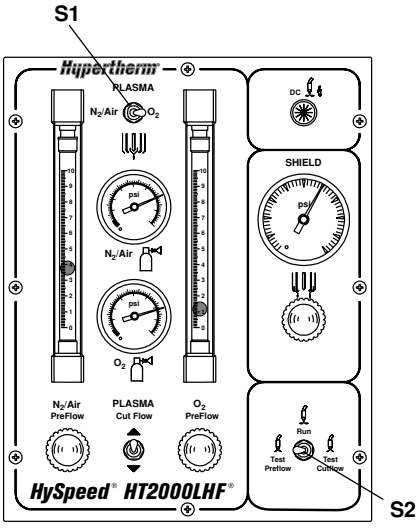
Note: For operation without argon-hydrogen manifold, see **Section 4: Operation.**

Check Torch

1. Remove the consumables from the torch and check for worn or damaged parts. **Always place the consumables on a clean, dry, oil-free surface after removing. Dirty consumables can cause the torch to malfunction.**

   - Check the pit depth of the electrode. The electrode should be replaced when the depth exceeds .044 inch (1.1 mm).
   - Wipe the current ring in the torch with a clean paper towel or Q-tip (see Figure 4-7).
   - Refer to the *Argon-Hydrogen Cut Charts* to choose the correct consumables for your cutting needs.

2. Replace the consumable parts. Refer to *Changing Consumable Parts* in **Section 4** for detailed information on replacing consumables.
3. Ensure that the torch is squared to the material. Refer to **Section 3** for the torch alignment procedure.
4. Verify that argon-hydrogen cable 14X1 is connected to the argon-hydrogen manifold.



Turn Gases On

1. Set S2 toggle switch on the gas console to Run**.**
2. Set S1 switch to the N2/Air position.
3. Turn the argon-hydrogen gas supply and the nitrogen gas supply ON**.** Verify that the oxygen and air gas supplies remain OFF.

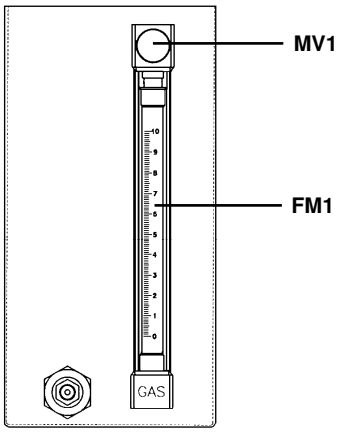
   - Adjust the argon-hydrogen plasma gas supply regulator to read 120 psi +/- 10 psi (8.2 bar +/- 0.7 bar).
   - Adjust supply regulator for shield gas to read 90 psi +/- 10 psi (6.2 bar +/- 0.7 bar).

Turn Power Supply On and Adjust Voltage/Current

1. Turn the main disconnect switch ON. See *Status Indicators Before Startup* in **Section 4**.

2. Turn on the power supply by depressing the POWER ON (I) button (PB1) on the power supply. Ensure that the green POWER ON indicator illuminates. Hold PB1 down until all of the status indicators extinguish.

3. Set the voltage and current. Select the arc current and arc voltage settings from the *Argon-Hydrogen Cut Charts* later in this section for the type and thickness of metal to cut.



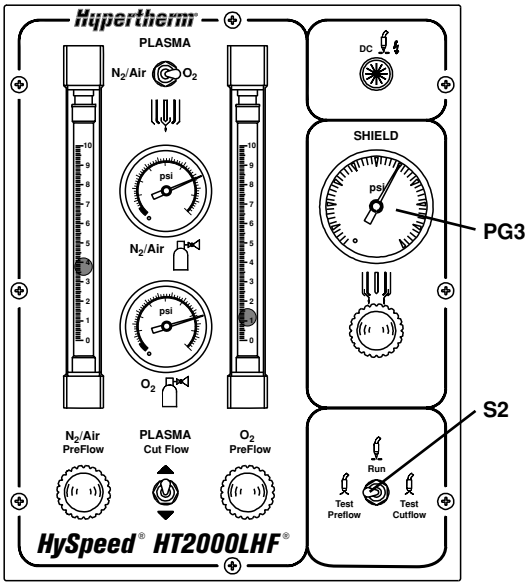
Adjust Preflow Gases

1. Set S2 on the gas console to Test Preflow**.** Verify that the argon-hydrogen supply regulator reads 120 psi (8.2 bar).

2. Look at the flowmeter (FM1) on the argon-hydrogen manifold and set the Preflow plasma gas flow rate % by referring to the *Argon-Hydrogen Cut Charts* and turning the argon-hydrogen flowmeter adjust knob (MV1).

3. Look at the shield gas pressure gauge (PG3) on the gas console, and set to the *Argon-Hydrogen Cut Chart* specifications by turning the shield gas adjust knob (MV4).

Note: If you have changed consumable parts or if the power supply has been off for more than 1 hour, purge gas lines by leaving the system in Test Preflow for 1 minute.



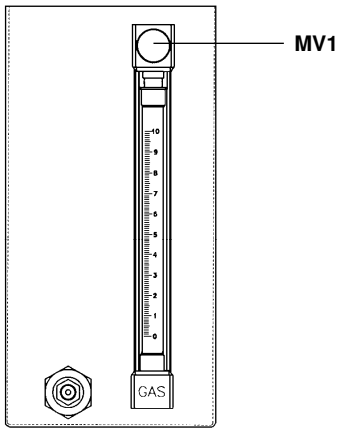
Adjust Cut Flow Gases and Prepare for Cutting

1. Set S2 on the gas console to Test Cut Flow**.**

2. Look at the flowmeter (FM1) on the argon-hydrogen manifold and set the Cut Flow plasma gas flow rate % by referring to the *Argon-Hydrogen Cut Charts* and turning the argon-hydrogen flowmeter adjust knob (MV1).

3. Set S2 to Run after the test preflow and test operate flow rates have been set.

The system is now ready for operation.



After Cutting with Argon-Hydrogen

1. Turn off the power supply, and disconnect the power.
2. Turn MV1 to the closed position.
3. Disconnect the 14X1 argon-hydrogen cable from the plasma system. See page a-2.
4. Remove the argon-hydrogen plasma gas torch lead from the torch. See Figure a-4.
5. Remove the 015049 connector and connect the plasma hose from the torch to SV5. See Figures a-3 and a-4.
6. Remove the nitrogen supply hose from the shield supply connection of the gas console.
7. Connect the nitrogen supply hose to the N_2 connection of the gas console. See Figure a-6.
8. Connect the shield gas supply hose to the shield supply connection of the gas console. See *Gas Console Connections* in Section 3.
9. Reconnect the 4X1 end of the valve cluster cable to the power supply off valve cable. See Figures a-4, 3-5 and page 3-10.

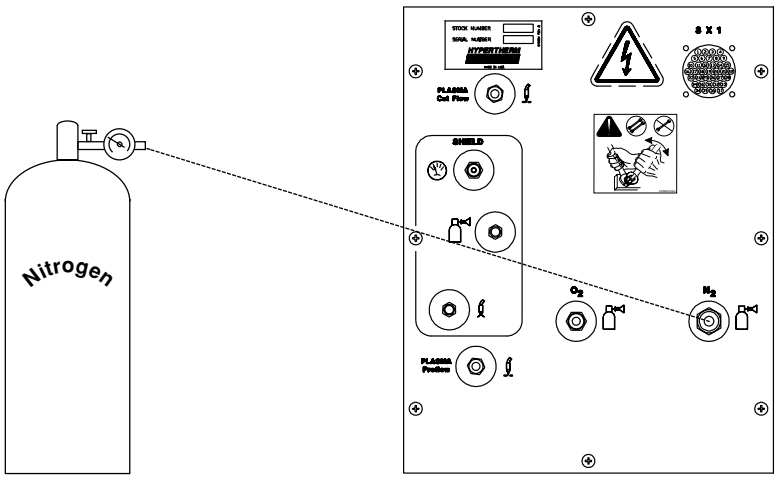


Figure a-6 Nitrogen Supply to N_2 Input of Gas Console

Argon-Hydrogen Cut Charts

The Argon-Hydrogen Cut Charts on the following pages provide the necessary information for the operator using the HT2000LHF system to be successful in plasma arc cutting and gouging using argon-hydrogen as the plasma gas. The HT2000LHF 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 drop cuts with minimal dross.

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

Argon-Hydrogen Cut Chart and Consumable Parts Index

Metal	Amps	Plasma Gas/ Shield Gas	Shield	Retaining Cap	Nozzle	Swirl Ring	Electrode	Page
 CUTTING Stainless Steel	**200**	H35 / N_2	020602	120837	020608	020607	020415	**a-9**
	100	H35 / N_2	020448	120837	020611	020607	020415	**a-10**
Aluminum	**200**	H35 / N_2	020602	120837	020608	020607	020415	**a-11**
	100	H35 / N_2	020448	120837	020611	020607	020415	**a-12**
 GOUGING Stainless Steel & Aluminum	**200**	H35 / N_2	020485	120837	020615	020607	020415	**a-13**

Stainless Steel

200 amps • H35 Plasma / N_2 Shield

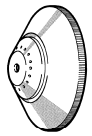
Argon-Hydrogen Manifold (073109) Required*

This gas combination (Hypertherm recommends a mixture of 35% hydrogen and 65% argon for the plasma gas) gives maximum thickness cutting capability, minimum dross levels, minimum amount of surface contamination, excellent weldability and excellent cut quality on thicknesses greater than 1/2". On thicknesses less than 1/2", excessive dross levels may be experienced. Electrode life is extended when this combination is used.

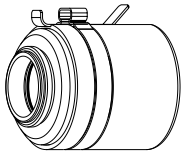
WARNING

Do not use water muffler when cutting with argon-hydrogen

020602
Shield



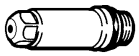
120837
Retaining cap



020608
Nozzle

020607
Swirl ring

020415
Electrode



Above Water Only

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (H35 %)	Cutflow (H35 %)	Shield Gas (N_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/4	6	**25**	**25**	**60**	3/16	5	3/8	10	135	62	1600	1.0
3/8	10	(89.9	(89.9	(275	3/16	5	3/8	10	140	52	1300	1.0
1/2	12	SCFH)	SCFH)	SCFH)	3/16	5	3/8	10	140	42	1100	2.0
5/8	15	S			1/4	6	1/2	12	145	37	940	2.0
3/4	20				1/4	6	1/2	12	150	32	810	2.5
7/8	22				5/16	8	5/8	16	155	27	690	2.5
1	25				5/16	8			155	22	560	
1-1/4	32	`			5/16	8			165	16	400	
1-1/2	38				5/16	8			170	11	280	
1-3/4	44 5/16					8			180	8	200	
2	50 5/16					8			185	6	150	

Notes: **Set argon-hydrogen plasma gas inlet pressure to 120 psi (8.3 bar)**
Set nitrogen shield gas inlet pressure to 90 psi (6.2 bar)
Drop cutting above 1-1/2" (38 mm) not recommended.
Production cutting above 7/8" (22 mm) not recommended

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

Stainless Steel

100 amps • H35 Plasma / N_2 Shield

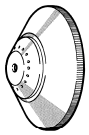
Argon-Hydrogen Manifold (073109) Required*

This gas combination (Hypertherm recommends a mixture of 35% hydrogen and 65% argon for the plasma gas) gives good cut speed, but may result in excessive dross. Some surface nitriding and surface oxidation of alloying elements can occur.

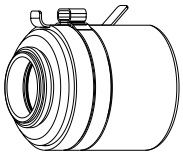
WARNING

Do not use water muffler when cutting with argon-hydrogen

020448
Shield



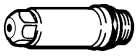
120837
Retaining cap



020611
Nozzle

020607
Swirl ring

020415
Electrode



Above Water Only

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (H35 %)	Cutflow (H35 %)	Shield Gas (N_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**13**	**13**	**60**	3/32	2.5	3/16	5	130	50	1260	
3/16	5	(46.7	(46.7	(270	1/8	3	1/4	6	135	40	1060	0.5
1/4	6	SCFH)	SCFH)	SCFH)	3/16	5	3/8	10	140	35	890	0.5
3/8	10				3/16	5	3/8	10	140	30	750	0.5
1/2	12				3/16	5	3/8	10	145	25	630	1.0

Notes: **Set argon-hydrogen plasma gas inlet pressure to 120 psi (8.3 bar)**
Set nitrogen shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 3/8" (10 mm) not recommended

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

Aluminum

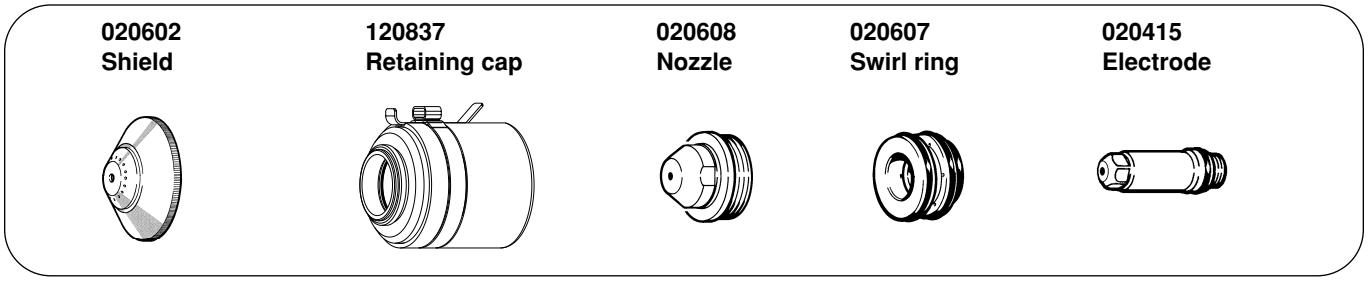
200 amps • H35 Plasma / N_2 Shield

Argon-Hydrogen Manifold (073109) Required*

This gas combination (Hypertherm recommends a mixture of 35% hydrogen and 65% argon for the plasma gas) gives maximum thickness cutting capability, excellent cut quality and excellent weldability. Electrode life is extended when this combination is used.

WARNING

Do not use water muffler when cutting with argon-hydrogen



Above Water Only

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (H35 %)	Cutflow (H35 %)	Shield Gas (N_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
3/16	5	**25**	**25**	**60**	3/16	5	3/8	10	130	170	4300	0.5
1/4	6	(89.9	(89.9	(275	3/16	5	3/8	10	130	155	4000	1.0
3/8	10	SCFH)	SCFH)	SCFH)	1/4	6	1/2	12	135	120	3000	2.0
1/2	12				1/4	6	1/2	12	140	100	2550	2.0
5/8	15				1/4	6	1/2	12	145	80	2000	2.5
3/4	20				5/16	8	5/8	16	150	60	1500	2.5
7/8	22				5/16	8	5/8	16	155	50	1250	2.5
1	25				5/16	8			155	40	1000	
1-1/4	32	`			5/16	8			165	26	660	
1-1/2	38				5/16	8			170	18	460	
1-3/4	44				5/16	8			180	12	300	
2	50				5/16	8			185	7	180	

Notes: **Set plasma gas inlet pressure to 120 psi (8.3 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 7/8" (22 mm) not recommended

1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

Aluminum

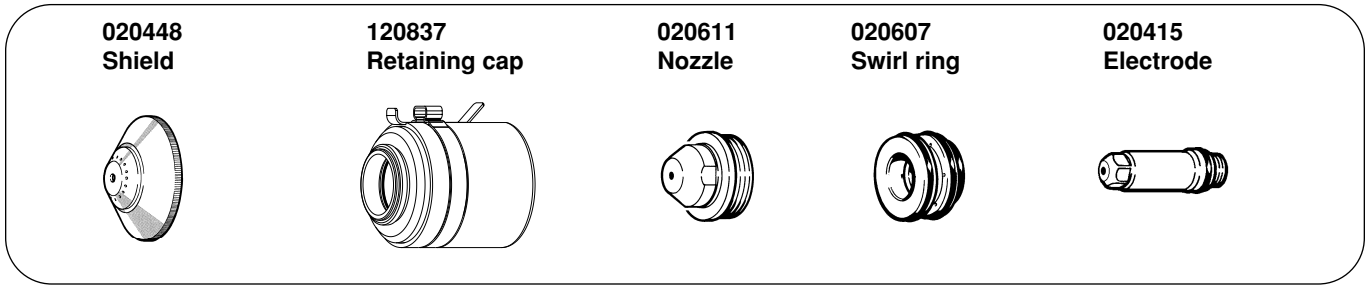
100 amps • H35 Plasma / N_2 Shield

Argon-Hydrogen Manifold (073109) Required*

This gas combination (Hypertherm recommends a mixture of 35% hydrogen and 65% argon for the plasma gas) gives good cut speed, low dross levels and is very economical.

WARNING

Do not use water muffler when cutting with argon-hydrogen



Above Water Only

Material Thickness (inches)	(mm)	Plasma Gas Flow Rate % Preflow (H35 %)	Cutflow (H35 %)	Shield Gas (N_2) Pressure (psi)	Torch-to-work Distance (inches)	(mm)	Initial Torch Piercing Height (inches)	(mm)	Arc Voltage Setting (volts)	Travel Speed (ipm)	(mm/min.)	Approx. Motion Delay Time (sec)
1/8	3	**13**	**13**	**60**	3/32	2.5	3/16	5	135	95	2440	
3/16	5	(46.7	(46.7	(270	1/8	3	1/4	6	140	85	2200	0.5
1/4	6	SCFH)	SCFH)	SCFH)	1/8	3	1/4	6	145	80	1980	0.5
3/8	10				1/8	3	1/4	6	145	60	1530	0.5
1/2	12				1/8	3			150	50	1280	

Notes: **Set plasma gas inlet pressure to 120 psi (8.3 bar)**
Set shield gas inlet pressure to 90 psi (6.2 bar)
Production cutting above 3/8" (10 mm) not recommended

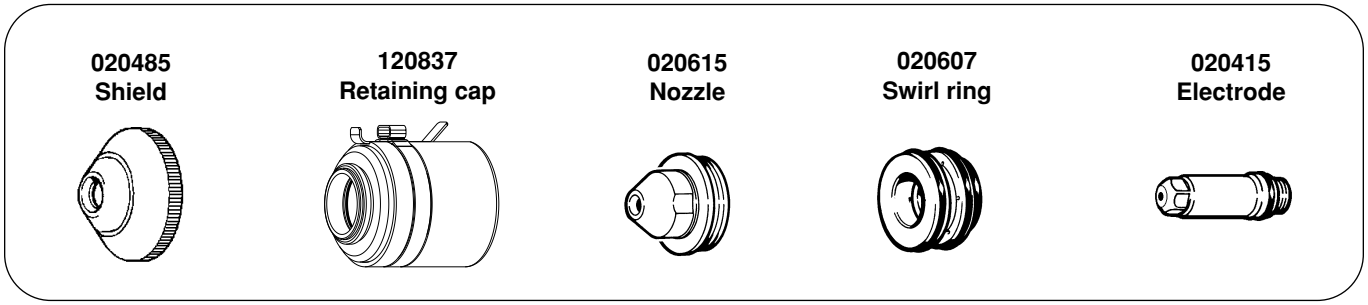
1 inch = 25.4 mm; 1 scfh = 28.316 liter/hour; 1 psi = .0689 bar = 6.895 KPa

Stainless Steel or Aluminum Gouging

200 amps • H35 Plasma / N_2 Shield

Argon-Hydrogen Manifold (073109) Required*

Hypertherm recommends a mixture of 35% hydrogen and 65% argon for the plasma gas.



Plasma Gas Flow Rate %		Shield Gas (N_2) Pressure (psi)	Arc Current Setting (amps)	Plasma Gas (H35) Inlet Pressure (psi)	Shield Gas (N_2) Inlet Pressure (psi)
Preflow (H35 %)	Cut Flow (H35 %)				
29	**29**	**50**	**200**	**120**	**90**
(81.8 SCFH)					

1 psi = .0689 bar = 6.895 KPa

Hypertherm

Appendix B

PROPYLENE GLYCOL SAFETY DATA
BENZOTRIAZOLE SAFETY DATA

In this appendix:

MATERIAL SAFETY DATA SHEET

SECTION 1 -- CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME	HYPERTHERM TORCH COOLANT

PRODUCT CODE	

ISSUE DATE	11-22-96

EMERGENCY TELEPHONE NUMBERS

MANUFACTURER	**HYPERTHERM**	**Transportation: (703) 527-3887 ***
STREET ADDRESS	**Etna Rd.**	*** For spill, leak, fire or transport accident emergencies.**
CITY, STATE, ZIP	**Hanover, NH 03755**	**Product Information: (603) 643-5638**

SECTION 2 -- COMPOSITION / INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENT	CAS No.	% by wt.	EXPOSURE LIMITS OSHA PEL	ACGIH TLV	NIOSH REL
Propylene glycol	0057-55-6	< 50	None Established	None Established	None Established

SECTION 3 -- HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW	Can cause eye and skin irritation. Harmful if swallowed..

POTENTIAL HEALTH EFFECTS	
INGESTION	Can cause irritation, nausea, stomach distress, vomiting and diarrhea.
INHALATION	May cause mild irritation of nose, throat, and respiratory tract.
EYE CONTACT	Causes eye irritation.
SKIN CONTACT	Prolonged or repeated contact may cause skin irritation.

SECTION 4 -- FIRST AID MEASURES

INGESTION	DO NOT induce vomiting, but give one or two glasses of water to drink and get medical attention.
INHALATION	No specific treatment is necessary, since this material is not likely to be hazardous by inhalation.
EYE CONTACT	Immediately flush eye with cool running water for 15 minutes. If irritation persists, get medical attention.
SKIN CONTACT	Wash with soap and water. If irritation develops or persists, get medical attention.
NOTE TO PHYSICIAN	Treatment based on judgment of the physician in response to reactions of the patient.

SECTION 5 -- FIRE FIGHTING MEASURES

FLASH POINT / METHOD	None / N.A.	FLAMMABLE LIMITS	Not flammable or combustible
EXTINGUISHING MEDIA	If involved in a fire, use foam, carbon dioxide or dry chemical extinguisher. Water may cause frothing.		
SPECIAL FIRE FIGHTING PROCEDURES	None		
FIRE AND EXPLOSION HAZARDS	None		

SECTION 6 -- ACCIDENTAL RELEASE MEASURES

RESPONSE TO SPILLS	Small spills: Flush into a sanitary sewer. Mop up residue and rinse area thoroughly with water. Large spills: Dike or dam the spill. Pump into containers or soak up on inert absorbent.

SECTION 7 -- HANDLING AND STORAGE

HANDLING PRECAUTIONS	Keep container in upright position.
STORAGE PRECAUTIONS	Store in a cool dry place. Keep from freezing.

SECTION 8 -- EXPOSURE CONTROLS / PERSONAL PROTECTION

HYGIENIC PRACTICES	Normal procedures for good hygiene.
ENGINEERING CONTROLS	Good general ventilation should be sufficient to control airborne levels. Facilities using this product should be equipped with an eyewash station.

PERSONAL PROTECTIVE EQUIPMENT

X	**RESPIRATOR**	Recommended for prolonged use in confined areas with poor ventilation
X	**GOGGLES / FACE SHIELD**	Recommended; goggles should protect against chemical splash
	APRON	Not necessary
X	**GLOVES**	Recommended; PVC, Neoprene or Nitrile acceptable
	BOOTS	Not necessary

SECTION 9 -- PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE	Clear liquid	BOILING POINT	160 deg F
ODOR	Not Appreciable	FREEZING POINT	Not established
pH	4.6-5.0(100% concentrate)	VAPOR PRESSURE	Not applicable
SPECIFIC GRAVITY	1.0	VAPOR DENSITY	Not applicable
SOLUBILITY IN WATER	Complete	EVAPORATION RATE	Not determined

SECTION 10 -- STABILITY AND REACTIVITY

CHEMICAL STABILITY		**STABLE**	X		**UNSTABLE**	
CONDITIONS TO AVOID	No special precautions beyond standard safe industrial practices.					
INCOMPATIBILITY	Avoid contact with strong mineral acids and strong oxidizers, including chlorine bleach.					
HAZARDOUS PRODUCTS OF DECOMPOSITION	Carbon monoxide may be formed during combustion.					
POLYMERIZATION		**WILL NOT OCCUR**	X		**MAY OCCUR**	
CONDITIONS TO AVOID	Not applicable					

SECTION 11 -- TOXICOLOGICAL INFORMATION

CARCINOGENICITY

	THIS PRODUCT CONTAINS A KNOWN OR SUSPECTED CARCINOGEN
X	**THIS PRODUCT DOES NOT CONTAIN ANY KNOWN OR ANTICIPATED CARCINOGENS ACCORDING TO THE CRITERIA OF THE NTP ANNUAL REPORT ON CARCINOGENS AND OSHA 29 CFR 1910, Z**

OTHER EFFECTS

ACUTE	Not determined
CHRONIC	Not determined

SECTION 12 -- ECOLOGICAL INFORMATION

BIODEGRADABILITY		CONSIDERED BIODEGRADABLE	X		NOT BIODEGRADABLE	
BOD / COD VALUE	Not established					
ECOTOXICITY	No data available					

SECTION 13 -- DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD	Product that cannot be used according to the label must be disposed of as a hazardous waste at an approved hazardous waste management facility. Empty containers may be triple rinsed, then offered for recycling or reconditioning; or puncture and dispose of in a sanitary landfill.								
RCRA CLASSIFICATION	NO								
RECYCLE CONTAINER		YES	X		CODE	2 - HDPE		NO	

SECTION 14 -- TRANSPORT INFORMATION

DOT CLASSIFICATION		HAZARDOUS			NOT HAZARDOUS	X
DESCRIPTION	Not applicable					

SECTION 15 -- REGULATORY INFORMATION

USA REGULATORY STATUS

	EPA REGISTERED (UNDER FIFRA)	
	FDA REGULATED	
	KOSHER	
	SARA TITLE III MATERIAL	
	USDA AUTHORIZED	

SECTION 16 -- OTHER INFORMATION

NFPA CLASSIFICATION

1	BLUE	HEALTH HAZARD
1	RED	FLAMMABILITY
0	YELLOW	REACTIVITY
--	WHITE	SPECIAL HAZARD

Information contained in this MSDS refers only to the specific material designated and does not relate to any process or use involving other materials. This information is based on data believed to be reliable, and the Product is intended to be used in a manner that is customary and reasonably foreseeable. Since actual use and handling are beyond our control, no warranty, express or implied, is made and no liability is assumed by Hypertherm in connection with the use of this information.

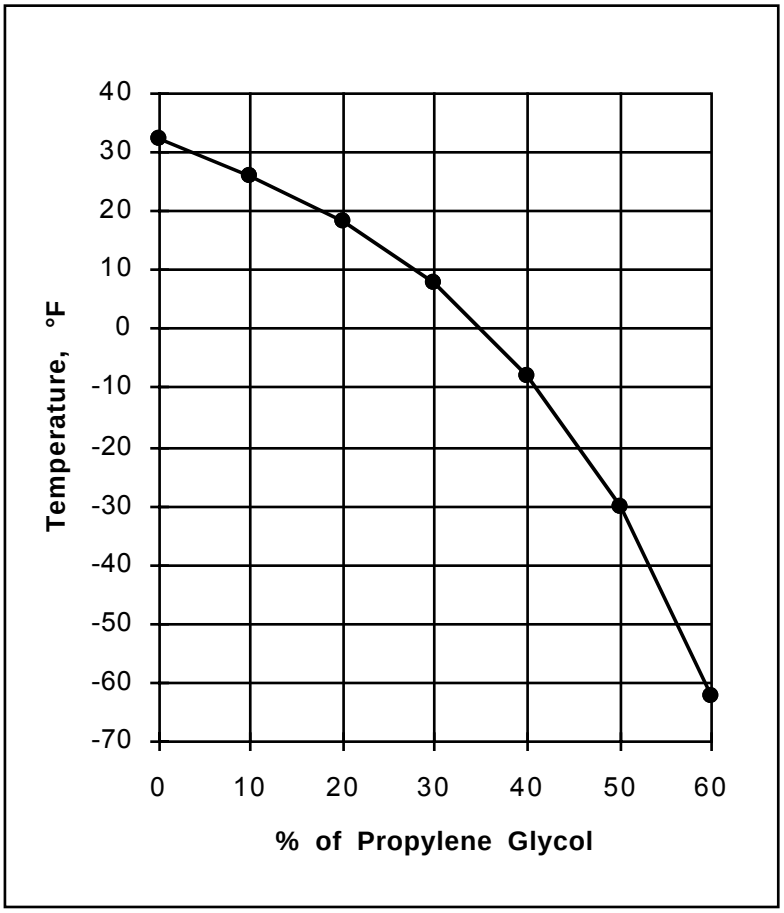


Figure b-1 Freezing Point of Propylene Glycol Solution

MATERIAL SAFETY DATA SHEET COBRATEC™ 99 Powder

SECTION I

MANUFACTURER:	PMC SPECIALTIES GROUP, INC.
ADDRESS:	501 Murray Road Cincinnati, OH 45217
EMERGENCY TELEPHONE:	(513) 242-3300
FOR TRANSPORTATION EMERGENCY:	(800) 424-9300
CHEMICAL NAME AND SYNONYMS:	1-H Benzotriazole, Benzotriazole
TRADE NAMES AND SYNONYMS:	COBRATEC® 99 Powder
CHEMICAL FAMILY:	Triazole
FORMULA:	$C_6H_5N_3$
DOT SHIPPING DESCRIPTION:	Not Regulated (Benzotriazole)
PRODUCT NUMBER:	X18BT5585

NFPA BASED RATINGS: Health: 1, Flammability: 1, Reactivity: 0
HMIS RATINGS: Health: 2, Flammability: 0, Reactivity: 0, PPE: E
WHMIS CLASSIFICATION: D-2-(B)

SECTION II INGREDIENTS

Material	CAS No.	Wt. %	Exposure Limits
Benzotriazole	95-14-7	>99	None Established

SECTION III PHYSICAL DATA

BOILING POINT:	>350° C
FREEZING POINT:	94-99° C
SPECIFIC GRAVITY:	1.36 (solid)
VAPOR PRESSURE AT 20° C:	0.04 mm Hg
VAPOR DENSITY (air=1):	4.1 (calculated)
SOLUBILITY IN WATER % BY WT at 20° C:	2.0
% VOLATILES BY VOLUME:	None
EVAPORATION RATE (Butyl Acetate = 1):	Non-volatile
APPEARANCE AND ODOR:	Off white powder. Slight characteristic odor.

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:	340° F. (CC)
AUTOIGNITION TEMPERATURE:	Not Available
FLAMMABLE LIMITS IN AIR:	LOWER: Dust MEC. 0.03 oz/(cu. ft.)
	UPPER: Not Available

EXTINGUISHING MEDIA: Carbon Dioxide, Dry Chemical, Foam

SPECIAL FIRE FIGHTING PROCEDURES: Full protective equipment including self-contained breathing apparatus should be used. Water spray may be ineffective. If water is used, fog nozzles are preferable. Water may be used to cool closed containers to prevent pressure build-up and possible autoignition or explosion when exposed to extreme heat. During emergency conditions, overexposure to decomposition products may cause a health hazard. Symptoms may not be immediately apparent. Get medical attention.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Airborne dust is rated a severe explosion hazard at a minimum concentration of 0.03 ounce per cubic feet (30 grams per cubic meter).

SECTION V HEALTH HAZARD DATA

OSHA AIR CONTAMINANTS: Due to its dusting nature during handling, exposure to dust must comply with OSHA's particulate not otherwise regulated limits for total and respirable dust.

EFFECTS OF OVEREXPOSURE: Contact with the eyes is likely to cause severe irritation. Detailed information about the effects of overexposure in the human being is unavailable. Experience thus far has not provided any example of obvious overexposure with resultant symptoms. Animal studies have indicated an effect on the central nervous system. An NCI bioassay showed no convincing evidence of carcinogenicity (NCI-CG-TR-88). Bacterial mutagenicity data exists. Experts consider the data inconclusive. (Environmental Mutagenesis, Vol. 7, Suppl. 5: 1-248 (1985) and references in RTECS #DM1225000).

EMERGENCY AND FIRST AID PROCEDURES: IF INHALED: If affected, remove from exposure. Restore breathing. Keep warm and quiet. IF ON SKIN: Wash affected area thoroughly with soap and water. IF IN EYES: Flush eyes with large amounts of water for 15 minutes. Get medical attention. IF SWALLOWED: Never give anything by mouth to an unconscious person. Give several glasses of water. If vomiting is not spontaneous, induce vomiting. Keep airway clear. Get medical attention.

TOXICITY DATA:

Oral LD_{50} (rat)	560 mg/Kg
Primary skin Irritation (rabbit)	Not a primary skin irritant
Dermal LD_{50}	>2000 mg/Kg
Eye irritation (rabbit)	caused severe eye irritation
Bluegill Sunfish (96 hr. Tlm)	28 mg/l
Minnow (96 hr. Tlm)	28 mg/l
Trout (96 hr. LC_{50})	39 mg/l
Algae (96 hr. EC_{50})	15.4 mg/l
Daphnia magna (48 hr. LC_{50})	141.6 mg/l

SECTION VI REACTIVITY DATA

STABILITY: Stable
INCOMPATIBILITY: Oxidizing Agents
HAZARDOUS DECOMPOSITION PRODUCTS: BY FIRE: Carbon Dioxide, Carbon Monoxide Nitrogen oxides, HCN in reducing atmospheres
HAZARDOUS POLYMERIZATION: Will Not occur

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE THE MATERIAL IS SPILLED OR RELEASED: If local high concentration of airborne dust occurs, dampen spill with water and ventilate to disperse dust laden air. Sweep up spill and reclaim or place in a covered waste disposal container.
WASTE DISPOSAL METHOD: Sanitary landfill or incinerate in approved facilities in accordance with local, state, and federal regulations. Do not heat or incinerate in closed containers.

SECTION VIII SPECIAL PROTECTIVE INFORMATION

RESPIRATORY PROTECTION: If personal exposure cannot be controlled below applicable exposure limits by ventilation, wear respiratory devices approved by NIOSH/MSHA for protection against organic vapors, dusts, and mists.

VENTILATION: Local exhaust recommended for dust control.
PROTECTIVE GLOVES: Recommended to avoid skin contact, Rubber, Vinyl
EYE PROTECTION: Use safety goggles where airborne dust is a problem.
OTHER PROTECTIVE EQUIPMENT: Safety shower, eye wash

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store in a cool, dry area. Keep containers tightly closed when not in use. Avoid creating airborne dust concentrations which could constitute a potential dust explosion hazard. Avoid contact with skin, eyes, and clothing. Avoid inhalation of dust and vapor. DO NOT TAKE INTERNALLY. Clean up spills immediately.

SECTION X REGULATORY STATUS

Benzotriazole (CAS No. 95-14-7) is contained on the following chemical lists:

1. TSCA Section 8(a)/40CFR 712 Preliminary Assessment Information Rule
2. TSCA Section 8(d) Health and Safety Data Rule
3. NTP Testing Program
4. Massachusetts Substance List
5. Canadian Domestic Substance List
6. WHMIS Ingredient Disclosure List
7. TSCA Inventory List

PREPARED: August 28, 1995
SUPERSEDES: May 25, 1994

Appendix C

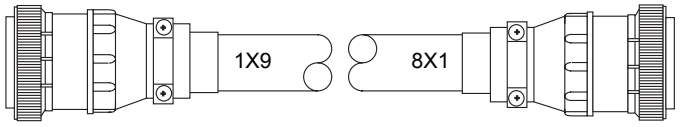
INITIAL HEIGHT SENSING CONNECTIONS

NOTE: If using Command THC refer to Instruction manual # 802780

See page 3-8 for connections to power supply and IHS console. See Fig. c-1 for typical IHS connections.

(14) *IHS Interface Cable – Power Supply to IHS*

Power Supply End **IHS End**



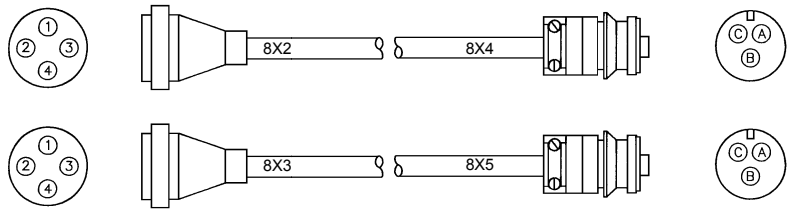
1X9	8X1	Color	Signal
1	1	Red	IHS Complete Sig
4	4	Black	IHS Complete Com
8		Shield	Drain
2	2	Green	Upper Limit Sw Sig
5	3	Black	Upper Limit Sw Com
9	5	Shield	Drain
11	9	Black	AC Power
14	8	White AC	Power
7		Shield	Drain
	7		Key

(14)

Part No.	Length
023859	25 ft (7.6m)
023860	50 ft (15m)
023861	75 ft (23m)
023862	100 ft (30.5m)
023863	150 ft (46m)
023864	200 ft (61m)

(14A) *IHS Sensor cables – IHS to Inductor Probes*

The two sensor cables are components of the interconnecting leads for the inductive IHS system – see page c-4.



8X2/8X3	8X4/8X5	Color	Signal
4	A	Red	Power (+15 VDC)
2	B	Black	Common
1	C	Clear	Signal
3		Braid	Shield

(14A)

Part No.	Length
023888	2 ft (.6 m)
023869	40 ft (12 m)

Part No.	Length
023889	2 ft (.6 m)
023870	40 ft (12 m)

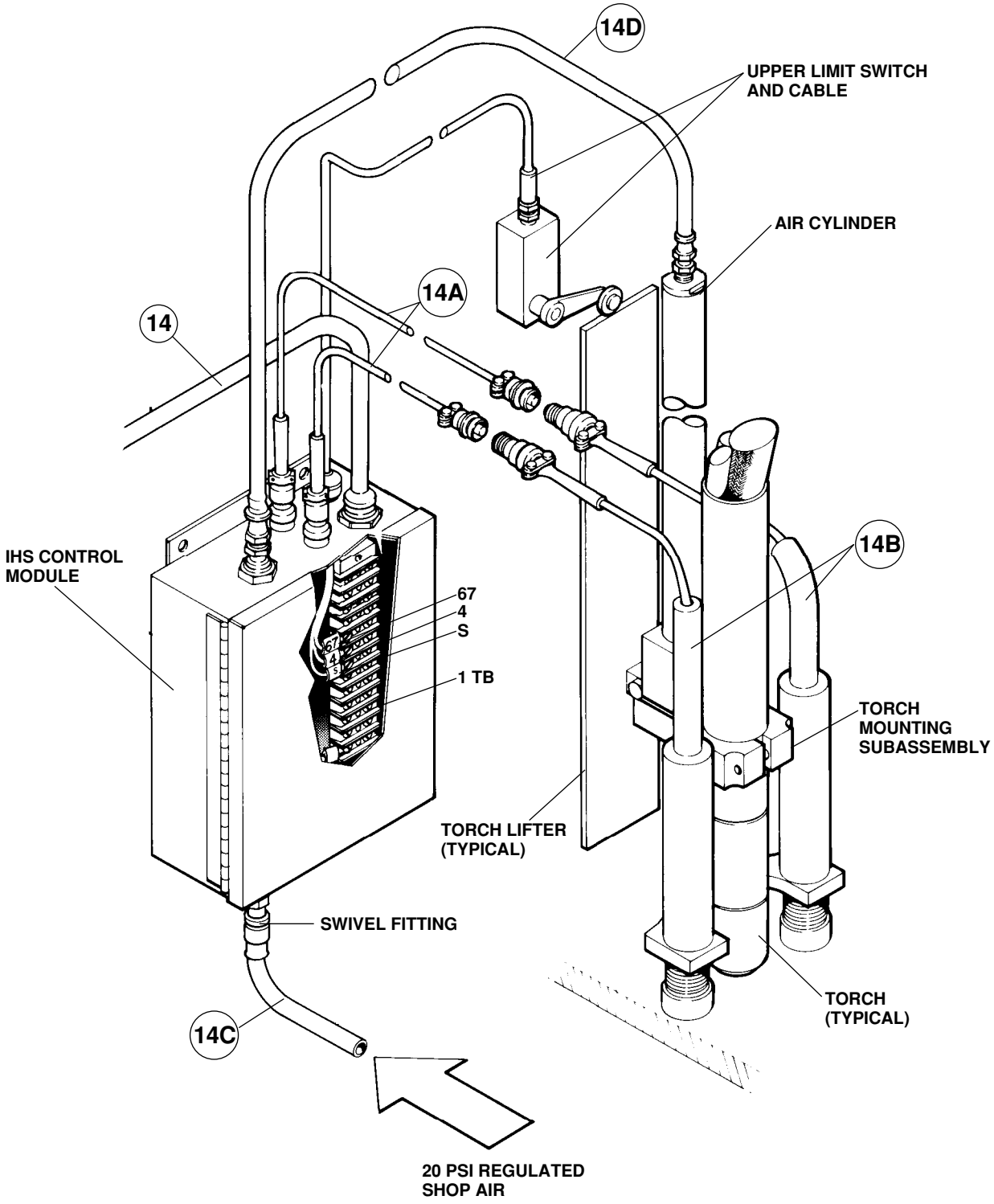
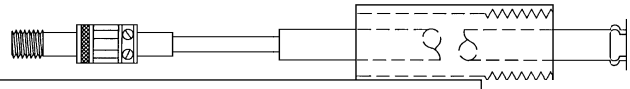


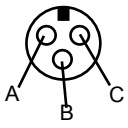
Figure c-1 Initial Height Sensing Connections

14B *IHS Inductor Probes*

The 2 inductive probes come with the torch mounting subassembly for the inductive IHS system – see page c-4.



Pin	Color	Signal
A	Brown	Power (+15 VDC)
B	Blue	Common
C	Black	Signal



14B

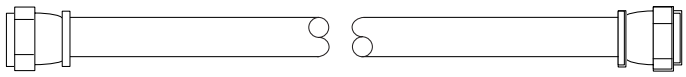
Part No.
005074

14C *IHS Air Supply – Air Supply to IHS Console*

The customer must supply the 20 psig (1.4 bar) regulated shop air and a 1/4" (6 mm) I.D. air hose between the regulator and the inductive height control console.

14D *Air Hose Assembly – IHS Console to Inductive Sensor Air Cylinder*

The 40-foot air hose is a component of the interconnecting leads for the inductive IHS system – see page c-4.



14D

Part No.	Length
024144	40 ft (12 m)

Upper Limit Switch and Cable - Upper Limit Switch to IHS Console

Note: **The customer must supply the upper limit switch option.** Switch specifications: +12 VDC @ 1.2 ma. Gold-type contacts preferred. Select a normally closed switch that opens when the lever is up (when the torch fully retracts). Install the upper limit switch behind the torch lifter as in Figure c-1.

Caution: **Follow the cable installation procedure below to avoid electromagnetic interference problems with the torch lead set.**

1. Use a shielded, twisted pair of 22-24 gauge wire (stranded). Use Belden #8761.
2. At the upper limit switch, connect the common wire (black) and signal wire (clear) to the upper limit switch. Cut the shield drain wire (uninsulated). Wrap the cut end with electrician's tape.
3. At the IHS control console, loosen the 2 latches and open the front cover.
4. Route the cable through the strain relief to connect the cable wires to 1TB.
5. Connect the shield drain wire (uninsulated) to 1TB-10 (#S). This connects the cable shield to the power supply frame. The shield drain must not touch the IHS console case.
6. Connect the common wire (black) to 1TB-11 (#4).
7. Connect the signal wire (clear) to 1TB-12 (#67).

Note: If the upper limit switch signal comes from an interface on the cutting machine, the shield must be electrically isolated from other shields in other cables. Use a separate cable to avoid ground-loop problems.

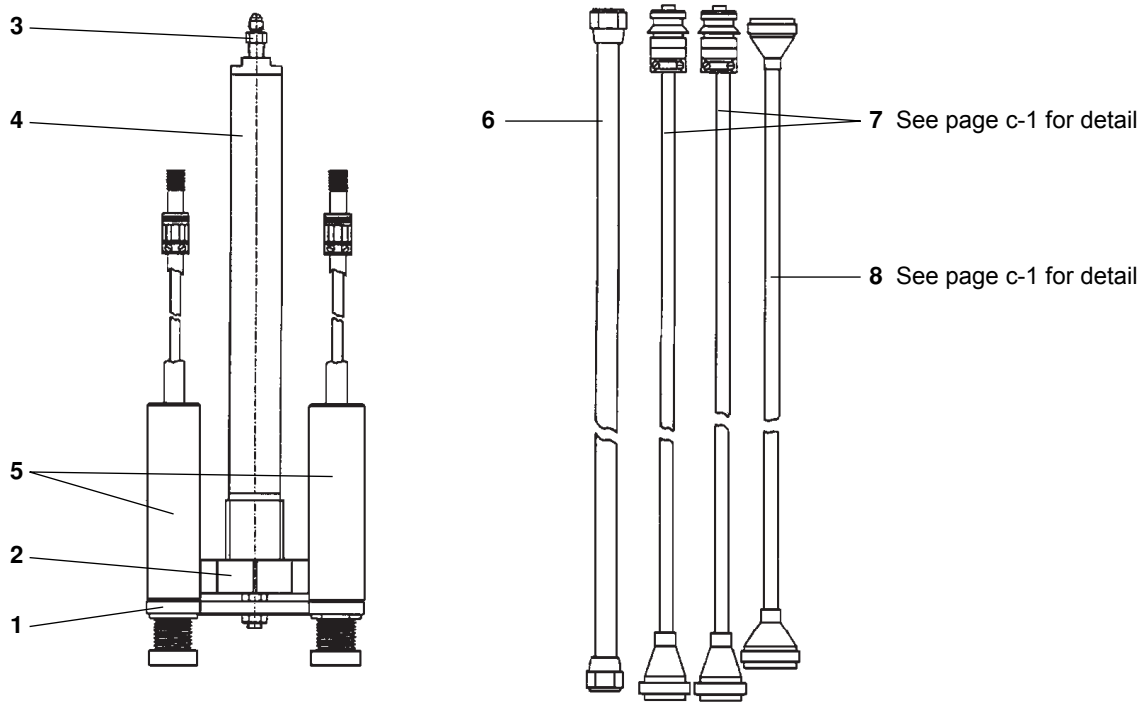


Figure c-2 Inductive IHS Torch Mounting Assembly with Interconnecting Leads for IHS Assembly

Parent Item No. **028720 Inductive IHS,** includes the items listed below, as well as the Initial Height Sensing Control Console which appears on page 6-11.

Torch Mounting Assembly for the Inductive IHS System

Item	Part Number	Description	Qty.
	029044	**Torch MTG SA, Induct IHS**	
1	004082	Bracket, IND Sensor, UW-IHS	1
2	004083	Bracket, IND IHS Torch Mounting	1
3	015005	Adapter, 1/4 NPT x #4	1
4	027024	Cylinder, IND Sensor, UW-IHS	1
5	**005074**	**Inductive Sensor Assembly**	2
	020044*	Clevis:Torch Mounting Bracket	1

* Item is not shown in Figure c-2.

Interconnecting Leads for the Inductive IHS System

Item	**028811** **25 ft** (7.6 m)	**028812** **50 ft** (15.3 m)	**028813** **75 ft** (22.9 m)	**028814** **100 ft** (30.5 m)	**028815** **150 ft** (45.8 m)	**028816** **200 ft** (61 m)
6	024144	024144	024144	024144	024144	024144
7	023869/023870	023869/023870	023869/023870	023869/023870	023869/023870	023869/023870
8	023859	023860	023861	023862	023863	023864

Hypertherm

Appendix D

ELECTROMAGNETIC COMPATIBILITY

General

This appendix will enable a qualified electrician to install the power cable to the EMI filter on the 400V CE power supplies (073235, 073236).

Power Cable

The power cable is **customer supplied**. See *Power Requirements* on page 3-4 for recommended cable sizes. Final specification and installation of the power cord should be made by a licensed electrician and according to applicable national or local codes. See also *Mains Supply* on page i for further power (supply) cable shielding recommendations.

Connect Power Cable

Connect one end of the power cable to the EMI filter first and then connect the other end to the line disconnect switch.

Power Supply

1. Locate the EMI filter on the top rear of the power supply (see Figure d-1).

2. Unscrew the 4 filter cover screws and remove the cover to access the input voltage connections at TB1 (see Figure d-2).

3. Insert the power cable through the strain relief (see Figure d-1).

4. Connect leads L1 to U, L2 to V, and L3 to W terminals of TB1 (see Figure d-3). Ensure that all connections are tight to avoid excessive heating.

5. Connect the ground lead to the terminal marked PE at TB1 (see Figure d-3).

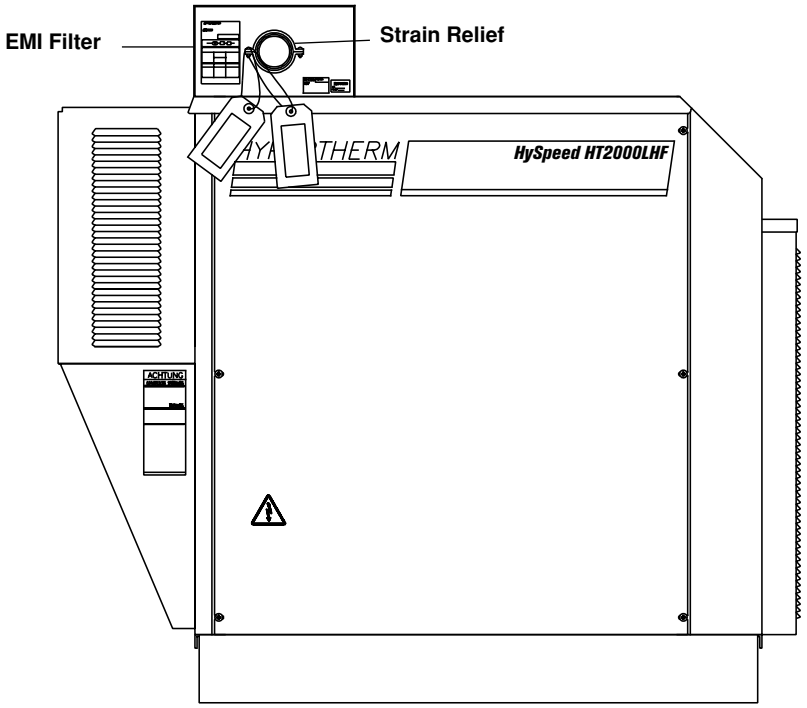


Figure d-1 Hyspeed HT2000LHF Power Supply with EMI Filter – Side View

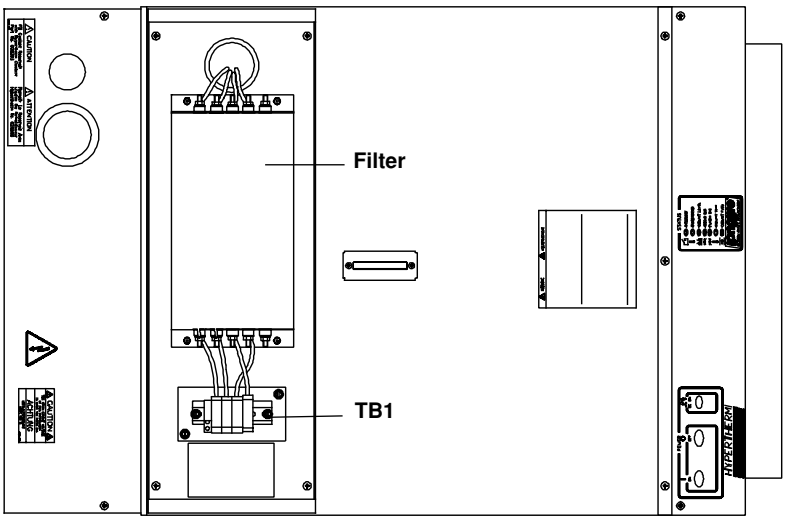


Figure d-2 Hyspeed HT2000LHF Power Supply with EMI Filter Cover Off – Top View

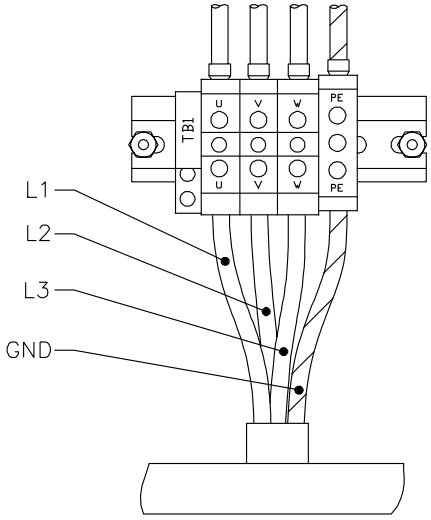


Figure d-3 Power Cable Connections to TB1

WARNING

There is line voltage at the filter even if the ON (1) pushbutton on the HT2000 power supply has not been pressed. As a common safety practice, ALWAYS verify that the line disconnect switch is in the OFF position before installing, disconnecting or servicing in this area.

Line Disconnect Switch

Connecting the power cable to the line disconnect switch must conform to national or local electrical codes. This work should be performed only by qualified, licensed personnel. See *Power Requirements* and *Line Disconnect Switch* on page 3-4.

EMI Filter Parts List

Item	Number	Description	Qty.
	001557	Cover:Hyspeed HT2000-CE Electronic Filter Enclosure	1
1	001558	Enclosure:Hyspeed HT2000-CE Electronic Filter	1
2	001559	Cover:Hyspeed HT2000-CE Top	
3	008489	Bushing:1.97 ID X 2.5 Hole Black-Snap	1
4	008610	Strain Relief:1-1/2NPT 1.5ID 2-Screw	1
5	029316	TB1 Input-Power SA:200/2000/4X00/HD	1
6	109036	Filter:60A 440VAC 3PH 2-Stage Electronic	1
7	109040	Filter Mounting Bracket for 109036	1

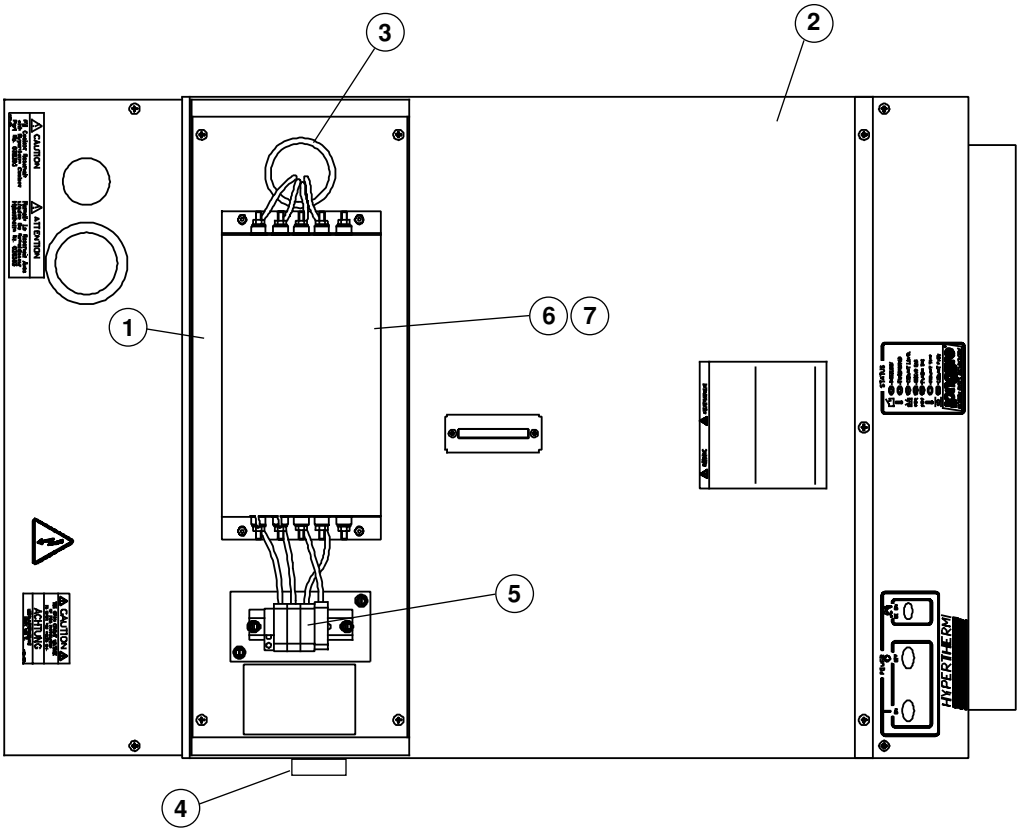


Figure d-4 Hyspeed HT2000LHF EMI Filter Parts

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Appendix E

AIR FILTERS

Air Filters

Gas purity is critical for maximizing consumable parts life, as well as for producing the highest quality cutting which Hypertherm plasma equipment can achieve. Plasma air must be clean, dry and oil-free, and air must be delivered at the pressure and flow rate specified for each plasma system. If the air supply contains moisture, oil or dirt particles, cut quality will be lowered and consumable parts life will be shortened, which increase production costs.

To optimize both consumables life and cut quality, Hypertherm recommends a three-stage filtering process for compressor air for removing contaminants from the air supply.

1. The first stage of filtering should remove at least 99% of all particles and liquids 5 microns and larger in size.

2. The second stage should be a coalescing-type filter to remove oil. This filter should remove 99.99% of particles 0.025 micron and larger in size.

3. The third and final stage of filtration should be an activated carbon adsorbent filter that removes 99.999% of oil or hydrocarbons that have not been trapped by the previous stages.

Appendix F

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

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.

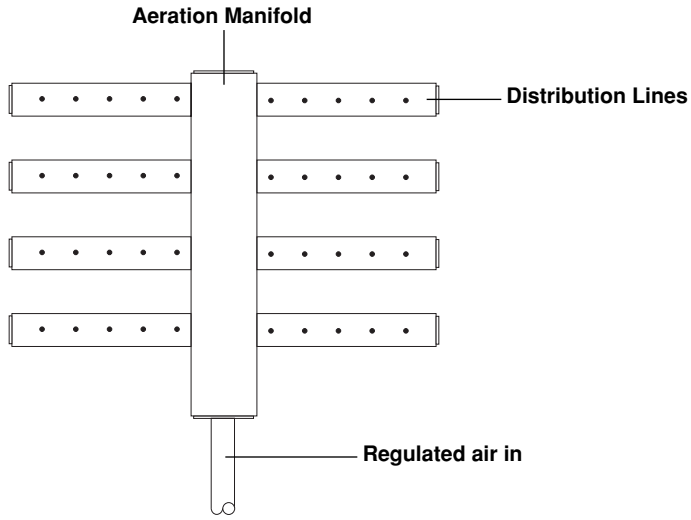
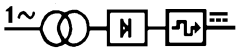


Figure g-1 Aeration Manifold

Appendix G

IEC SYMBOLS

IEC Symbols Used

	Direct Current (DC).
	Alternating current (AC).
	Plasma cutting torch.
	AC input power connection.
	The terminal for the external protective (earthed) conductor.
	A chopper-based power source.
	Anode (+) work clamp.
	Temperature switch.
	Pressure switch.
	Plasma torch in the TEST position (cooling and cutting gas exiting nozzle).
	The power is on.
	The power is off.
	Volt/amp curve.

Appendix H

SYSTEM GROUNDING

System Grounding Requirements

The plasma system must be grounded for safety reasons and to suppress EMI:

- *Safety* The entire system – power supply, accessory enclosures, and worktable – must be grounded to protect it and the operator from a ground fault. The protective earth (PE) ground connections must be installed by a licensed electrician and conform to national and local codes.

- *EMI Suppression* If allowed by national and local codes, the ground system can also be used to suppress EMI (electromagnetic interference). Below is a guide to configure the plasma system for minimal EMI. See Electromagnetic Compatibility in this manual for additional information.

Suggested Ground Cable Routing

Power Supply

Connect the power supply to the PE ground terminal, using a properly sized color-coded conductor. This PE ground is connected to the service ground through the line disconnect switch. See the Installation section for further information on the power cord and the line disconnect switch.

Equipment Grounding

All accessory modules that receive power from the plasma power supply must also use the power supply's ground – either by connection to the PE terminal of the power supply, or by direct connection to the equipment ground conductor. Each module should have only one connection to ground to avoid ground loops. If any enclosure is grounded to the work table, the work table must be grounded to the power supply.

Effective grounding for EMI reduction is highly dependent upon the installation configuration. Two acceptable configurations are shown in Figures j-1 and j-2.

The RHF console should be installed near the work table, and grounded directly to it. Other modules should be installed near the power supply, and grounded directly to it (Figure j-1).

All modules may also be installed near the work table, and grounded directly to it (Figure j-2). Do not ground the RHF console directly to the power supply.

The customer must furnish all conductors for equipment grounding. Grounding conductors may be purchased through Hypertherm in any length specified by the customer (Part No. 047058). The conductor may also be

purchased locally, using a minimum 8 AWG UL Type MTW cable (USA specification) or the appropriate cable specified by national and local codes.

Consult the appropriate manufacturer's instructions to ground equipment that does not receive power from the power supply.

Work Table Grounding

If a supplementary ground rod is installed near the worktable to reduce EMI, it must be connected directly to the PE ground of the building structure, connected to the service ground; or to earth, providing the resistance between the ground rod and the service ground meets national or local codes. Place the supplementary ground rod within 20 ft (6 m) of the worktable according to national or local codes.

If any module is grounded to the work table, the work table must be grounded to the power supply, or the configuration must be changed to comply with applicable national and local electrical codes.

A ferrite choke can be placed in the conductor between the work table ground rod and the PE ground, with a number of turns through the choke to isolate the safety ground (at 60 Hz) from any electromagnetic interference (frequencies above 150 Khz). The more turns the better. A suitable ferrite choke can be made by wrapping 10 turns or more of the ground lead through Magnetics part number 77109-A7, Fair-Rite part number 59-77011101, or other equivalent ferrite choke. Locate the choke as close as possible to the plasma power supply.

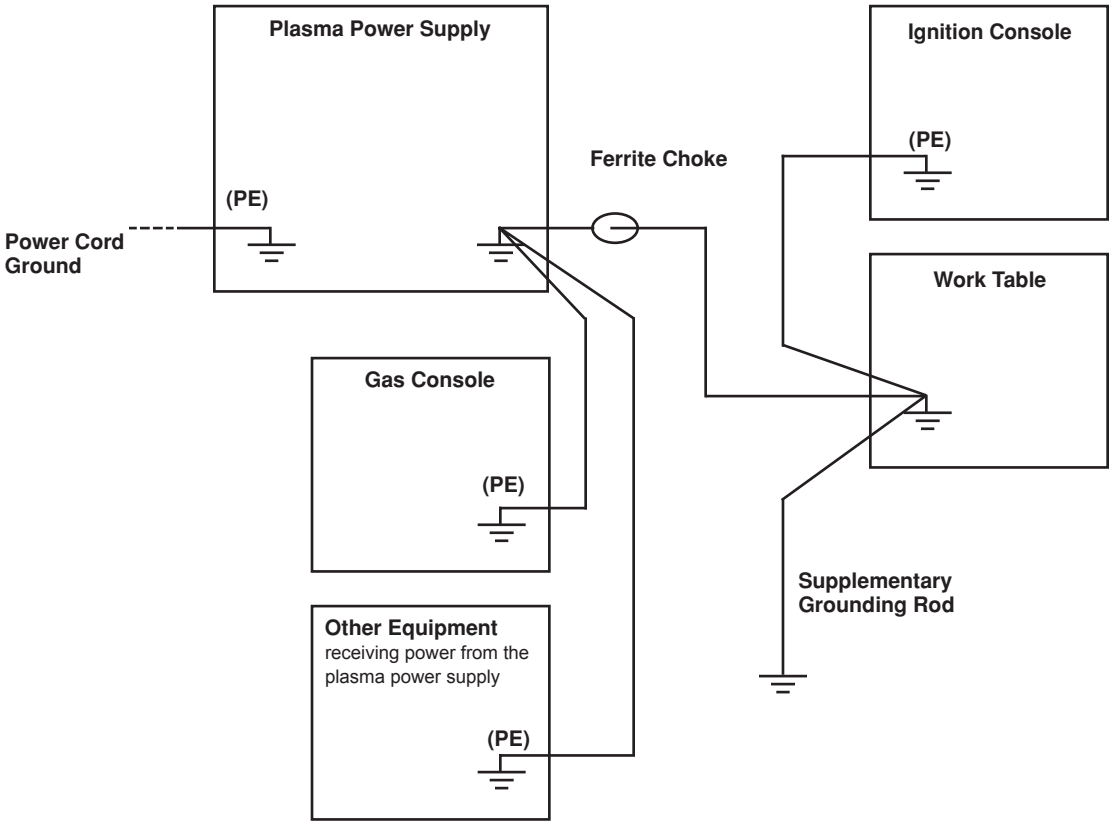


Figure j-1 Recommended Ground Connection Configuration

Note: Configuration may vary for each installation and may require a different ground scheme.

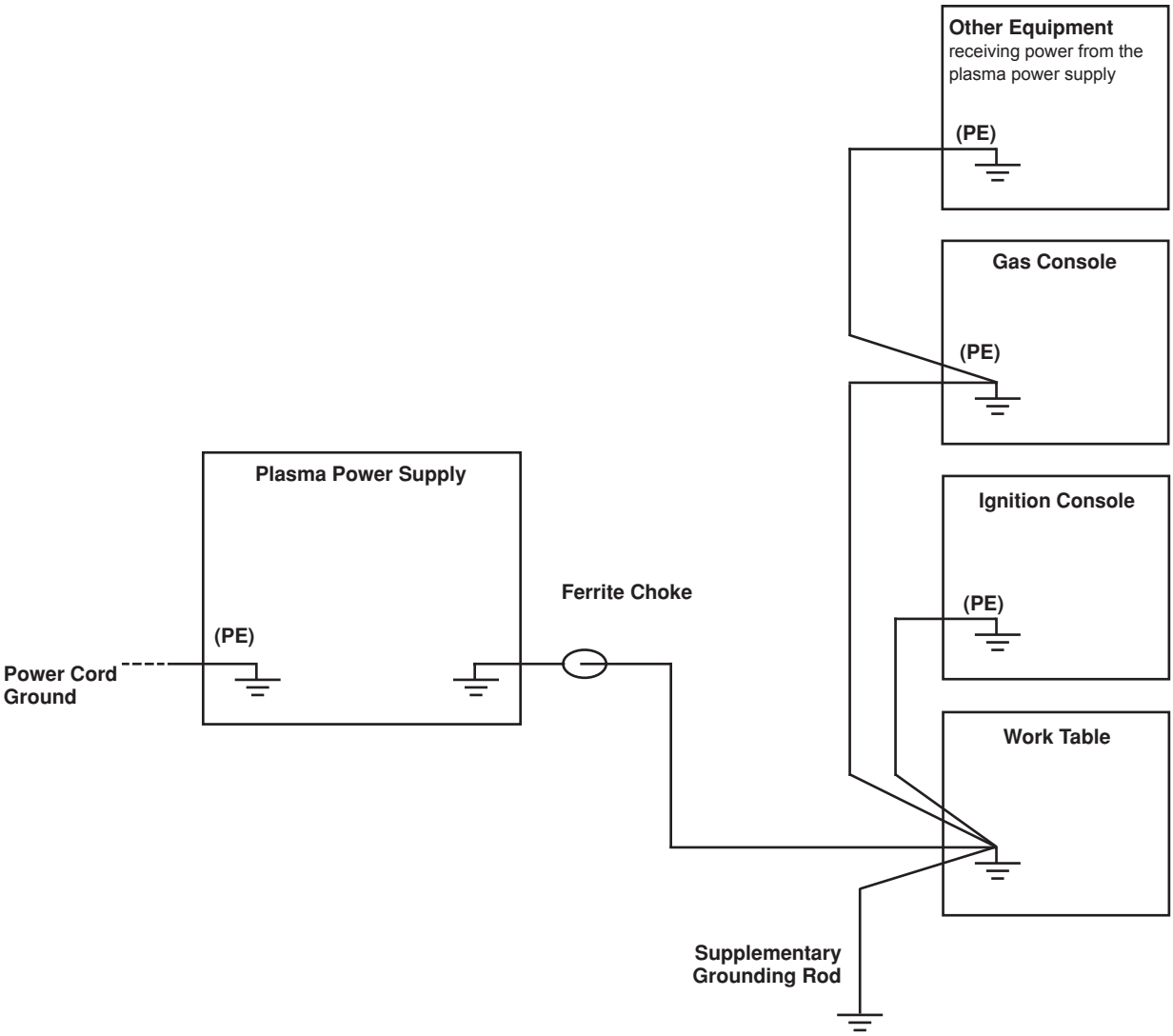


Figure j-2 Alternate Ground Connection Configuration

The preferred cable routing for this configuration is as shown, but it is acceptable to “daisy-chain” the grounds for the gas console and other equipment to the ignition console. The ignition console should NOT be daisy-chained through the other components to the work table.